UGANDA

Household Energy Status Report

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1.0 Introduction

Uganda consists of 4 regions and 45 districts. A total of 3,434,177 households live in the country, of which 446,980 households are found in the urban areas; the vast majority (2,987,197 households) live in rural areas. Almost all of these rural households (2,929,102 households) have no access to electricity. It is estimated that there are about 2,550,537 unelectrified rural households living in Uganda. UEB power will remain largely inaccessible to the rural areas. Even under a revamped and restructured Owen falls generation plant, access to electricity in the rural areas is not likely to increase appreciably. Today rural electrification is under 1%, and about 3.9 million rural households are not connected to the grid. Optimistic projections indicate that by the year 2010 rural coverage will reach only 2%, with the number of households not connected reaching 4.3 million.

In general, population density in Uganda is relatively low while road networks are reasonable given that Uganda is considered as one of the poorest countries in the world. Approximately 40 of the districts have population density between 51-100 person per square kilometers. The rest are distributed almost evenly in the ranges of 101 to 150, 151 to 200, 201 to 250, and 251 to 300. The only exception are Kampala and Jinja, which are actually the two largest cities in the country. On the contrary in the districts with the highest population density i.e., density ranges between 251 to 300, three quarter of the population in these districts live in trading centers/towns (peri-urban) and their surroundings.

1.1 Energy Sector Organisation

The Ministry of Energy and Mineral Development (MEMD) is responsible for the management and development of the country's water, forests, energy and mineral resources. Within the energy sector MNR sets broad sector policies and strategies and currently supervises and regulates the power and petroleum sub-sectors. As part of the civil service reform program, MEMD has been reorganised and its functions redefined to improve effectiveness. The state-owned Uganda Electricity Board (UEB) is responsible for power generation, transmission and distribution, and is the largest State Corporation in the country with about 3,400 employees. The distribution of petroleum is in the hands of sister companies of six international oil companies and one local company.

Concerns about the rapidly degrading environment and the need for prudent natural resource management led the government to launch the preparation of a National Environment Action Plan (NEAP) in 1990. The NEAP process identified, analysed and is currently prioritising environmental problems and opportunities and has developed a comprehensive national strategy for participatory, sustainable development based on sound environmental management. The NEAP programs focus on institutional capacity building particularly at the central and district level, training, legislative reforms, and awareness-building. They also include broadly defined projects in the areas of "resource productivity enhancement", "bio-diversity management", "environmental education" and "environmental health and pollution management".

In the energy sector, the efficient provision and use of energy can contribute importantly to environmental sustainability. This linkage is evident in both the traditional and modern energy sectors. Efficient and reliable distribution of modern energy reduces the need to increase supplies. Also, the "lifeline" tariff for electricity can effectively target those lower income groups that are most

affected by environmental problems, through, for example, the development of energy resources, or through toxic emissions and wastes from petroleum. A preliminary assessment of a wide range of potential environmental problems associated with the energy sector reveals that environmental issues are not generally a major constraint on activities in the sector. Uganda is fortunate in that, many of the environmental problems experienced elsewhere in the world have not yet reached significant levels.

1.2 Overview of the political economy

During fiscal year 1998/99, the Ugandan after two years of stagnation achieved real GDP growth rate of 7.8% p.a. per capita GDP grew by 5.1%, much faster than in the previous two years. Monetary GDP grew by 8.1% p.a. during 1998/99 while non-monetary GDP had a growth of 6.9% p.a. in the same period. Much of the growth in GDP came from the recovery of the agricultural sector which achieved a growth rate of 8.1% p.a. in the same period as compared to 1.9% in 1997/98. Construction and commerce performed well too attaining growth rates of 7.7% p.a. and 8.2% p.a. respectively. Support to private investment is yielding results; the industrial sector maintained its buoyancy with the manufacturing sector achieving a real growth of slightly over 11%. The "all items" index of industrial production, which measures the performance of the industrial sector, rose by 19.4% in December 1998 from the 1987 level, while the index for the 13 major manufacturing industries rose by23% between February 1998 and February 1999. The sub-sectors which performed very well were sugar, beer, soft drinks and cement.

Fiscal performance. Macroeconomic stability, restraining expenditures, redirecting resources towards priority programmes, and reducing dependence on external resources by raising the revenue base in the least distortionary and equitable manner governed Government's fiscal policy. However, the resource base in 1998/99 was slightly lower than expected despite the substantial increase with respect to the previous fiscal year. The under-performance occurred mainly on account of the shortfall in import support grants, and the disappointing performance of non-tax, non-URA revenue collections. The budget deficit excluding grants was larger than in the last fiscal year as expenditures rose more rapidly than domestic revenue collections. The increase in expenditure was mainly in poverty reduction areas. Also the shilling depreciation boosted donor supported expenditures that are disbursed in hard currencies, such as external development expenditures, and some programmes supported through the Poverty Action Fund, thus raising the shilling amount beyond programmed levels. Improved tax administration, especially with collection of import taxes, also made a noticeable contribution in 1998/99. As a result, tax revenue increased from 10.6% of GDP in 1997/98 to 11.3% in 1998/99.

Total government expenditures were projected to amount to 18.6% of GDP in 1998/99 compared to 17.2% of GDP the previous year. The main elements that contributed to the rise were expenditures under the wage bill, defence, poverty reduction programmes and externally funded development expenditure. One of the reasons for the sharp increases in expenditures for poverty eradication programmes has been the additional resources made available from the multilateral debt relief initiative for the Highly Indebted Poor Countries (HIPV). All of these funds have been channelled through the newly created Poverty Action Fund (PAF). In 1998/99, the PAF has, to date, mobilised government and donor resources amounting to Ush 70 billion for the implementation of the Poverty Eradication Action Plan.

The government embarked on an ambitious programme to clear the outstanding stock of arrears in 1998/99. A total of Ushs 117 billion (either in cash or with promissory notes) in payments for domestic arrears is projected by June 1999. This compares favourably with a reduction in

domestic arrears of 47.4 billion in 1997/98. Despite the significant reduction in arrears in1999, the outstanding stock remains big, estimated at around Ushs 260 billion by June 1999. Government has made a commitment to pay all domestic arrears over a three year period, and new measures have been instituted to avoid accumulation of new ones.

The overall budget deficit excluding grants rose from 5.9% of GDP in 1997/98 to 6.6% of GDP in 1998/99. Excluding grants, the deficit increased from 0.3% of GDP to 0.9% in the sample period. The increase in the deficit was caused by expenditures rising faster than domestic revenue, despite a substantial increase in the latter during 1998/99. The increase in expenditure was part of the medium term fiscal strategy to increase expenditures towards poverty reduction programmes as a necessity for poverty eradication. The recent depreciation of the shilling has also enlarged the size of the deficit as it increases the shilling has also enlarged the size of the deficit as it increases the shilling value of donor funds.

Monetary Developments and the Financial Sector. The conduct of monetary policy during 1998/99 which was aimed at maintaining low inflation and keeping the exchange stable faced two major challenges. The first related to the financial problems in the banking sector that led to the closure of four commercial bank, viz; Trust Bank, International Credit Bank, Greenland Bank, and the Co-operative Bank. The second challenge was the sharp depreciation of the Uganda shilling vis-à-vis other major international currencies that occurred between March and May 1999. The lack of full disclosure of information on commercial banks' operations and the wilful lack of transparent reporting of bank accounts and balance sheets caused serious limitations on the effectiveness of conventional Bank of Uganda surveillance systems. Because of massive violation of prudential requirements which included insider lending and the financing of non viable projects, a number of commercial banks faced severe liquidity problems that resulted in net injection by Bank of Uganda of Ushs 30 billion. Bank of Uganda simultaneously increased the issuance of instruments in open market operations to dampen inflationary pressure that would have resulted from increased money supply.

Inflation. During 1998/99 inflation remained very subdued, with negative annual headline inflation rates during the first seven months of the financial year. Headline inflation rate became positive in February 1999 and quickly reached its peak of 5.4% in April, raising fears of an inflationary momentum generated by the sharp depreciation of the shilling. The annual underlying inflation rate was above the level of the previous year throughout 1998/99. The negative inflation was due to the fall in the prices of food crops since December 1997 as prices reverted to more normal levels after the weather induces supply shocks and also by the very high level of the CPI throughout the second half of 1997 caused by El Nino weather phenomenon. Thereafter the headline annual inflation rate increased steadily from –2.7% in January 1999 to 5.4% in April 1999.

Foreign Exchange Market. The nominal exchange rate depreciated much faster during fiscal year 1998/99 than in the previous years, mainly on account of the turmoil in the foreign exchange market that occurred between March to May 1999. The behaviour of the exchange rate was influenced by a series of factors. First, the depreciation of the shilling since June 1998 reflects the situation in the balance of payments with a large trade and deficit and decline in both official and private transfers. The slow recovery of the coffee sector from the bad weather of 1997/98, the ban on fish exports and the decline in private transfers indicate that the pressures emanating from increased import demand could not be counteracted by increased foreign exchange inflows. Second, there was an international dimension to the persisted devaluation of the shilling. The dollar has been very strong against almost all currencies in the world: for example it appreciated by 9% against the Euro from January to April 1999. Other regional currencies, such as the Kenyan

shilling and the South African depreciated since the beginning of 1999. The tightening of liquidity and intervention on the sell side by Bank of Uganda and the onset of the coffee season in the West, changed perceptions in the market which prompted speculators to rapidly sell foreign currency in order to avoid the losses associated withholding foreign currency. This sudden change in market perceptions led to a very strong appreciation of the shilling in second half of May. The depreciation of the exchange rate over the last twelve months, in an environment of low inflation, should help to restore the competitiveness of the export sector.

The External Sector. Provisional figures indicate that the overall balance of payments position remained almost uncharged at US$ 56 million in 1998/99 as compared to US$ 59 million in 1997/98. Foreign exchange reserves at the Bank of Uganda are projected at US 719.8 million by June 1999, 4.7% less than its level in June 1998. The net inflow of foreign exchange into the country reduced significantly from over US$ 140 million in 1997/98 to about US$ 3.0 million in 1999. This was due to the decline in private transfers, coupled with an increase in non-project government imports of 135% in 1998/999. The trade balance improved for by the first time in the last few years, from a deficit of US$ 1,237 million in 1997/98 to a deficit of US$ 1,022 million in 1998/99. In real terms, the trade deficit narrowed from 20.5% of GDP in 1997/98 to 17.8% in 1998/99. The improvement was largely accounted for the decline in private imports since the export sector showed sluggish growth. However, the improvement in the trade balance was not enough to avoid a deterioration in the current account balance as current transfers, both private and official fell. The current account deficit widened from 6.1% of GDP in 1997/98 to a deficit of 7.6% of GDP in 1998/99.

1.4 The Uganda power sector restructuring, privatisation, strategic and implementation plan

In 1997 the government of Uganda formulated a comprehensive and detailed Strategic Plan for transforming the Uganda Power sector into a financially viable electricity industry, in order to enable it to supply reasonably priced and reliable power, and to make its full contribution to the further economic and social development of Uganda. At that time the government decided that the plan would be updated as the power sector evolved and more information became available on the experience of power sector reform around the world and of private sector participation. The government has now fundamentally revised the 1997 Plan and prepared this New Strategic Plan.

The New Strategic Plan has been formulated to address the key problems in the power sector, and in particular those of very poor financial and commercial performance by the UEB and the need to finance a relatively large investment programme. Specifically, the plan has been designed to meet the following objectives which the government has set for the power sector.

- Making the power sector financially viable and able to perform without subsidies from the government budget.
- Increasing the sector's efficiency;
- Meeting the growing demands for electricity and increasing area coverage;
- Improving the reliability and quality of electricity supply
- Attracting private capital and entrepreneurs; and
- Taking advantage of export opportunities.

Proposed reforms should be practicable and implementable in Uganda, and be politically/socially acceptable. This New Strategic Plan places particular emphasis on the role of competition in promoting efficiency within the power sector and on private sector participation as being a key

driver to enhance the power sector's performance. The proposed reforms of the power sector are set out briefly below.

Generation

The core strategy for generation is to increase the scope of competition in the provision of new generating capacity and in the running of existing generation assets. New generating capacity will be provided competitively by the private sector through independent power projects (IPPs). Separate Power Purchase Agreements (PPAs) will be developed for Owen Falls Power Station (OFPS) and the Owen Falls Extension (OFE). Both the existing power station at Owen Falls and the soon to be commissioned Extension will continue to be owned by the public sector but let to the private sector through concessions. GoU's privatisation transaction advisers will determine whether it is feasible to let separate concessions for the existing power station and the Extension respectively, or whether it is optimal to have both facilities operated by the same company. The development of new capacity, including co-generation capacity by major industrial plants will be encouraged.

Transmission

A separate Transmission Company will be responsible for network maintenance, system operation and dispatch, and bulk purchase and supply of electricity. Bulk purchase and supply will be undertaken by a ring-fenced business unit within the Transmission Company, which will purchase capacity from competing providers under long term contracts. The transmission Company will be regulated by an independent regulatory authority. Initially responsibility for transmission will remain with UEB and be operated as a n independent and profit-making business. In the medium term UEB's existing transmission assets will be let under a concession contract to a private sector entity, while ownership of the existing assets will remain in the public sector. The transmission concessionaire will not be allowed to operate either generation or distribution businesses. New transmission capacity will as far as possible be developed, financed, constructed, operated and owned by the private sector.

Distribution

Reform of the distribution system, in order to make it financially viable and improve its commercial performance, will be the key to the success of the whole reform programme. The maximum number of financially viable distribution companies will be created out of the existing UEB customers to the new distribution companies. The transaction advisers will advise government with regard to the number and scope of the new distribution companies.

Market Structure

A ring-fenced business unit within the Transmission Company will be responsible for bulk purchase and supply of electric power. It will therefore hold PPAs for OFPS, OFE and the IPP's under development, and contracts to supply distribution companies. It will also be responsible for generation planning, contracting for new capacity, settlements etc.

In the longer-term government intends to introduce a structure for the generation market whereby distribution companies and large consumers will contract for generation capacity directly with generators (with appropriate regulatory oversight), and the transmission network is operated on an open access basis. Government will require its privatisation transaction advisers to recommend the appropriate timing for the introduction of this market structure. In furtherance of its objective to promote competition, the Government also proposes to introduce competition into the final retail markets. However, government's priority is to successfully let concessions by the end of the year 2000, which will be assisted by assuring revenue flows from large consumers. Hence the

introduction limited retail competition will be delayed to the medium term. Government will require its privatisation transaction advisers to recommend the appropriate timing for the introduction of limited retail competition.

Ownership

While control of existing assets will be let to the private sector through long-term concessions, ownership of existing assets will remain in the public sector in the near term. However government will continue to investigate mechanisms for transferring ownership to t he private sector in the medium to long term to the extent feasible ownership of incremental and new assets will remain in the private sector. To preserve open and transparent market operation, there will be restrictions on cross ownership.

Regulation

A key component for the reforms being put in place by the Government will be a new regulatory system for the power sector. This will give confidence to both private sector participants and consumers that the new power system will function under an agreed and transparent set of rules and procedures. Regulation will be through an autonomous regulatory authority, with powers defined under the new Electricity Bill.

Implementation programme

- the programme comprises a number of integrated dated actions, and the failure to meet any of the major actions by the due date would inevitably introduce significant slippages into the whole programme; and
- a number of consultancies must be procured to support the programme-work must commence immediately on agreeing the terms of reference and mobilising finance for the consultancies
- from the outset an interactive process with the market will be pursued, permitting flexibility to package the various transactions to reflect market feedback
- a consortium of advisers led by a management consultants will be appointed by September 1999 to advise government with regard to the implementation of the full set of power sector privatisation transactions.
- the reform of distribution and the letting of the concessions for the areas that account for the majority of the sectors revenues will be the key to the whole reform programme;
- building on the work to be undertaken for the asset valuation study, the government aims to establish the new distribution entities by December 1999;
- an investor conference for the distribution concessions will be held in January 2000;
- the government will issue requests for concessionaires in February 2000;
- final bids for distribution concessions should be received by July 1st 2000; and
- negotiations with preferred bidders should be concluded, and contracts awarded in October 2000.

The detailed Uganda Power Sector Restructuring and Privatisation - New strategic plan & Implementation plan is in Annex 1.

2.0 Overview of the Energy Situation

Uganda is richly endowed with renewable energy resources - biomass and hydrological resources, favourable solar conditions, and a large quantity of agricultural residues but their utilisation is low. The country has a comparative advantage in hydropower, which is concentrated on the Nile River. The total hydro potential is estimated at 2,000 MW of which only 150 MW has been developed at the Owen Falls plant. Geothermal resources have been identified in the west of the country but

their economic viability is not yet known. Woodfuel and other biomass are plentiful in many areas of southern Uganda. Localised deforestation is affecting some peri-urban regions, which have to import wood from the surplus regions. Given the low per capita income, modern commercial fuels such as kerosene and LPG are not affordable for most households. The exploited and unexploited potential energy forms in Uganda include: petroleum generator sets, mini-hydro power sources, sugar factory waste potential energy, wind, coffee husk residues and solar energy.

a) Diesel and Petrol Generators: Facts and Statistics

Table 2.1: Number Of Genset Imports By Size And Type, 1993 To 1998

Year	Capacity (kVA)			Total
	< 75 kVA	75-375 kVA	>375 kVA	
1993 (from Jul)	91	6	4	113
1994	421	39	20	535
1995	545	77	31	748
1996	450	52	24	694
*1997	400	20	20	420
*1998	450	50	20	540
Total	**2,357**	**244**	**119**	**3,050**

Source: URA
* Projected

Table 2.2: Estimated Size of Gensets Imported, 1993 to 1997 (kVA)

URA category (KvA)	Est. avg size (kVA)
<75	10
75-375	50
>375	400
Petrol	1.5

Taking the URA data shown in Table 2.1, and the estimates for sizes shown in Table 2.2, the estimated total capacity of diesel and petrol generators imported during this period, as illustrated in Table 2.3.

Table 2.3: Estimated Total Capacity of Genset Imports, 1993 to 1997 ('000 kVA)

Year \ Capacity (kVA)	< 75 kVA	75-375 kVA	>375 kVA	Total
1993 (from Jul)	910	283	1,600	2,793
1994	4,207	1,967	7,867	14,041
1995	5,447	3,833	12,533	21,813
1996	4,503	2,583	9,600	16,686
1997	5,953	2,67	8,600	14,622
Total	**21,020**	**8,735**	**40,200**	**69,955**

Table 2.3 shows that a minimum of 70 MW of capacity was imported between July 1993 and mid-September 1997. It is however important to note that URA data on value of imports are inaccurate. The import values are invariably underestimated, as are the taxes and import duties charged for those imports. Therefore, URA data cannot be relied upon

to provide the value of imports. However, being the only available official source, the data provides an acceptable basis for estimating the value of the imports.

b) Small Hydro Resource Data and Energy Potential

Reliable information on small hydropower is largely unavailable available in Uganda. A number of studies have been carried out over the past 25 years, each with a separate mission, and none co-ordinated with the other. This makes small hydropower estimation very difficult in Uganda. Almost inevitably, wherever work has been undertaken to estimate potential, it has been from the point of view of estimating large hydropower potential. Those sites not satisfying the large-hydropower criteria, have had virtually no further work or studies carried out on them.

The main potential for small scale hydropower development exists in the areas of rivers draining Mt. Elgon in Eastern Uganda; the extreme South West of Uganda; rivers draining West Nile, near Arua (North-West); and rivers draining the Ruwenzori mountains in the West. Although many potential schemes exist, preliminary studies have been carried out only on a few of them. It is, therefore, not possible to estimate reliably the potential installed capacity that could be realised from the development of small hydropower sites. Within the 2 MW range, available studies list the potential and developed capacities as shown in Table 2.4. Table 2.5 provides a very rough estimate of the potential of some of the most promising mini- and micro-hydropower sites in Uganda. Table 2.6 provides fairly extensive information on the five operating small hydropower sites (and the Kikagati site that is not currently operational).

Table 2..4 Small Hydropower Sites in Uganda with Estimated Costs of Development (1997)

Site	District/Region	Estimated potential (MW)	Estimated Cost (US/mill.)	Status
Rwizi	Mbarara	0.70	2.10	Estimate
Kakaka	Kabarole	1.50	4.20	Estimate
Nzongezi	Mbarara	2.00	5.40	Estimate
Nyamabuye	Kisoro	0.70	2.10	Estimate
Siti	Kapchorwa	1.00	1.75	Estimate
Sipi	Kapchorwa	2.00	2.54	Estimate
Anyu	Arua	0.30	1.50	Estimate
Heisesero	Kabale	0.30	1.30	Estimate
Kitumba	SW	0.20	0.70	Estimate
Mpanga	SW	0.40	1.40	Estimate
Nyakibale	Rukungiri	0.10	0.50	Estimate
Kisizi	Rukungiri	N/A	N/A	Developed
Moyo	Moyo	N/A	0.80	Estimate
Ora	Arua	0.90	N/A	Estimate
Nkussi	Mbarara	0.90	N/A	Estimate
Mitano	Kabale	2.00	N/A	Estimate
Maziba I	Kabale	1.00	N/A	Developed
Maziba II	Kabale	1.50	N/A	Estimate
Kikagati	Mbarara	1.25	N/A	Abandoned

Sezibwa	Mukono	0.50	N/A	Estimate
Mgiita		0.15	N/A	Estimate
Kagando	Kasese	N/A	N/A	Developed
Kuluva	Moyo	0.20	0.80	Developed
Total		**17.6**	**25.09**	

Source: UEB, various

The Maziba plant is connected to the national grid at Kabale. While the two grid-connected plants are owned by UEB (Government), the four decentralised plants are privately owned. Three of the four are owned and operated by the Church of Uganda (COU) and one (Sipi) by a private individual. The COU developed these plants to provide electricity for its own institutional requirements e.g., hospitals.

Table 2..5 Potential Sites for Micro- and Mini-Hydropower Development (1997)

Stream	**Location/ Region**	**Micro (0-100 kW)**	**Mini (100 kW- 1MW)**
Nyakizumba	South West		✓
Namafwa	East		✓
Namatala	East	✓	
Mpologoma	East	✓	
Malaba	East	✓	
Agu	East		✓
Kapiri	East		✓
Sezibwa	Central		✓
Kelim	East		✓
Sironko	East		✓
Simu	East		✓
Muyembe	East		✓
Atari	East		✓
Tochi II	North		✓
Kafu	West		✓
Rwimi	South West		✓
Rukoki	West		✓
Kyambura	South West	✓	
Nyamugasani	South West	✓	
Mitano	West		✓
Nkusi	West		✓
Wambabya	West		✓
Waki I	West		✓
Pager	North		✓
Anyarwodo	North West	✓	
Kochi	North West		✓
Agugi	North West		✓
Orci	North West		✓
Aswa (Minor)			✓

Source: Sir Alexander Gibb, "Hydropower Development Master Plan" (Final Draft), 1994.

Table 2..6 Information Available on Small Hydropower Sites Developed in Uganda

Power Station	Year commissioned	0wnership	Type of devpt scheme	Installed capacity (MW)	Av. annual energy (GWh)	Catchment area (km^2)	Design head (m)	Design flow (m^3/s)	Hours of utilisation per day	Load factor	Grid connection
Maziba	1963	UEB	Dam	1.00	8.5	800	90	2.8	4	0.53	Yes
Kikagati	1934	UEB	Diversion	1.25	N/A	N/A	6	200	N/A	N/A	Yes. But not operational
Kisizi	1970	COU	Diversion	0.06	N/A	N/A	30	0.25	24	N/A	No. 43 km from UEB grid
Kagando	Mid- 1990's	COU	N/A	0.06	N/A	N/A	N/A	N/A	N/A	N/A	No
Kuluva	1995	COU	N/A	0.12	N/A	N/A	N/A	N/A	N/A	N/A	No
Sipi	N/A	Dr. Chebrot	Diversion	0.0013	N/A	90	80	N/A	N/A	N/A	No

COU = Church of Uganda

Trends in Small Hydro-power Development

Available records indicate that small scale hydropower development is still very slow. However, judging by the three micro-hydropower plants installed in the 1990s (Kagando, Kuluva and Sipi Falls), there is increased interest in small hydro. Because UEB has been the sole licensing authority for the supply of electricity, and since it does not have any records of licensees in recent times, one would think that it would have information on all new small hydropower sites. However, this does not seem to be the case, as the Kagando and Kuluva plants are operating without UEB's licences.

Much of the development of potential small scale hydropower sites will depend on the location of load centres relative to the sites. Simu Falls and Nabiyongo Falls originating from Mt. Elgon, and Sezibwe Falls in Mukono District are in areas with good hydrology which are, therefore, agriculturally productive. With the promotion of rural agricultural processing, the development of the sites to provide power for these processing industries can become a reality. The fact that the industry would settle its workers around the industry means that the site could be a nucleus for more resettlement, thus generating its own demand.

c) Sugar Factory Waste and Energy Potential

Large-Scale Sugar Plants

Uganda's sugar industry is currently recovering rapidly. As a by-product of sugar production, thousands of tonnes of bagasse are produced. Bagasse is currently being used for co-generation in Uganda's three large sugar industries, Kakira Sugar Works Ltd, Sugar Corporation of Uganda Ltd (Lugazi), and Kinyara Sugar Works Ltd. These factories generate 2.5MW (installed capacity is 4.5 MW), 2 MW and 1.5 MW of electricity respectively.

The technologies employed are inefficient. The owners are now focussing on more effective technologies for generating electricity to connect to the grid and to sell electricity to the national utility (UEB). Kakira has already completed a feasibility study, financed by the United States Trade Development Agency (USTDA). Government has also contacted USTDA to look into the possibility of financing a similar study for Lugazi and Kinyara. The Kakira project aims at generating 15 - 20 MW at a total investment cost of approximately US$ 14 million. The investments into the project will include the following:

- provision of about 2 acres of land for the plant;
- procurement of a high efficiency boiler of 75 TPH, 64 kg/m^3, 510^0C with a micro-processor control system and an efficient pollution control equipment;
- an extraction-cum-condensing turbo alternator of 14.5 MW generating electricity at 11 kV, 50Hz;
- a transmission line of 11 kV or 33 kV with a step-up transformer connected to the UEB main sub-station with an associated switch gear (10 km line);
- a feed water system with a treatment plant for the new boiler;
- accessories for the turbo alternator comprising a condenser, a cooling tower, circulatory water pumps and a condensate extraction system.

Revenue will comprise : an average annual service payment of US$1.2 million to UEB; about US$3 million per annum from the sale of electricity to UEB and other industries; and the sale of high quality steam to Kakira Sugar Works.

The operating expenses will include rent for land and other related services provided by Kakira Sugar Works (estimated at US$0.2 million per annum), the cost of bagasse at a rate of US$10 per tonne (for a total of approximately US$2.8 million per year), and operations and maintenance costs estimated at US$1.0 million per year. The pay back period for this investment, on these terms, is estimated to be 2 - 3 years at an IRR of 25%.

d) Small-Scale Sugar Plants (Jaggaries)

There are at least 39 smaller-scale sugar "jaggeries" that produce between 15-20% of the sugar consumed in Uganda. They utilise wood almost exclusively to refine the cane to "jaggery" (a relatively inferior form of sugar, somewhat between molasses and unrefined caster sugar). Most of these jaggeries are relatively small, and fall within the informal sector. They are generally situated far form the grid. They should ideally offer good opportunities for off-grid electrification. However, the enterprises are poorly capitalised. Their boilers are very primitive, and could not be used to raise steam.

e) Sawmill Wood Residues and Energy Potential

Uganda has a large number of sawmills and wood processing facilities. It is rich in forestry products, both from the natural and the plantation forests. As shown in Tables 2.7 and 2.8, there is great potential for sawmills to generate their own electricity in situ, as is done in many parts of the world. The incentive for this would be much greater if wood were further processed (e.g., for fine timber, furniture, veneer, etc.). Such processing would require steam heat for processing. This would then justify the investment in plant for steam, and for co-generating electricity. As it is now, wood processing is so dispersed and at such a low-level of technology, that there is little likelihood in the near future of any electricity generation from wood waste. The high cost of capital, the distances from centres of demand, and the scale of the technology required will, as with sugar jaggaries, hinder this sector from providing electricity for a long time to come. Average capacity utilisation of sawmills in Uganda is 30%.

Table 2..7 Wood Waste Production from Natural Forests

Company	**Area of Operation**	**Estimated Installed Capacity Input (m3)**
Budongo Sawmill	BudongoMasindi	10,000
Amaply	BudongoMasindi	21,000
Nileply	Mabira, Mukono, West Mengo	20,000
Rwenzori Saw mill	Budongo, Masindi	7,500
Nkombe Sawmill	Kalinzu, Bushenyi	5,000
Bubwa saw mill	Budongo, Masindi	5,000
Kapkwata saw mill	Mt. Elgon, Kapchorwa	5,000
Tesekererwasaw mill	Sesse Islands, Kalangala	5,000
Jinja Construction and Joinery	Public and Private land	5,000
Total/avg.		**83,500**

Table 2..8 Wood Waste Produced from Plantations

Company	Area of Operation	Installed capacity input (m3)
Kanyankole & Sons Ltd.	Oruha Kabarole	2,000
Techna Saw mills (2)	Keyhara/kagora, Kabarole	8,400
Kwewayo Furniture & Timber Dealers	Kagorra, Kabarole	
Western Patriotic Sawmill	Kikumiro, Kabarole	
Rusekere Sawmill	Kikumiro, Kabarole	4,000
Muko Sawmills	Mafuga, Kabale	
Ishasha Ban Dev. Scheme (2)	Mufuga & Muko, Kabale	8,400
Katugo Sawmill	Katugo, Luwero	
Ndyagenda Sawmill	Katugo, Luwero	
FMB Enterprises Sawmill	Katugo, Luwero	
BESEPO Uganda Ltd (2)	Bugamba, Mbarara & Kibale NP, Kabarole	
Capital Sawmill	Kiriima	5,000
Adaga Uganda Ltd (2)	Namafuma, Iganga	10,000 (?)
Kagera Sawmills Ltd.	Mafuga, Kabale	1,000
Casements (A) Ltd	Mafuga, Iganga	15,000
B.M. Technical Services	Bugamba, Mbarara	4,000
Uganda Wood Fabricators	Bugamba, Mbarara	8,000
Kapkwata Sawmills (2)	Lendu, Nebbi & Kapkwata, Kapchorwa	10,000
Sipi Sawmills Ltd.	Kapkwata, Kapchorwa	4,200
Bukenya and Sons Ltd.	Katugo, Luwero	3,000
Arbo Construction Ltd.	Wampanga	4,200
Cypress Sawmills Ltd	Kanyawara, Kabarole	4,200
Dissa Youth Group	Awang	4,200
Rugettee Overseas Ltd.	Usi	2,000
Forest Department (3)	Katugo, Luwero and Nyabyega, Masindi	12,600
Forest Research Institute	Katugo, Luwero	4,200
Total		>114,400

f) Coffee Husk Residues and Energy Potential

Because Uganda has very limited examples of biomass generated electricity (only limited cogeneration in the sugar industries), there is almost no basis for estimating the various costs of energy from biomass power plants. There is no data about importation of steam or gas fired turbines, gas combustion engines, or gasifiers. Therefore, estimations can only be made based mainly on inferred data from operating plants in other parts of the world. In a district like Mukono, which produces one of the largest quantities of coffee husks and has relatively good infrastructure, it is possible to transport the coffee husks to one central place for generation of electricity, to either connect to the grid or serve large communities living far from the grid. Mukono District produces over 39,000 tonnes of husks annually. If half of this amount is available for energy production and is collected at one point, about 30 GWh of electricity can be generated annually. Table 2.9 shows the estimated coffee husk resource potential by district.

Table 2.9 Coffee Husk Resource and Energy Potential by District (1997)

District	Active Factories	Active Hullers	Est Annual Husks (Tonnes)
Bushenyi	19	35	9,730
Hoima	9	15	4,170
Iganga	18	38	10,564
Jinja	8	19	5,282
Kabarole	4	9	2,502
Kampala	5	10	2,780
Kamuli	8	12	3,336
Kasese	5	7	1,946
Kibale	4	11	3,058
Kiboga	8	16	4,448
Kigulu	1	2	556
Luwero	32	61	16,958
Masaka	62	116	32,248
Mbarara	9	16	4,448
Mpigi	52	96	26,688
Mubende	29	50	13,900
Mukono	78	141	39,198
Nebbi	1	4	1,112
Ntungamo	20	24	6,672
Rakai	18	34	9,452
Rukungiri	14	16	4,448
Total	**404**	**732**	**203,496**

g) Rice Husk Residues and Energy Potential

Rice is produced primarily in the eastern parts of Uganda, mainly in Iganga, Bugiri, Pallisa and Mbale Districts. In 1996 Uganda produced 28,000 tonnes of rice, yielding over 15,000 tonnes of rice husks. The survey showed that most of the rice mills are concentrated around townships, where the rice harvest is collected from small holders. Mbale municipality alone, for instance, has 33 small rice mills. The mills generate considerable quantities of husks which pose major problems of disposal. Often the rice husks are burnt in-situ, thus posing environmental problems.

h) Solar Resource

Table 2.10 illustrates the distribution potential for solar energy in Uganda.

Table 2..10 Solar Resource Distribution and Insolation

Zone	Station	Temperature (^{0}C)	Sunshine (hours)	Cloud Cover (oktas)
	Wandelai	25.4	7.9	N/A
S.E	Kabale	16.6	5	6.7
West	Kasese	23.1	6.4	6.6
North	Gulu	23.1	7.9	5.6

N.E	Atumatak	21.8	8.6	N/A
South	Entebbe	21.2	6.5	5.9
	Kibanda	20.2	5.9	N/A
	Bugusege	21	5.8	N/A

i) Petroleum Products

Petroleum products demand in Uganda is low compared to neighbouring Kenya and Tanzania. According to preliminary official data, the total consumption was about 346 million litres in 1995. From 1997 to 1998, the consumption of petroleum products increased by of 12 percent. The rapid increase in the number of motor vehicles (to an estimated 150,000 in 1998) and an annual average GDP growth rate of about 6 percent accounted for this increase. Smuggling of petroleum products from neighbouring countries is rampant due to the high prices for petroleum products in Uganda. Therefore the official figures presented in Table 2.13 do not give the net petroleum consumption in Uganda.

Prices and Taxation.

Pump prices of petrol, kerosene and diesel are high when compared to neighbouring Kenya and Tanzania. The price in Kenya, for example, is less than one-half of that in Uganda. The retail prices in Uganda range from 4 to 5 ½ times their CIF landed cost at the seaboard in kenya and Tanzania. The principal reasons for the high prices are high inland transportation costs from the seaboard – about one third of the CIF Kampala cost of the product – and high wholesale and retail costs because of the small size of the market. Another reason is the high taxes levied on petroleum: tax rates o the respective CIF prices range from 17% for petrol, 130% for diesel and 90% for kerosene. As a result, almost half of the retail price for petrol and diesel are taxes. Yet an additional reason for the high prices has been the oil companies' relatively high margins before the liberalisation. Given the significant price differential between Kenya and Uganda, smuggling has developed quickly, particularly in the eastern regions of the country. It is estimated that about 10 percent of the petrol, kerosene and diesel consumed in Uganda was illegally imported in 1993. It is, thus, estimated that the government lost about 10 billion shillings in revenue from petroleum taxes. Table 2.11 below provides the cost structure for petrol, diesel and kerosene.

Table 2.11 Petroleum Product Cost Structure (as % of retail pump price)

	Petrol	**Diesel**	**Kerosene**
FOB Gulf	17%	19%	22%
Shipping to Mombasa	3%	4%	4%
Inland Transport etc.	10%	11%	13%
Uganda Wholesale	17%	21%	23%
Uganda Retail	4%	4%	5%
Uganda Taxes	49%	42%	33%
Retail pump Price	100%	100%	100%

Source: Ministry of Natural Resources, 1993

The Government deregulated the retail price of petrol, kerosene and diesel in January 16, 1994. This, coupled with the liberalization of the foreign exchange market has opened the door to competition.

A recent survey of household fuel retail prices in and around Kampala shows standard LPG prices as depicted in table 2.12 below.

Table 2..12 Current LPG Retail prices (Kampala)

Cylinder (Kg)	**Refill**	**Cylinder with Grill & Burner**
7	11,050	95,000
13	24,300	105,400
15	28,200	113,600
50	80,000	277,400

REDC; Survey (Feb. 2000)

Table 2..13 Imports of Petroleum Products (Litres) in Uganda

1997	**Jan-97**	**Feb-97**	**Mar-97**	**Apr-97**	**May-97**	**Jun-97**	**Jul-97**	**Aug-97**	**Sep-97**	**Oct-97**	**Nov-97**	**Dec-97**	**Total**
Petrol	16,047,467	13,628,111	13,863,061	17,646,353	15,640,805	13,716,527	16,754,435	16,045,192	15,570,843	15,475,357	13,694,278	13,149,720	**181,232,149**
Diesel	11,679,721	11,464,981	10,802,592	10,588,560	10,177,059	9,456,710	11,170,896	12,114,943	11,245,830	13,692,826	8,796,479	9,761,099	**130,951,696**
Kerosene	4,816,482	4,511,527	3,713,160	3,995,497	4,029,875	4,599,159	4,493,397	3,949,206	3,740,266	4,815,466	4,473,873	4,615,740	**51,753,648**
Jet A1	977,490	-	1,012,920	1,779,411	2,058,310	111,671	1,594,069	1,558,536	1,280,176	1,592,281	1,767,704	2,114,577	**15,847,145**
LPG	25,156	-	21,770	21,660	-	21,690	19,958	49,854	11,288	-	24,182	50,090	**245,648**
Grand Total	**33,546,316**	**29,604,619**	**29,413,503**	**34,031,481**	**31,906,049**	**27,905,757**	**34,032,755**	**33,717,731**	**31,848,403**	**35,575,930**	**28,756,516**	**29,691,226**	**380,030,286**

1998	**Jan-98**	**Feb-98**	**Mar-98**	**Apr-98**	**May-98**	**Jun-98**	**Jul-98**	**Aug-98**	**Sep-98**	**Oct-98**	**Nov-98**	**Dec-98**	**Total**
Petrol	16,047,467	13,628,111	15,197,623	14,592,616	14,953,672	16,776,545	17,462,027	15,601,091	18,866,993	19,538,032	13,793,566	17,608,957	**194,066,700**
Diesel	11,679,721	11,464,981	11,364,215	11,364,215	11,881,750	12,687,421	13,348,174	11,951,536	14,632,920	14,796,533	13,568,015	13,433,180	**152,172,661**
Kerosene	4,816,482	4,511,527	4,442,200	4,854,498	4,371,152	5,204,646	4,541,110	4,289,312	5,569,436	5,683,301	4,846,083	5,649,390	**58,779,137**
Jet A1	977,490	-	-	-	-	-	2,493,295	3,061,897	4,393,031	4,540,815	2,569,938	7,248,390	**25,284,856**
LPG	25,156	-	-	-	-	-	25,664	25,512	78,559	43,122	25,203	71,732	**294,948**
Grand Total	**33,546,316**	**29,604,619**	**31,004,038**	**30,811,329**	**31,206,574**	**34,668,612**	**37,870,270**	**34,929,348**	**43,540,939**	**44,601,803**	**34,802,805**	**44,011,649**	**430,598,302**

1999	**Jan-99**	**Feb-99**	**Mar-99**	**Apr-99**	**May-99**	**Jun-99**	**Jul-99**	**Aug-99**	**Sep-99**	**Oct-99**	**Nov-99**	**Dec-99**	**Total**
Petrol	17,421,419	15,794,397	16,920,347	17,725,426	14,938,615	17,939,035	17,488,837	17,792,138	17,346,610	NA	NA	NA	NA
Diesel	13,543,396	14,213,884	14,327,020	14,979,127	12,573,197	15,176,602	16,105,705	14,099,913	15,893,705	NA	NA	NA	NA
Kerosene	4,442,655	4,927,533	4,762,782	5,407,596	3,919,313	5,890,427	4,794,398	4,853,428	5,445,826	NA	NA	NA	NA
Jet A1	2,414,700	2,094,396	1,351,107	1,084,669	1,220,218	-	-	1,697,832	860,690	NA	NA	NA	NA
LPG	10,125	40,525	25,342	25,177	50,278	-	-	25,470	25,172	NA	NA	NA	NA
Grand Total	**37,832,295**	**37,070,735**	**37,386,598**	**39,221,995**	**32,701,621**	**39,006,064**	**38,388,940**	**38,468,781**	**39,572,003**				

Total imports of petroleum products in Uganda 1995-1996

Product	**1995**	**1996**
Petrol	174,848,126	180,884,356
Diesel	121,514,946	122,436,676
Kerosene	42,316,848	46,103,855
Jet A1	6,667,495	15,996,660
LPG	824,512	989,332
Grand Total	**346,173,922**	**366,412,875**

3.0 Household Energy Overview

Analysis of household energy use has been based on the Uganda Integrated Household Survey 1997/8, categorised according to income as shown in Table 3.1. The data source does not segregate households according to whether they are urban or rural. We can however roughly assume that predominantly the Category I households (low income) are rural, Category II are peri-urban and Category III (high income) households are urban.

Table 3.1 Annual Household Income Categories

Category	Annual Income (UShs)
I	0 – 1,000,000
II	1,000,001 – 5,000,000
III	Over 5,000,000

Source : Uganda Integrated Household Survey 1997/8

Analysis of the 1997/8 household survey data revealed that electricity, firewood, charcoal, paraffin, petroleum gas and solar are the energy types used by households in Uganda. Households require energy for four main purposes: cooking/heating, lighting, entertainment (radio and TV) and cooling (refrigeration, fans, air conditioning). Of these, cooking/heating and lighting constitute the greatest consumption uses, and these were the parameters investigated by the survey. Tables 3.2. and 3.3 summarise the energy sources used for cooking and lighting by households of the different income categories.

Table 3.2 Types of Energy Used for Cooking by income Category (%)

Energy Type	Household Category		
	I	II	III
Firewood	78.1	52.9	24.2
Charcoal	19.1	42	62.6
Paraffin	74.6	48.3	13.6
Electricity	0.3	1.2	7.3
Gas	-	0.1	7.3
Solar	-	-	-
Other	0.6	0.3	1.1

Source : Uganda Integrated Household Survey 1997/8

Table 3.3 Types of Energy Used for Lighting by Income Category (%)

Energy Type	Household Category		
	I	II	III
Electricity	4.85	22.9	59.2
Paraffin (Lantern)	11.3	27.7	26.5
Paraffin Tadooba	74.6	48.3	13.6
Candlewax	0.3	0.5	0.4
Wirewood	8	0.3	0

Solar	0	0	0.04
Other	0.9	0.1	0

Source : Uganda Integrated Household Survey 1997/8

As indicated by Tables 3.2 and 3.3, households use electricity for lighting mainly. Fire wood is the most commonly used energy type for cooking followed by charcoal and paraffin in that order. The households of Categories I and II mainly use firewood and paraffin to cook while Category III households mainly use charcoal and fire wood. Table 3.3 indicates that for lighting, the majority of households in income Categories I and II use the paraffin wick-lamp "*Tadooba".* Some Category II and III households use paraffin lanterns, but electricity is the most common form of energy used for lighting. The above findings show that the households that have electricity use it mainly for lighting. Further analysis of the quantity and value of the of electricity used by households revealed that there is no significant difference in the amount spent on electricity by households of different income categories.

Household Energy Expenditure Patterns

Table 3.4 summarises the monthly expenditure on energy for 16 selected districts in Uganda district and income category.

Table 3.4 Monthly Households Expenditure by District and Income Category

District	**Income Category**		
	I	**II**	**III**
Kalangala	4,025	7,432	3,400
Luwero	3,828	7,475	8,400
Masaka	5,774	9,026	12,080
Rakai	4,596	8,248	8,050
Iganga	6,463	11,342	12,507
Kapchorwa	3,708	6,702	14,500
Mbale	7,164	11,965	17,398
Soroti	4,269	8,582	15,036
Bushenyi	3,447	8,700	10,410
Kabale	4,831	6,725	17,450
Kibaale	5,909	8,732	4,700
Masindi	7,156	10,410	14,141

Mbarara	4,180	8,394	19,546
Rukungiri	3,041	7,329	22,200
Arua	6,015	9,374	14,375
Lira	8,335	12,426	14,756

Source : Uganda Integrated Household Survey 1997/8

Although there are slight variations in the monthly expenditure on energy in the different districts, the proportion of expenditure in relation to income is almost the same in all districts. From the results of the 1997/8 household survey, the majority of households spend between 0.50 – 1.00 % of their income on energy needs. However, the expenditure patterns differ based on the household income category. While the majority (40%) of Category I (low income) households spend between 1.00 – 5.00 % of their income on energy, the majority of the higher income households of Categories II and III spend less than 0.5 % of their income on energy needs. Details of the results on expenditure patterns on energy are summarised in Table 3.5.

Table 3.5 Proportion of Income Spent on Energy by Household Category

Proportion (%)	Household Category Proportion (%)		
	I	II	III
< 0.50	29.0	61.4	98
0.50 – 1.00	27.5	32.3	2
1.01 – 5.00	40.8	6.3	0
> 5.00	27.0	0	0

Source : Uganda Integrated Household Survey 1997/8

Further analysis of the expenditure on energy households revealed that the difference in expenditure on electricity by household category is not significant. Based on the 1997/8 Integrated Household Survey data, households spend between UShs 3,200 – 3,400 (US$ 2.0 - 2.2) per month on energy. Total expenditure on energy is positively related to income, although the lower income households spend a lot less than their higher income counter parts. This is because the higher income households use more of the efficient energy types than their lower income counter parts. Table 3.6 summarises the average monthly expenditure on energy by income category.

Table 3.6 Average Monthly Expenditure on Energy by Income Category

Energy type	Income Category		
	I	II	III
Electricity	3,554	3,222	3,583
Paraffin	1,342	2,153	2,531
Charcoal	4,745	7,029	10,098
Firewood	1,593	2,287	3,440
Battery	1,707	2,157	2,796

Total	**12,941**	**16,848**	**22,448**

Source : Uganda Integrated Household Survey 1997/8

3.1 The Fuel Consumer Price index (CPI) Kampala/Entebbe/Jinja/Mbale/Masaka/Mbarara

The consumer price index Table 3.7 is a measure of the cost of all goods and services purchased by households. The purpose of the CPI is to measure changes over time in the general level of prices of goods and services that a reference population consumes. The objectives of the index are: i. To measure inflation, ii. To deflate key economic statistical indicators, iii. To adjust incomes.

Table 3.7 Average Market Prices For A Sample Of Selected Consumer Goods, Kampala: 1993-1998

Period	Charcoal	Paraffin	Cook oil	Soap
Unit	Kg	Litre	Pepsi bottle	Kg
Quarter				
1993 1st	151.7	908.3	583.3	857.8
2nd	151.3	940.0	610.0	866.7
3rd	139.4	923.3	616.7	986.7
4th	134.8	911.7	613.3	968.9
1994 1st	154.7	844.4	560.0	716.7
2nd	156.7	811.1	553.3	792.2
3rd	159.9	811.1	546.7	788.9
4th	163.1	855.6	540.0	845.6
1995 1st	158.5	908.3	563.3	831.1
2nd	160.4	866.7	540.0	825.2
3rd	160.4	866.7	550.0	873.8
4th	179.7	946.7	550.0	911.1
1996 1st	186.3	946.7	522.3	918.3
2nd	182.0	935.0	530.0	914.0
3rd	180.3	972.2	936.7	936.7
4th	177.7	944.7	530.3	948.3
1997 1st	182.9	945.0	550.0	937.0
2nd	194.7	1,022.2	538.7	940.7
3rd	184.9	1,022.2	511.0	937.0
4th	193.0	1,022.3	511.1	933.3
1998 1st	207.0	1,020.0	500.0	933.3
2nd	184.8	1,026.7	530.5	985.2
3rd	177.7	1,030.0	600.0	1,029.6
4th	174.3	1,000.0	655.6	1,040.7

Source: Adapted from the Statistical Abstract 1999; (MFPED).

Table 3.8 below depicts the CPI of Key household consumables including rent fuel and utilities

Table 3.8 Consumer Price Index: Kampala/Entebbe (Base: September 1989 = 100)

Year And Month	Food	Rent, Fuel Utilities	H.hold & Personal Goods
Weights	48.6	12.5	10.4
ANNUAL Calendar Year			
1990	108.1	149.6	120.8
1991	132.9	211.9	151.3
1992	214.5	289.6	22.8
1993	206.5	333.2	236.1
1994	240.3	366.6	235.2
1995	255.1	436.8	239.6
1996	269.3	473.9	249.3
1997	316.1	481.0	249.8
1998	306.1	507.2	258.4
Financial Year			
1990/91	119.3	175.1	132.0
1991/92	170.2	252.2	190.8
1992/93	214.9	315.2	228.6
1993/94	226.1	351.6	240.4
1994/95	246.2	396.0	233.5
1995/96	258.9	464.8	245.9
1996/97	291.9	477.3	249.4
1997/98	322.1	486.6	251.2

Source: Adapted from the Statistical Abstract 1999; (MFPED).

4.0 Household Energy Fuels

4.1 Woody-biomass Use

Today the Statistics Department assumes an urban population growth rate on the order of 6.5% per annum and the rural population growth at 2.2% per annum. The estimates of the proportion of households utilising charcoal as their primary fuel source are in Table 4.1

Table 4.1 Proportion Households Using Charcoal

Category	HHs Use (%)
Charcoal rural	2.7
Charcoal overall urban	54.9
Charcoal Kampala	88.4
Charcoal Jinja	84.0
Charcoal Entebbe	86.0

Source: Statistics Department

Urban Households. 85% of the households in urban areas use charcoal as their primary fuel. Over 1.5 million people in Uganda utilise charcoal as their primary source of fuel. Based on previous survey estimates from the HEPP and the 1994 ESMAP urban surveys, per capita urban charcoal consumption is estimated on the order of 160 - 200 kg per capita per. ESMAP's 1994 surveys showed 190 kg per capita for Kampala. Urban household charcoal consumption is estimated at between 250,000 - 310,000 metric tonnes per annum.

Wood consumption in urban areas is about 15% of the urban households. These will generally be the poorest of the population and at the periphery of the largest urban centres. Their consumption is estimated at 607 kg per capita. This implies that urban households consume about 1.4 million tonnes of fuel wood per annum. An estimated 60% (840,000 tonnes) of this fuel wood is purchased commercially.

Rural Households. The Statistics Household Budget Surveys statistics 1996-7 indicate that less than 3% of rural households consume charcoal. While the percentage of households utilising charcoal in rural areas is low, the consumption accounts for approximately 16,500 tonnes (or about 7% of total charcoal consumption in Uganda). 90% of all rural households obtain their fuel wood free of charge. The other 10% purchase their wood fuel for household purposes. Rural household consumption of wood fuel is on the order of 9.6 million tonnes, of which an estimated 8.7 million tonnes is obtained free of charge.

Wood fuel

Uganda's economy has become increasingly biomass-dependent over the past two decades. Industries, commercial and institutional establishments have shifted over to biomass while the entire structure of biomass proprietorship and management has remained virtually unchanged since independence. In fact, the Forest Department is far weaker today than it was thirty years

ago. It has far fewer personnel, financial and administrative powers today than in the mid-1960s. Cost-effective mechanisms to improve biomass production and exploitation need to be implemented. The woof fuel sector analyses presented in this Chapter are primarily based on the European Union 1995 Woody Bio-Mass Study of the Forestry Department – Ministry of Natural Resources.

Charcoal Production

Charcoal and wood Production surveys were carried out in a number of major charcoal producing sites based initially on agro-ecological criteria:

- Buvuma Islands representing tropical islands of Lake Victoria;
- Mpigi and Mukono areas representing tropical Lake Victoria shore conditions;
- Nakasongola, Lwampanga and Masindi representing semi-arid areas if dry land savannah and bush;
- Kitugo and Luwero for newly settled or resettled areas; and,
- Kamuli, Iganga; Kiboga and Mubende areas for zones of mixed agriculture and livestock, with moderate agro-ecological conditions.

The results obtained from the surveys indicated that:

- the majority of charcoal burners have little formal education yet have worked as charcoal producers most of their lives (being trained by their fathers and families);
- the majority (well over 60%) come from far afield (mainly western and southwestern Uganda) to produce charcoal on contract with local land holders;
- nearly 80% of all producers engage in charcoal production as their sole or major economic activity;
- with one exception (observed in Iganga), producers are not organised; they prefer to operate almost exclusively as individuals in all aspects of contracting, production and sales;
- nearly all charcoal producers do not own or have land holding rights to the land they use to produce charcoal; rather, they enter into contract with land holders (who may be landowners or had proprietary access to the land through a variety of recognised means);
- producers almost always produce charcoal for an agreed, negotiated fee, either paid in cash or as a proportion of the charcoal produced;
- almost all producers obtain production licenses from local Forest Department officers;
- charcoal produced in most areas surveyed is produced by inefficient, old traditional earth kilns known in the vernacular as ‘kinyankole’ and nicknamed the ‘bus’ by producers.
- the ‘kinyankole’ provides yields of approximately 0.64 sacks per person day;
- a locally-improved kiln known as the ‘kasisira increases these yields to nearly a sack of charcoal per day (over 40% increase in return on the ‘kinyankole);
- simple tools (axes, pangas, hoes, shovels and rakes) are used in all the areas; charcoal production is extremely labour-intensive;
- accessibility to areas and demand for charcoal are major factors that influence charcoal prices; production site prices per bag vary widely from a low of UShs 1,250 in remote areas produced by subsistence farmers to a high of UShs 6,500 in areas nearest to Kampala and Entebbe during the rainy season.

This wide range of prices reflects a number of factors ranging from access to sites, to the level of sophistication of producers and lack of organisation that leads to little bargaining power. Prices fluctuate widely during the course of the year arising mainly from the poor state of Uganda's roads and illustrating the point that charcoal is often produced in inaccessible areas. Transporters normally go to a producer the first time and offer a price and often given the lack of producer and market organisation, most producers are forced to sell at that price.

Charcoal Production Fees

The largest proportion of charcoal burners are poor rural people who do not own forest land. A small proportion (about 10%) are squatters on forested land. They produce charcoal and other woody biomass products under agreement with the land holder. The vast majority (over 80%) reach agreement with a land holder to clear the landholder's land for agricultural and livestock purposes. Charcoaliers receive the bulk of the charcoal, as their return for clearing these small land pieces. There are other tariffs charcoal burners pay and these include:

- **Charcoal Production Permit**: The price for the permit varies from area to area and there is no uniform fee applied;
- **Sub-County Fee (Revenue Levy)**: Some districts e.g. Mukono and Mpigi impose fees on top of a permit for production of UShs 200 per bag. In some districts it is UShs 400 per bag;
- **Landholder's fee**: The fees agreed upon vary substantially both in terms of the mode of payment and the amount paid.;
- **FD General Receipt**: Some charcoal burners who produce and transport charcoal to the market themselves are liable to pay for the movement permit (transport permit). Again the price varies in some districts; and,
- **Town Council Fee:** Some town councils impose a fee on producer and traders to raise revenues for development programmes in their areas.

Traders pay the following fees:

- **District Administration Revenue Fee/Levy:** The fee of between UShs 200 and 300 (sometimes as high as UShs 400) per bag of charcoal is paid by transporters for local district authorities. These fees are collected at road blocks within districts or on district borders. A receipt is issued in the district where charcoal originates. It is considered valid at other road blocks in other districts so long as the amount paid is not less than the fee imposed in the succeeding (next) district(s).
- **Forest Department Movement Permit:** The Forest Department (District Forest Officers/DFOs) charge a fee of UShs 22,500 for a lorry and UShs 15,000 for a pickup valid for three days' worth of transport for charcoal. Likewise, the Forest Department issues a movement permit for UShs 8,000 for bicycles with a time limit of 30 days after issuance. There is no indication Forest Department Officers charge for charcoal moved by train; and,
- **Transport to Market:** Transport costs for the charcoal to the market varies by distance, carrying capacity and the mode of transport, as illustrated above.

Charcoal Production Technology and Charcoal Yield

Although the bulk of the charcoal produced in Uganda is made using traditional earth, some producers have begun to adopt a new kilning technique using a round kiln. This shift from the traditional earth kiln to the improved kiln provides a source for optimism for transforming the sector. This should be examined carefully, and should form the basis for further work to encourage improved efficiencies and higher returns to production in the future. Based on this information, charcoal yield per capita, per kiln per day by kiln type has been calculated for nine production sites as shown in Table 4.2.

Table 4.2 Charcoal Yield per Capita per Kiln per Day, by Area

	No of Bags per Kiln Type	
Site	**Round**	**Rectangular**
1. Buvuma Island		0.30
2. Mpigi	1.00	
3. Nakasongola/Lwampanga		0.70
4. Katugo		0.80
5. Mukono	1.00	
6. Kamuli		0.70
7. Iganga		
8. Kiboga		0.70
9. Mubende	0.80	
Average	**0.93**	**0.64**

Source: ESD Field Interviews and Surveys of over 200 producers

Charcoal Markets and Price

Most charcoal producers produce charcoal for either Kampala, Entebbe or Jinja markets. However, unofficial reports indicate that some charcoal is exported to the Kenyan market, through the border towns of Malaba and Busia by bicycle and over Lake Victoria by boat. The list of markets for charcoal produced in each area is summarised in Table 4.2:

Prices for charcoal along the trading centres surrounding Mabira Forest Reserve are high because of the FD ban on charcoal production in forest reserves. The restriction has caused short supplies of the commodity in these areas. Similarly, export of charcoal to Kenya has influenced the price for charcoal in most places in Iganga District. Tororo District as a net importer of charcoal, and the little charcoal produced in the District is exported to Kenya. Charcoal in Kiboga and Mubende districts is also very expensive because of the high demand exerted by the proximity of Kampala and Entebbe urban areas. Charcoal in Kampala, Entebbe and Jinja markets costs the same – Ushs 8,000 on average.

Table 4.3 Markets for Ten Sites of Charcoal Production

Production Site	**Markets in Uganda**	**Other Markets**
1. Buvuma Island	Kampala/Jinja	None
2. Mpigi	Kampala/Entebbe	None
3. Mukono/Baale	Kampala/Entebbe/Jinja	None
4. Nakasongola/Lwampanga	Kampala/Entebbe	None
5. Luwero	Kampala/Entebbe	None

6. Kamuli	Kampala/Jinja/Tororo	None
7. Iganga	Kampala/Jinja/Tororo	Kenya (Kisumu)
8. Tororo	Tororo	Kenya (Busia)
9. Kiboga	Kampala	None
10.Mubende	Kampala/Entebbe	None

Source: EC ESD Field Surveys

The distances from the production areas to the markets are often over 50kms. The most common transport mode (over 75%) is by truck hired by wholesalers. The trucks carry on average 150 bags per 5-6 tonne truck. Pick-ups, boats/canoes and bicycles are also used. There are approximately 32 markets in Kampala and 45% of households purchase woodfuel from markets. 35% of households purchase woodfuel from small stalls. 20% of the households purchase wood fuel from other sources including roadsides. Much of the woodfuel sold to households outside the markets had previously been purchased from markets by the final retailers. Market retailers sell on average 300 30-40kgs sacks per annum. Village retailers sell only160 sacks each per annum.

4.2 Electricity

Uganda faces significant constraints to its continued rapid economic recovery due to the lack of adequate electrical power to meet economic and social demand. Less that 5% of Uganda's population is served by the Uganda Electricity Board (UEB). Approximately 20% of Uganda's urban population are connected to UEB's grid, while less than 1% of all rural dwellers are connected as shown in Table 4.4 and 4.5 below. What is worse, the percentage of people connected to the grid decreases with every year because of Uganda's rapid population growth and UEB's inability to keep up with the existing system. Over 50% of urban Ugandans were connected to UEB in 1970, compared to 18% today.

Table 4.4 Households Connected to the UEB Grid (Urban and Rural, 1997)

Location	*Connections*	**No Households (1997)**	**Households connected (%)**
Kampala, Entebbe & Jinja connections	77,000	363,000	21%
Other urban connections	49,000	343,000	14.2%
Rural connections	14,000	3,461,000	0.0041%
Total connections	**140,000**	**4,167,000**	**3.4%**

Source: MFEP, Statistics Department. 1991 Census, updated and adjusted 1997.

Most of the grid connections are in Kampala, which accounts for over 50% of all grid connections (households, industries and commercial establishments) in the country.

Rural households pay, on average, over US$6 per month on drycell batteries for torches, radios, and radio cassettes. This represents just over 4% of the average household's entire monthly expenditures. Approximately 9% of households who own and use lead-acid batteries, expenditures are on the order of US$10 per month, or 6.7% of their mean monthly incomes (additional to the use of dry cells, kerosene or other non-grid energy). It is estimated that some

100,000 peri-urban and rural households in Uganda use SLI batteries for electrification. The total expenditures on lead acid batteries (including charging, transport and capital depreciation), is about US$10 million per annum. Households that use both lead acid batteries and drycells for rural electrification (approximately 4.3% of rural households), spend US$ 16 per month, or approximately US$ 192 per annum on electricity.

With only 126,000 urban households connected to UEB's grid, this implies that not more than 21% of Kampala's households are connected and less than 15% of all other urban dwellers in the rest of the country. If 4% of the rural and peri-urban households are using SLI batteries, this would imply that, at a minimum, another 100,000 households in Uganda enjoy electricity services.

Table 4.5 Some Grid Electricity Statistics

UEB electricity sales (GWh 1995)	488
Percent UEB load that is residential	55.0%
UEB residential consumption (GWh)	268
Total UEB residential consumers (MNR)	148,000
Proportion urban UEB residential consumers (MNR)	90.0%
Urban UEB electricity consumption (1995 GWh, MNR)	228.1
Per household UEB consumption (kWh 1998, MNR)	1,310.3
Average price paid by residential consumer per kWh (1998)	$0.10
Urban residential expenditures for UEB (US$ mi, 1995, MNR)	$22.8
Per household expenditures for UEB (US$ in 1995, MNR)	$154.1

UEB is under significant pressure both to expand its coverage (grid) and to strengthen its supplies to current consumers. Shortfalls in generation are on the order of 50-60 MW peak, and UEB's distribution system is weak. Conflicting interests lobby for intervention: industries and commercial establishments are constantly demanding that UEB improve and strengthen its services; political pressures force UEB to extend the grid ever wider to administrative centers throughout the country (an estimated US$11 million was budgeted for 1998).

The consequence is that UEB's entire grid system has become increasingly weak and unreliable. Outlying connections, even those newly-connected, get little, if any electricity (maximum of four hours per day). Furthermore core consumers, such as industries in Kampala, Jinja, Tororo, Mbarara and Entebbe get less and less reliable UEB electricity, and invest in their own generating capacity as a consequence. Table 4.6 provides a brief overview of the enterprises that generate their own power and the amount of petroleum generation capacity they have invested in to meet the grid's shortfall.

Table 4.6 Supply Survey Sample Large Petroleum Auto-Generation (kVA) - 1997

Major Kampala Autonomous Generators	**kVA**
Mukwano (Oil & Soap)	1,500
Mukwano (AK Plastics)	812
Dairy Corporation	635
Equatoria Hotel	600

Grand Imperial Hotel	600
Sheraton Kampala	560
Mukwano (AK Detergents)	350
Kampala Phone Exchange	316
Uganda Batteries	277
Bank of Uganda	250
EADB	250
Nakawa Phone Exchange	200
Makerere Phone Exchange	200
BAT	187
Mengo Phone Exchange	55
Mbuya Phone Exchange	30
Nsambya Phone Exchange	30
Kololo Phone Exchange	10
Total	**6,862**

Source: MNR, SDC field teams

The prospects for UEB to significantly strengthen its national coverage to non-grid areas over the next 20 years are remote. The costs of such work are prohibitive, and UEB's priorities should be to improve supplies and service to its existing core consumers. At present UEB cannot cover its costs from centralised urban customers, much less so from distant, isolated customers that consume even less than their urban counterparts. The result is that UEB is hemorrhaging. Every new connection results in further losses, particularly connections to outlying rural areas.

In this situation, there is no financial incentive for UEB to embark on any further rural electrification, even if it could strengthen its services, raise its tariffs and improve its collections. Even if UEB were to connect all urban consumers in Uganda's three largest cities (Kampala, Jinja and Entebbe) this would still leave 75% of Ugandans without UEB grid electricity. The Owens Falls extension that is currently in progress will bring on another 200MW of capacity. However, the main station at Owens Falls (the 180MW currently installed) will have to undergo rehabilitation when the new capacity comes on line, reducing the available capacity for at least three more years. Second, lack of generating capacity is not UEB's main problem. It is poor bill collections and lack of distribution capacity. This either requires major investment on UEB's part or on someone else's part. Government's current vision is to privatize distribution, requiring major investments on any buyers' part, who will transfer these costs to the users through higher tariffs.

The supply survey conducted by the MNR under the ESMAP Rural Electrification Study -1998 indicate that over 35MW of diesel generators are installed in the three largest urban areas by Ugandan industrialists. A further 1.1 MW is installed in smaller commercial establishment, hotels, restaurants and shops in these three large urban areas. The survey estimates show an additional 10MW of capacity in other "urban" areas of Uganda (i.e., towns with over 3,000 inhabitants). Rural surveys show that at least 10 MW of non-UEB generating capacity has been installed by a wide range of private enterprises, from dairy processing companies to coffee processors, from saw mills to rural hotels and restaurants. Over 400 coffee processing plants operate with diesel generators,

while more than 20 dairy plants have over 5 MW of installed capacity (run as base load) to meet demand in this fast growing sector.

What emerges from both the supply and demand side surveys is a picture showing the tremendous willingness and capacity of private Ugandans to pay for electricity to meet their industrial, commercial and residential demands. Uganda Revenue Authority figures show that over US$ 30 million was invested by private Ugandans to import diesel and petrol generators since 1993. Interviews with all major suppliers and distributors, and with major consumers, show that many of these systems are oversized and under-utilized, particularly in urban areas. At least 25% of rural private generating capacity, and closer to 90% of urban generating capacity is under-utilized. This represents a major loss to the national economy as this power could be put to effective use to support, promote and accelerate economic development.

Moreover, due to historical UEB and national restrictions, each private generator is currently only allowed to supply the owner's own needs. This leads to considerable underutilized capacity that could immediately be supplied to other consumers. The use of expensive SLI batteries and the large investments by rural and urban consumers in private generating capacity demonstrates in the most concrete terms possible that Ugandans are willing to pay far more than the industrial and residential tariffs charged by UEB to obtain electricity where there is none in order to obtain reliable supplies for their businesses and pleasure. The task now is to identify how to organize this demand better and to invest in more sustainable, economical, environmental sustainable, and financially inexpensive electricity supply opportunities. The existence of over 60MW or more of independent, private diesel and petrol generating capacity provides opportunities for meeting much of this suppressed demand. Considerable opportunities exist for investing in the sector to supply these needs. However, Uganda's institutional environment needs to change to enable and to stimulate such development.

4.3 Lead Acid/Car Batteries

The ESMAP Rural Electrification Strategy Report (1998) provides the following information (Table 4.7) on the use of motor vehicle batteries in the rural areas.

Table 4.7 Summary Results on Rural Household Use of Car Batteries and Extrapolation

Survey					Extrapolation		Estimation	
car batteries								
	total rural hh in 33 districts	Total rural hh in 12 district	covered by survey	car batt used (sample)	car batt in rest of 12 districts	total batts in 12 districts	car batt in remaining 21 districts	total in 33 districts
East	749,748	380,717	218,852	11,048	3,268	14,316	5,589	19,905
West	818,549	265,222	111,602	8,397	4,623	13,020	12,490	25,510
Central	781,980	343,308	152,815	20,550	10,247	30,797	17,697	48,494
North	198,053	197,570	69,150	3,977	2,954	6,931	8	6,940
Total	2,548,330	1,186,817	552,419	44,194	21,093	65,287	35,784	101,071

				% of hh with car batt in sample	% of hh with car batt in rest of 12 districts 1)	% of hh with batt in 12 districts	% of hh with car batt in remaining 21 districts 2)	total batt coverage
East				5.0%	2.0%	3.8%	1.5%	2.7%
West				7.5%	3.0%	4.9%	2.3%	3.1%
Central				13.4%	5.4%	9.0%	4.0%	6.2%
North				5.8%	2.3%	3.5%	1.7%	3.5%
Total				8.0%	3.2%	5.5%	2.4%	4.0%
					1) assuming coverage in the remaining households in the 12 districts = 40% of the sample			
					2) assuming that coverage in the remaining 21 districts is 75% of that in the 12 districts			

drycell batteries

	total rural hh in 33 districts	Total rural hh in 12 district	covered by survey	sample	12 districts - sample	12 districts	remaining 21 districts	total in 33 districts
East	749,748	380,717	218,852	205,721	60,861	266,582	193,800	460,382
West	818,549	265,222	111,602	104,906	57,761	162,667	254,527	417,194
Central	781,980	343,308	152,815	143,646	71,625	215,272	206,302	421,574
North	198,053	197,570	69,150	65,001	48,286	113,287	208	113,494
Total	2,548,330	1,186,817	552,419	519,274	238,533	757,808	652,016	1,409,824
				% of hh with drycell batt in sample	% of hh with drycell batt in rest of 12 districts 1)	% of hh with drycell batt in 12 districts	% of hh with drycell batt in remaining 21 districts2)	total drycell batt coverage
East				94.0%	37.6%	70.0%	52.5%	61.4%
West				94.0%	37.6%	61.3%	46.0%	51.0%
Central				94.0%	37.6%	62.7%	47.0%	53.9%
North				94.0%	37.6%	57.3%	43.0%	57.3%
Total				94.0%	37.6%	63.9%	47.9%	55.3%
					1) assuming coverage in the remaining households in the 12 districts = 40% of the sample			
					2) assuming that coverage in the remaining 21 districts is 75% of that in the 12 districts			

*It is notable however that these batteries that are used in the households are normally worn out motor vehicle rejects.

Estimation Methodology

Uganda consists of 4 regions and 38 districts. A total of 3,434,177 households live in the country, of which 446,980 households in the urban areas; the vast majority (2,987,197 households) live in rural areas. Almost all of these rural households (2,929,102 households) have no access to electricity. However, due to political instability in the Northern region 5 districts in the north with a combined population of 378,564 households were excluded from consideration for the survey. As a result, it is estimated that there are about 2,550,537 unelectrified rural households living in 33 districts in all 4 regions. Out of the 33 districts, only 12 districts were considered for the survey. The number of unelectrified rural households in the 12 selected districts consisted of almost half – 46%- of the total unelectrified rural households. Their combined population was estimated at 1,186,818 households. The universe for the survey consisted of about 550 thousand households

in 12 districts. Expansion to all 38 districts. was estimated, although this could not be verified from the survey data. Based on discussions and casual inspection, it was decided to apply a factor of 75% to the averages of coverage by Region for the 12 districts found; i.e. if there are x% battery users in Region A (among the 12 districts sample), there would be 75% of x% battery users in the remaining districts (among the 33-12 non-surveyed) in this Region A.

In comparison, a study by a local businessman in Uganda indicated that the annual demand for vehicle batteries in Uganda is about 87,000 units, based on the number of motor vehicles registered in the country (150,000). About 60,000 battery units were produced locally and 25,000 units were imported in 1998, mainly from the United Arab Emirates.

It is apparent that the ESMAP figure is a over-estimate, because based on facts on the ground, the larger proportion of batteries in the country is with the motor vehicles and not households as the ESMAP figures tend to suggest.

The duty on imported batteries is shown in Table 4.8.

Table 4.8 Duty on Imported Batteries

Duty	Tax Rate (%)
Import duty	15
COMESA Duty	6
Excise Duty	10
Withholding Tax	4
Import Licence Commission	2
Surcharge	22

5.0 Overview of Household Energy Technologies

5.1 Comparative Energy Costs

Energy cost comparisons carried out by a 1994 ESMAP mission indicate that biomass is often the least expensive energy option for both households and energy-intensive industries. Many urban households that responded to the Pilot Survey mentioned that they were cooking with electricity before the electricity tariff hike in the summer of 1993, but switched to charcoal because electricity became expensive. Table 5.1 shows that the cost of cooking with electricity is roughly double that of cooking with charcoal. Since the prices of woodfuels and electricity reflect their economic costs of supply, the reported substitution away from electric cooking to charcoal in urban areas serves to remove uneconomic cooking demand from the electricity system.

As may be expected from the relatively high cost of petroleum products, cooking with paraffin and LPG is 3 to 4 times more expensive than wood or charcoal. Even if duties were eliminated on paraffin and LPG, displacement of woodfuels by paraffin and LPG would double urban household fuel expenses.

Table 5.1: Comparative Urban Cooking Costs in Central & Eastern Uganda, 1994

	Unit	Heating Value	Stove Effic.	Fuel Cost Ush/unit	Fuel cost Ushs		Total cooking cost Ush/utilized MJ	
		(MJ)	%	Financial	Financial	Financial	Financial	Economic
Fuelwood								
Traditional stove	Kg	16.0	17	63	23	0	23	23
Improved stove		16.0	25	63	16	1,000	17	17
Charcoal								
Traditional	Kg	30.0	25	112	15	2,500	15	15
Improved stoves		30.0	30	112	12	6,854	13	13
Paraffin	Litre	34.1	45	889	58	5,576	59	44
LPG	Kg	45.2	55	1,778	72	21,053	74	39
Electricity	kWh	3.6	70	70	28	7,925	29	29

Notes: See Annex 8 for assumption.

Woody biomass is economically Uganda's most important Uganda's energy source compared to all other energy sources combined. This applies not only at a household level but also at an industrial, institutional and commercial level. Commercially sold woody biomass contributes over 90% of the value of energy utilised in Uganda's commercial sector, and an even higher proportion in Uganda's institutional sector. According to the EC funded-Uganda Woody Biomass Study (1995), it is estimated that substituting petroleum products for the woody biomass consumed by Uganda's industrial sector alone, would increase Uganda's import bill by over US$ 100 million per annum, at 1994 levels of industrial production. Substituting kerosene for charcoal in urban households (250,000 tonnes of charcoal in 1994), for example, would cost the country an additional US$ 180 million per annum.

Woody biomass production accounts thousands of jobs for Ugandans and many billions of Shillings in value-added through employment, income-generation, and in billions of Shillings in taxes and revenues obtained from commercial woody biomass producers and intermediaries. Moreover, woody biomass has assumed a proportionately growing role in the country's industrial, institutional and commercial sectors as the costs of electricity and petroleum products have escalated. Biomass use in industry has increased both in absolute terms (e.g. amount of energy consumed) and in relative terms (vis-a-vis electricity and petroleum products) over the past five years. Over 90% of Uganda's population is in the rural areas, and wood fuel is the exclusive from of energy used for cooking and over 80% of the urban households use charcoal. This illustrates the importance of woody biomass to Uganda's economy, and to its domestic, commercial and industrial sectors. The estimates of the proportion of households utilising charcoal as their primary fuel source are in Table 5.2.

Table 5.2 Proportion Households Using Charcoal

Category	*HHs Use (%)*
Charcoal rural	2.7
Charcoal overall urban	54.9

Charcoal Kampala	88.4
Charcoal Jinja	84.0
Charcoal Entebbe	86.0

Source: Statistics Department, 1995

In recognition of woody biomass as an important energy source and the adverse effects the indiscriminate/over exploitation of the forest reserves of the country would have on the environment, technology interventions in the energy sector so far have been on more efficient biomass resource use. This chapter describes the technological interventions in the household sector.

5.2 Cooking Efficiency

Work on improving household cooking efficiency began in Uganda in the mid-1980s with pilot production of the Kenya Ceramic Jiko (KCJ) charcoal stove. Local groups and small enterprises continued to work on improved stoves throughout the 1980s. The World Bank-financed the Household Energy Policy Programme (HEPP) whose objective was to test various stove models and recommend improved stoves for commercial production. At least eighteen organisations, projects and groups in Uganda have worked with household stoves since 1984. However these activities have not been co-ordinated. The impact of these efforts have not been effectively monitored and evaluated. A brief household energy survey conducted during the World Bank Energy Sector Management Assistance Programme (ESMAP) mission in February 1995 estimated that 15% of urban households (Kampala and Jinja) owned "improved" charcoal stoves. This is a relatively low adoption rate, considering improved stove programmes have been in place for over ten years in Uganda.

5.3 Improved Charcoal Stoves

The most popular improved charcoal stove on the market is made from clay and a casing of a heavy metal gauge. Although a relatively poor charcoal stove, it is highly demanded. Over the past five years the prices of the improved charcoal stoves have dropped. Relative to the urban household consumer goods, charcoal prices have risen the least compared to any other major commodity including food items. This is almost entirely due to the fact that so much charcoal is coming into urban areas as a result of rapidly increasing land clearing (for grazing and agriculture). Thus, economic incentives to conserve charcoal have diminished over the past five years. Thus the need for energy efficient stoves is of low priority.

Tests have showed that two of the three improved stove types are more efficient than traditional stoves (*sigiri*). Both stoves (one type manufactured by Usika Industries, the other by various producers), incorporate the ceramic liner, based on the Kenya Ceramic Jiko experience. The Usika stove clearly and consistently outperformed the other improved stove, and its efficiency improvements were on the order of 25-35% higher than the traditional "sigiri" (charcoal stove). ***However, its quality and availability on the market, remain major issues in improved stove commercialisation.***

Even in the face of decreasing relative prices for charcoal in urban areas, there is a financial case to be made at a household level for utilising improved charcoal stoves. The medium-range (in

terms of cost and efficiency) “improved” stoves save 25% of charcoal over traditional charcoal stoves. This provides, at current charcoal prices (UShs 6,500-7,000 per 50 kg bag in Kampala, UShs 5,000-6,000 in Jinja and Entebbe), a pay back period on the order of less than four months for the average household. ***Thus, until households clearly view substantial benefits in terms of real money savings accruing form improved stove minimal adoption will be achieved.***

Another improved stove type, the new "Refugee Stove” is being produced and disseminated to the refugee camps in north-western Uganda under the Refugee Stove Project funded by the Norwegian Forestry Society. The stove uses grass, wood shavings, agricultural residues and small woody biomass materials. The stove is more efficient than any other stoves at high power water boiling test. It is appropriate for rural community and refugee camps.

5.4 Improved wood stoves

Improved wood stoves in rural areas have suffered from the same problems as charcoal stove programmes. One can only estimate how many of these stoves have actually been disseminated, but it is probably on the order of several thousand. The reasons for lack of successful dissemination of these stoves mirrors those of charcoal stoves, but are compounded by the fact that very few rural dwellers purchase their fuel wood. Studies have also shown that most rural people spend relatively little time collecting fuel, and do not view energy saving as a priority relative to health, education, improved agricultural production, transport and water. Hence, there are few forces driving rural households to adopt energy-saving wood fuel devices.

It is estimated that approximately 90% of all rural households freely collect their fuel wood. The other 10% purchase their wood fuel for household purposes. Rural household consumption of wood fuel is on the order of 9.8 million tonnes, of which an estimated 8.7 million tonnes is obtained free. Experience in Uganda points to the difficulties of disseminating wood stoves in rural area as the a result of poorly-co-ordinated, piecemeal programmes and the fact that rural people rarely purchase their fuels. Therefore, two major economic factors have to be overcome in order for rural stove programmes to work; the absence of any monetised value to the fuel source, and the lack of any experience with stoves. When this is compounded by such issues as training large numbers of people to build stoves themselves, or convincing rural dwellers to part with disposable income on something that has a low priority, it is no wonder little success has been achieved with these programmes.

With regard to institutions, at least 100 schools in and around Kampala, Jinja and Entebbe have converted their cooking facilities (generally open fires) to enclosed “improved” institutional stoves. Most of these have followed one or more “improved” designs promoted by NGOs and private installers in the region. Considerable savings accrue to institutions who improve the stove efficiencies. This also reduces generally localised pressures on woody biomass stocks.

At least ten donors (NGOs and bilateral agencies) have tested and/or promoted “improved” wood stoves, primarily for rural dwellers. Wood stove trials and dissemination have mirrored charcoal stoves in that most of the designs are modeled on Kenyan examples. The two most prominent are the ceramic “kuni mbili” and the self-made “maendeleo” stoves. All wood stove donor efforts have been components of wider programmes such as settlement schemes, agricultural extension programmes, women’s projects and health programmes. There has been no household testing of

results to gauge changes in consumption, rate of adoption, use over time, among other key issues. Thus, little can be said about the impact of these efforts. Given the lack of success of similar rural stove approaches in neighbouring countries, it should be safe to say the impact of these rural wood fuel programmes has been limited.

Several international NGOs have worked in Uganda on improved institutional stoves. The most noteworthy effort was through the Bellerive Foundation (Aga Khan Foundation), primarily using their Kenyan-developed institutional brick and cement stove design (with moulded, fitted pots). Bellerive alone helped install over 20 institutional stoves in schools in and around Kampala. Ministry of Education estimates, and the current Study (in which a number of schools, hospitals and prisons were visited and personnel interviewed) show that at least 100 schools and hospitals have installed more energy efficient institutional stoves since 1991.

5.5 Future Course of Action to Improve Stoves

It is estimated that the continued momentum of the existing stove improvement programs could lead to the replacement of 25 percent of old charcoal stoves. However, to raise the saturation level to as much as 50 percent, which would be compariable to the most successful stove dissemination efforts previously realized in eastern Africa, a much more concerted campaign focusing on support to stove makers, stove certification, and stimulating the adoption of efficient stoves, should be carried out. With respect to wood stoves, well targeted dissemination efforts in rural areas, similar to the Dutch program, should be able to reach 1`5 percent of wood-using rural homes over a 15 year period. Households cooking with improved stoves may be assumed to achieve 45 percent wood-use reductions and 35 percent charcoal-use reductions. Assuming that the improved charcoal stove cost about Ush. 7,500 more than a Sigiri, and the improved wood stoves Ush. 5,000, the potential economic returns oaf successful dissemination projects could be very high.

A recent review of the experience of over 50 stove programs around the world indicates that in addition to a rapid pay back period, which appears to be necessary for successful dissemination of stoves, successful efforts are those that maintain consistent, long-term, and high level commitment to stove manufacture and dissemination, and pay attention to targeting markets, and design stoves that consumers actually want. It is important to continue research and development of improved stove designs by having stove producers work closely with stove users. Emphasis must be placed on flexibility of design, customer feedback, and service. Moreover, projects must include training of manufacturers in business operations and practices – projecting the number of units to be sold, the number of units and parts to be produced and inventoried, and estimating needed production capacity. Certification and demonstration activities such as stove fairs and cooking competitions at community events have proved to be effective at convincing people to adopt improved stoves in other Eastern African countries.

Given the limited success of NGOs in disseminating improved stoves, the Government has an important role to play in reviewing, evaluating and co-ordinating improved stove activities, while leaving the actual supply of stoves to private enterprise. Government can serve as a:

- Testing agency for technologies to gauge their actual performance;
- Promoter an certifier of the technologies which actually save energy and which are acceptable and beneficial to customers;

- Promoter of technical assistance to stove producers to improve and maintain quality; and
- Co-ordinator, monitor and evaluator to track developments in the market and facilitate the rapid dissemination of the best energy saving technologies and techniques.

5.6 Improved Stove Interventions *(1987-1994)*

1. Modernised Village Technology
   - Implementing Agency – Ministry of Agriculture and Ministry of Local Government
   - Funding Agency: WHO/DENIVA
   - Main Activities : Raised cooking platforms were set up in houses in the three villages. Training was the major focus. The number of extension workers trained is unknown. Some demonstration stoves are said to be operational.

2. Appropriate Technology Energy and Environment
   - Implementing Agency: YWCA
   - Funding Agency YWCA International
   - Main Activities: To help women improve their levels of income and home economics.

3. Development Through Conservation
   - Implementing Agency: CARE International/UNP
   - Funding Agency: USAID
   - Main Activities: (i) Pilot production of energy-efficient wood stoves; (ii) Training women and users of improved stoves in technical skills and household energy management.

4. Improvement of Catering in Ugandan Institutions
   - Implementing Agency: Ministry of Education
   - Funding Agency: US NGO/Bellerive Foundation
   - Main Activities: (i) Promotion of improved institutional stoves; (ii) Improvement of catering standards.

5. Promotion and Distribution of Improved Cookstoves
   - Implementing Agency: MNR, Energy Department
   - Funding Agency: IDA
   - Main Activities: (i) Testing and standardising cookstove prototypes and promotion of the most efficient types; (ii) Training artisans and users of improved stoves in technical skills and household energy management.

6. Fuel Efficient Stoves Project
   - Implementing Agency: Usika Industries
   - Funding Agency:
   - Main Activities: (i) Create public demand for fuel efficient stoves at household and institutional level; (ii) Develop an all ceramic stove which is cheaper and more durable than either the traditional metal charcoal stove and the ceramic metal stove on the market; (iii) Construct an electric kiln in order to supplement the wood kiln for more

refined ceramic products; (iv) Produce cast iron grates and accessories for institutional stoves; and (v) Provide demonstration facilities for a range of new and renewable sources of energy.

- Objectives: (i) Disseminate at least 200,000 household stoves; (ii) Construct 100,000 institutional stoves; (iii) Create awareness through posters, decals, public demonstrations; and (iv) Construct incinerators at a joint clinic and city abattoir.

7. Wood Energy Conservation Programme
   - Implementing Agency: IRDI (JEEP), Ministry of Health
   - Funding Agency: HIVOS (Netherlands)
   - Main Activities: Self-reliance in stove production.
   - Project Status: Four hundred and thirty-eight trainers trained directly, and intended to train others.

8. Tobacco Curing Pilot Project
   - Implementing Agency:
   - Funding Agency: UNDP/WB
   - Main Activities: Designed to test a number of technical packages (improve furnace which aims to save fuel.

9. Household Energy Planning Program (HEPP)
   - Implementing Agency: Min. of Energy, CODA & Partners
   - Funding Agency:
   - Main Activities: To assess the Household energy consumption

10. Fuel Wood/Forestry Project Feasibility Study
    - Implementing Agency: Ministry of Natural Resources/UNDP/WB
    - Funding Agency: WB/UNDP
    - Main Activities: Study to explore the feasibility of integrated wood-cover management through rehabilitating peri-urban fuel wood plantations, rehabilitation of the Forestry department, social forestry programmes, improvement of natural forest management, support to wood industry and improved research.

11. Energy Efficiency in Tobacco Curing Industry
    - Implementing Agency: Ministry of Natural Resources/UNDP-WB
    - Funding agency: UNDP-WB
    - Main Activities: Study the sector and set out how (i) to support the country's rehabilitation efforts in the Agricultural/Industrial sector by tobacco curing industry; (ii) to help alleviate the scarce fuelwood supply situation in tobacco growing areas; (iii) to enhance the economic viability of the tobacco industry.

12. Energy Efficiency in the Brick and Tile Industry
    - Implementing Agency: MNR, UNDP/WB
    - Funding Agency: UNDP/WB

- Main Activities: Study to identify possible solution to the energy constraints in the fuelwood inefficient small scale artisan units of firing tiles and bricks using fuelwood which is contributing to National deforestation concerns.

13. Energy Efficiency in Agro-Industries
    - Implementing Agency: MNR
    - Funding Agency: SIDA
    - Main Activities: Study to formulate a strategy and medium term investment programme to improve the overall efficiency of energy used by rural and agricultural enterprises in Uganda.

14. The National Biomass Study
    - Implementing Agency: MNR – Norwegian Forestry Society
    - Funding Agency: Norwegian Ministry of Development Cooperation
    - Main activities: (i) Phase I - Study TOR- to estimate the growing stock and annual increment of the woody biomass and agricultural residues suitable for woodfuel in targeted areas; (ii) Phase II - To obtain information regarding biomass energy resources and land use in Uganda so as to serve as a basis for Natural resources policy decisions, land use planning and energy planning (phase II).

15. Uganda Forestry Rehabilitation Project
    - Implementing Agency: MNR/WB Nordic countries
    - Funding Agency: IDA/EEC/DANIDA/UNDP/CARE/GOU
    - Main activities: (i) Improvement of management of Uganda's forestry resources to meet domestic needs for timber, woodfuel and other wood products on sustainable basis, while at the same time increasing the areas and improving the management of conservation of forests in order to protect unique ecological systems.
    - Objectives: (i)The overall objective of the project is to improve management of Uganda's forest resources to meet domestic needs for timber, woodfuel and other wood products on a sustained basis, while at the same time increasing the areas and improving the management of conservation forests in order to protect unique ecological systems. In particular: (ii) To increase the production of woodfuels and poles for urban population through encouraging private wood farming in peri-urban areas and managed production of charcoal in natural forests; (iii) To increase the production of wood products for the rural population and conserve soil fertility through encouraging farmers and community groups to plant multi-purpose trees species for woodfuel, poles, fodder, fruit and soil enrichment; (iv) To manage and conserve Uganda's natural forests for sustained timber and charcoal production by the private sector, for revenue collection from logging, for environmental protection and native conservation; (v) To increase the productivity of the softwood plantations for sustained production by the private sector for timber and to encourage a shift in exploitation for timber from the ecologically fragile natural forests to the softwood plantations. (vi) To provide logistical and institutional support to the Forestry Department for achievement of the above objectives and to create the information and management base for long-term planning, development and conservation of Uganda's forest resource.

16. Biomass Energy for Industrial Development in Africa

- Implementing Agency: MNR
- Funding Agency: UNDO
- Main Activities: Preparatory Phase, Needs and opportunities assessment for the feasibility of utilisation of biomass for industrial development and Country level programme. (i) Improvement of charcoal production methods; (ii) Improvement of efficiency in industrial use of biomass as fuel; (iii) Promotion of industrial utilisation of agriculture residues for energy; (iv) Promotion of production of oils from biomass.

17. Promotion of Charcoal Briquettes and Improved Charcoal Stoves
    - Implementing Agency: YWCA
    - Funding Agency CODEL/YWCA
    - Main Activities: (i) Training women in the skills of Making charcoal briquettes from agri-residues; (ii) Promoting the use of charcoal briquettes as an alternative source of energy; (iii) Promoting production and utilisation of improved charcoal and briquette stoves.

6.0 Key household energy stakeholders

A listing of the key private sector, NGO, government and donor stakeholders in the household energy sector and their area of interest is provided in Annexes 4, 5, 6, 7, 8 and 9. (A detailed list of the members of Uganda Renewable Energy Association (UREA) is in Annex 9).

7.0 Overview of Renewable Energy Resources

Vast amounts of renewable energy resources - small/mini-hydro, biomass, geothermal, and possibly wind remain untapped in Uganda. Private development of these resources, however, has been constrained to self-use applications due in part to the widely held belief that sale to the grid was not permitted. About five small/mini-hydro, sites are currently developed with a total capacity of about 2.5 MW. Small/mini-hydro reserves have been estimated at about 400 MW, although many of these are sites which are not currently suitable for development due to unfavourable geographic features or large distances to load centers. Sugar mills already use biomass, in particular bigasses, for their own consumption. Preliminary estimates suggest that sugar mills could expand their current 7 MW of generating capacity by about 30 MW and sell excess power to the grid. There also is limited potential for generation form woody biomass, especially at sawmills. However, given the current deforestation situation in Uganda. Wood-based electricity projects can only be considered in a limited number of sustainable harvest situations. Initial assessments estimate geothermal resources in the Western Rift Valley, confirm the geothermal resource but also could be used for rural electrification schemes. Uganda's generation on a national scale. In the longer-term, wind resource monitoring may reveal areas with developable resources. Also, small-scale wind generation, suitable for mini-grids, may be viable in some locations

7.1 The World Bank's African Rural and Renewable Energy Initiatives programme (AFRREI)

(a) Main grid-based extensification and intensification

While some grid extension has occurred over the past decade, the number of grid connections has not risen by more than 30,000 since 1986, mostly in Kampala, Entebbe and Jinja. Very few in smaller towns and rural areas have been connected such that a significant number of businesses and households within or close to UEB's existing distribution system are waiting to be connected to the grid. For these consumers, the least cost supply option is connection to the integrated network. However, UEB's current and medium-term supply constraints combined with UEB's current weak financial situation severely limit the number of new consumers who could be connected. Further, even those consumers who do get connected to the grid are likely to face repeated load-shedding.

At the same time, the demand for power supply from business and households is rising rapidly. The number of licensed business establishments in towns and trading centers in the Kampala, Entebbe, Jinja area has increased over 7% per annum since 1991. Average per capita income in the upper quartile of the population in these area has grown by 8-10% per annum in real terms over the same time period, leading to substantial growth in demand which UEB is unable to meet. An estimated 125,000 businesses and 400,000 households fall within this category in areas on the fringes of UEB's distribution network at present. This calls for rapid independent Power Producers (IPP) promotion and expansion to provide local generation to connect these consumers. With such expansion, at least 200,000 business and domestic consumers would connect to the grid over the next ten years.

(b) Isolated grid systems.

For towns, trading centers, and other clusters of customers located far from the existing grid network, with diesel or renewable energy generators would be the least cost service option. Such mini-grid systems could serve from tens to hundreds of customers, although affordability increases with larger customer loads. Low cost system designs would be emphasized which still maintain adequate safety and reliability standards. Where future UEB interconnection is possible, compatible technical standards would be used. Given the decentralized nature of these investments, local ownership, operation, tariff setting, and regulation would be stressed. Extension of these systems would proceed over time based on financial viability of the proposed extension.

7.2 Renewable energy development

The renewable energy project components should be approached in a conservative sequenced manner to build up local experience and confidence. In the initial projects, the existing distribution infrastructure should be used if possible to demonstrate the technology application in an environment not encumbered with need for heavy investment in distribution infrastructure. In the near-term, small/mini-hydro and biomass power projects have the greatest potential for development, powering either the national grid or mini-grid systems. Small/mini-hydro systems would use run-of-river designs up to about 5 MW in size. Biomass systems would utilise bagasse or sawmill waste either for power-only generation or cogeneration (i.e. combined generation of electricity and heat for industrial processes). About 20-35 MW of small/mini hydro and about 25-30 MW of biomass generation could be developed within the proposed AFRREI program.

(a) Sugar Mill Cogeneration

The owners and management of 2 of the 3 larger sugar mills in Uganda (Kakira in Jinja District and Lugazi in Mukono District) have expressed a desire to co-operate with and to participate in AFRREI, and both have existing Cogeneration project development studies to put forward (Kakira with 18MW for grid supply and Lugazi with 4.5 – 6MW for grid supply).

The third large sugar mill Kinyara sugar works (KSW) is in Masindi District. Kinyara is a Government of Uganda owned sugar mill with a management contract held by Booker-Tate of the United Kingdom. It is well located between the towns of Masindi and Hoima and could easily service the demand in that regional area from its surplus electricity potential. Hoima and Masindi are now connected to the central UEB grid. A rudimentary preliminary, study suggests they could generate up to 3-5 MW of surplus power in conjunction with a sugar processing expansion plan they would put into implementation

(b) Woodwaste Utilization

In 1997 the Forestry College in Nyabyeya, Masindi District has made a proposal to NORAD to install a sawmill waste power generation system to supply the college with a more cost-effective and more reliable supply of electricity.

(c) Other Biomass Resources

Uganda has other biomass resources. There is a significant coffee industry that produces significant residues. There are other crops such as rice and cotton that could also be considered for future use of residues. Such residues are productively used in other countries. There can also be crossovers between industries and resources such that a tea estate could develop a hydroelectric project to meet its demand and that of the surrounding area. A sugar mill might consider developing a hydroelectric project to use to drive irrigation pumping systems to improve unpredictable land productivity.

(d) Geothermal Potential

There has been some geothermal resource definition activities in the Western Rift Valley. Three sites of interest were identified, the Katwe-Kikorongo field, the Buranga field, and the Kibiro field. The Buranga field is quite remote such that the preferred initial site would be Katwe or Kibiro (possible access to the Hoima load).

(e) Wind Potential

The wind resource is not well-defined in Uganda some reasonable wind resources (average wind speeds that could produce an annual capacity factor in a wind turbine of at least 30%) could exist. These are not be close to dense population centers or to the grid. There is a history of small wind turbine water pumping in the country. The maximum wind turbine unit size that would be feasible in Uganda in the near term will be between 200 & 300kW because of turbine erection constraints. This constraint will limit the ultimate competitiveness of wind power in Uganda.

(f) Mini/Small Hydro Potential

Many sites throughout the country have been well studied for mini and small hydro application. The Dutch have very recently studied 19 rivers in the Nebbi, Arua, Moyo Region under their Community Action Programme (CAP), and several technically viable projects have been identified. The very comprehensive Dutch study specified 8.8 MW as the initial program components for development with a follow-on for program expansion. The Dutch have done substantial work on the local participation and ownership issues. The US Trade and Development Program in 1998 verified the technical feasibility of a 3.3. MW project close to Nebbi at Paidha on the Nyagak river (also included in the Dutch study). The Austrians in 1996 did a very detailed study of the 3.7 MW Ishasha project in South west Uganda and produced a complete set of tender documents for the project that is ready to be bid out, if the commercial conditions and ownership issues are resolved. In the Ishasha case it was assumed that UEB would develop the project. The Norwegians in 1993 thoroughly defined a 10 MW project named the Biseruka project on the Wambabya River with the purpose of its serving as a 4 hour per day main grid peaking power project (because it could not compete in price for baseload service against the big dam facility). Another study by Government of India experts also defined good options for mini and small hydro development in he country on the Siti, Sipi, Kagera and Mitano rivers. A Church of Uganda operated 60kW hydro plant in Kisizi, Rukungiri District is being evaluated for expansion to perhaps 150kW or more

Project Ownership The main issue to deal with quickly for mini and small hydro electric projects in general, since enough specific potential projects have been well-enough defined, is who will be the owners and operators of the various generation facilities, and how will the distribution network be dealt with. The resource assessment is ahead of the institutional development for hydroelectric power project development purposes.

(g) Individual/institutional solar PV products.

The potential for PV development in Uganda for rural electrification for households, communities and businesses, is largely untapped. Photovoltaic system sales are low, prices high, and technical capacities are limited. There is considerable scope for a rapid scale up of market development.

While detailed market intelligence data is not now available, it is possible to very broadly indicate key aspects of the market dimensions. Current annual sales have been estimated at &US1-2m, equivalent to 80-160kWp at $12Wp, predominantly crystalline silicon modules. The market is mainly institutional, often donor supported (e.g. rural offices, service and community facilities; vaccine refrigerators; telecommunications; parks) There are reportedly several thousand household systems installed. The largest vendor is estimated to sell 20kWp annually. Prices are high-consumer retail prices of panels in Kampala are 25-50% higher than in Nairobi, and as much as double the prices in many Asian markets. These price differentials are due mainly to the lower scale of operations and the higher costs of doing business in Uganda. There are also some reports of inconsistent duty and tax treatment which contribute to higher costs. In many systems all components are imported. Local batteries have not been adopted for the PV or TV market. There is some local production of lights and solar lanterns are reportedly produced by vocational school.

Existing PV suppliers have the following characteristics: (i) small/medium size, entrepreneur driven, family business; (ii) partially in the informal sector (iii) main financing is savings, family, friends; (iv) some receive some limited supplier credit; (v) few if any have credits from financial intermediaries

for the PV business; (vi) a few have had finance and training links with suppliers and other organisations; (vii) many have institutional procurement sales experience.

The potential household PV market comprises dispersed households in rural areas which (i) are not going to be reached in the near term by the main grid or an isolated grid; (ii) have high ability and willingness to pay as indicated by salary income or cash income from farming, fishing, livestock, small businesses; and (iii) who are currently spending cash regularly to purchase energy services such as kerosene, vehicle batteries and dry cell batteries for household lighting and TV/radio. This market can be served by PV products ranging from solar lanterns to full solar home systems.

Assuming that there are currently 2.0 million households which are beyond the foreseeable national grid or isolated grids, and that 25% are able to afford a $100 basic solar lighting system or 'solar lantern', then the potential market would be 500,000 households. A revised estimate of the potential market will be made once additional household income and expenditure data is compiled and analysed. An immediate market for solar systems, starting at 12Wp, are those who currently use a battery for TV and radio. This segment has been estimated at 100,000 households.

Constraints to market development include: (i) limited consumer affordability; (ii) limited consumer awareness and acceptance of PV products; (iii) the small current entrepreneurial and technical base in the sector; (iv) the general weak capacity currently of the financial sector to support any but short term working capital lending; and (v) the lack of strong PV dealer sales and service networks.

Strength include the widespread availability of microfinance facilities and the existing UNDP/GEF photovoltaic pilot project, which is taking steps to increase market awareness and to strengthen the capabilities and support the efforts of entrepreneurs currently in the sector.

An AFRREI program offers the opportunity for an ambitious component to accelerate PV market development by taking advantage of the potential to lower prices, increase product quality and increase consumer acceptance. Based on experience in other countries, this could be achieved through a package of interventions which would: (I) strengthen PV company capabilities in business, finance and technical areas both directly and through motivating higher levels of supplier support; (ii) encourage additional investors and entrepreneurs to enter the sector; (iii) facilitate access to end-user finance through linkages with microfinance capabilities; (iv) increase the access of PV companies to credit through linkages with financial institutions channels; (v) increase consumer awareness and confidence; (vi) increase access to best price sourcing opportunities, including possibly the local production of some system components; (vii) facilitate improve quality; (viii) establish a sound market framework in terms of tax and duty treatment and technical standards; and (ix) provide a per Wp susbsidy, possibly on a reducing basis, gradually phasing out over the course of the program.

This package of interventions would increase sales by increasing consumer affordability, acceptance and choice while reducing the technology and market risk perceptions of entrepreneurs for investments in expansions of distribution infrastructure and human resources. The package would be implemented in ways which would reduce the pipeline development and transaction costs and technology and market risk perceptions of interested microfinance and financial sector institutions. The expected result would be competitive, commercial PV sales and service networks

extending into rural areas, offering consumers a wide product and price range, with robust product standards and strong after sales and warranty services. Initial planning targets would be price reductions of 50% and unit sales to 200,000 households over the course of a ten year program.

Capacity building efforts in support of the PV component would be undertaken in collaboration with existing institutions and capacities as much as possible. These potentially include:

- Support mobilisation – provincial workshops, donor contacts, major supplier contacts
- Support for creation of an enabling legal and regulatory environment
- Business development, such as investment promotion, preparation of financial and technical models, business plan preparation, steps to increase credit worthiness for PV service providers, financial management and accounting, links with financial institutions and investors, suppliers,
- Market survey, market information, market intelligence and monitoring
- Consumer awareness activities
- Technical training, best practices information
- Product improvement and quality assurance through specifications and standards, design assistance, testing, and certification.

ANNEXES

ANNEX 1: UGANDA POWER SECTOR RESTRUCTURING AND PRIVATISATION

New strategic plan & Implementation plan

1. Introduction

In 1997 the government of Uganda formulated and the cabinet accepted a comprehensive and detailed strategic plan for transforming the Ugandan power sector (UPS) into a financially viable electricity industry capable of providing the people of Uganda with a reasonably priced and reliable power service while maximising inter-regional export opportunities. In this way the power sector would be able to make its full contribution to the further economic and social development of Uganda

The recent history of Uganda's power sector had been characterised by consistent power supply deficits, massive load shedding, resource constraints, government involvement in finance and management and inadequate accountability in the sector. This situation could not be allowed to continue.

The 1997 Strategic Plan set out proposals to address these deficiencies and developed implementation plans for the near, medium and long term. The Plan was intended to be updated as the UPS evolved and more information became available on the experience of power sector reform around the world and of private sector participation. The government has now fundamentally revised the plan to take into account the up-to-date evidence and information, and developments in the Uganda Electricity Board (UEB) since 1997. This New Strategic Plan sets out

the government's mission statement for the sector and its proposals to make the UPS efficient, financially viable and able to meet consumers' growing demands for electricity.

Adoption of the New Strategic Plan by the government expresses the government's unambiguous support for private sector participation (PSP) in the UPS. It also allows all participants, whether private or state, to have confidence in the Strategic Plan. This confidence will strengthen the prospects of achieving the fundamental objectives.

In developing the New Strategic Plan, the government has reviewed international experience in the reform of power sectors and the introduction of the private sector in order to identify the key lessons which can be used in Uganda and identify the best way forward. It also undertook a survey of potential investors in the UPS to provide a firm underpinning for the proposals, which will involve the private sector. In developing the proposals he government has also taken into account the likely impact of privatisational and sectoral restructuring options on tariffs. Further , throughout it has considered the risks associated with different options for reforming the sector and enhancing the role of the private sector.

In preparing the New Strategic Plan, the government has benefited from extensive stakeholder consultation, including a number of conferences and workshops which have been held in Uganda on the reform of the power sector, and from advice received through a number of consultancies.

2. Mission Statement

The mission of the New Power Sector Strategic Plan is to strengthen and enlarge the power sector to make it efficient and financially viable, to enable it to provide adequate and reliable energy to assist in the sustainable social and economic development of Uganda and to take advantage of the opportunities to export electricity to other countries.

3. Background

3.1 Introduction

The existing power sector and key problems are described briefly in this section, and Uganda's energy resource endowment is reviewed.

3.2 Existing Power Sector

The existing power sector is a publicly owned and vertically integrated power utility, the UEB. The supply system is dominated (over 98%) by the hydro plant at Owen Falls, with a current capacity of 180 MW. Transmission is principally through the 132kV network, although both 66kV and 33kV lines are also used for transmission.

Currently, only 5% of Uganda's population of about 18 million is supplied with grid electricity. Around 20% of the urban population is connected to the grid, but less than 1% of the rural population. Official records show that there are over 148,000 grid electricity users. The average per capita energy consumption in the Kampala-Entebbe district is 170kWh, compared with less than 10kWh in most outlying districts.

Most of Uganda's electricity is consumed by residential or service sector users. Industrial users account for only a small proportion of the total. The main categories oaf consumers by energy sold

are residential (55%(), commercial and general (25%) and industrial (20%). The bulk of electricity (72%) is consumed by the 12% of the population that lives in the Kampala metropolitan area, and in the nearby cities of Entebbe and Jinja.

Recent studies conducted by the Ministry of Energy and Mineral Development (MEMD) and the ESMAP/World Bank team have shown that self oar private electrification using diesel generation or car batteries is reasonably common in outlying areas. It is estimated that there is around 80 MW of privately installed captive electricity generation capacity, of which at least 50 MW is in Kampala – Entebbe – Jinja area. Studies have also shown that there are over 200,000 households using car batteries, electricity from which is very expensive – in the order of US cents 250.0/kWh compared to US cents 7/kWh for UEB power.

Issues

The sector has been suffering from a number of fundamental problems which have led the government to develop plans its for fundamental reform. The key problems are as follows:

- Very poor supply reliability, characterised by extensive and increasing load shedding and reductions in voltage;
- Inadequate investment in all parts of the sector during the 1990s and an inability to finance future required investments, particularly in distribution;
- Very poor commercial performance by the UEB, characterised by collections being received for less than 50% of the electricity generated;
- High technical and non-technical losses, exceeding 30%;
- High accounts receivable, which in early 199 were equivalent to about nine moths billings, but with around 50% being due for more than one year;
- Low productivity, despite the recent retrenchment of around 30% of UEB's employees; and
- Poor rate of connection of new customers.

In addition to the above problems, which relate directly to the UEB, there has been a further problem of the support required by the UEB from the government's budget. Such support reduces the ability of the government to finance needed social and other expenditures. Therefore, the level of government support to the UEB must reduced or eliminated.

The UEB has been failing to provide the quality of service demanded by consumers, and more broadly to respond adequately to consumer requirements. Power outages are frequent, as are brown outs and voltage fluctuations. The outages, caused by both system breakdowns and planned load shedding, impose severe costs on consumers and the economy. The frequent voltage fluctuations shorten the life of light bulbs and damage motors and appliances. This situation cannot be allowed to continue and hence this New Strategic Plan has been developed, building on the 1997 Strategic Plan, to address the foregoing problems.

3.3 Resource potential

Uganda is well endowed with considerable hydropower resources. The potential capacity on the White Nile in Uganda is estimated to be in excess of 2,000 MW, of which only 180 MW at Owen Falls had been developed by the end of 1998. There is therefore, considerable potential for further development of the resource for local and export consumption. Apart from the Owe Falls, five

other major sites have been identified; Bugali, Kalagala, Kamdini (Karuma), Ayago North and Ayago South.

There is also the potential for small hydropower development, especially along the tributaries of the Nile. Twenty-two min hydro sites in the capacity range 0.5 –5 MW have been identified. There are also numerous micro hydro sites, especially in the mountainous parts of Western and Eastern Uganda.

A number of non-conventional resources also exist and can be developed to supply electricity as either decentralised or grid connected systems. In particulars, solar energy is capable of supplying electricity to many small isolated loads like households since the generators are in small, modular, portable units. Uganda receives relatively high insolation levels averaging about 5kWh/m^2/day. However, at the current level of development of solar photvoltaic technology, the supply of electricity from solar energy is only competitive in small modular units. This mode of electrification is already being promoted by the MEMD in rural areas.

Geothermal resources are estimated at about 450 MW in the Western Rift Valley. Apart from basic studies on the physicochemical characteristics of the hot springs that have been carried out by the Department of Geological Survey and Mines, no programme for power development has been put in place. The successful exploitation of this resource in Kenya indicates its potential for Uganda.

Biomass can provide substantial amounts of electricity, especially by co-generation, where it is the energy source for process heat. The government believes that Uganda's sugar industry should be encouraged to invest in co-generation. The three sugar factories at Kakira (2.5 MW – with a total installed capacity of 4.5 MW), Lugazi (1.5 MW) and Kinyara (1.2MW) produce electricity for their own consumption. If modern co-generation technology was installed, power production would be enhanced and could be sold to the grid. The New Strategic Plan sets out proposals for the sale of own generation onto the grid.

Wind has good characteristics in certain parts of Uganda, like Karamoja and Kalangala, and hill-top in many parts of the country. Wind turbine technology is already mature, is in application in many countries, and the costs of generation have been reducing quickly. Potential for investment in wind power generation in Uganda exists both at power production and competent/system manufacturing levels.

4. Objectives and actions

The Government has set a number of objectives for the power sector, which were articulated in the 1997 Strategic Plan. They include:

- Making the power sector financially viable and able to perform without subsidies from the government budget;
- Increasing the sector's efficiency;
- Improving the sector's commercial performance;
- Meeting the growing demands for electricity and increasing area coverage;
- Improving the reliability and quality of electricity supply;
- Attracting private capital and entrepreneurs; and

- Taking advantage of export opportunities.

Proposed reforms should be practicable and implementable in Uganda, and be politically/socially acceptable.

In Uganda the key to making the sector financially viable is to increase the proportion of electricity generated which is billed, to substantially increase revenue collection and to significantly reduce technical losses.

This would assist in freeing the sector from the need for subsidies and make it financially viable in its operations. It would also assist fundamentally in developing an environment which would attract private capital entrepreneurs. The combination of making the sector financially viable and, therefore, able to self-finance higher levels of investment programmes, along with attracting private capital, will assist the sector in meeting the growing demands for electricity and increasing area coverage.

In addition, the government sees enhancing efficiency to be of key importance for the future of Uganda's power sector. Efficiency has three main dimensions, and all are important. They are:

- Operating the existing system to minimise costs;
- Expanding the system at minimum cost; and
- Pricing electricity to reflect the marginal costs of supply.

The government's plans for the reform of the UPS are aimed at achieving all three dimensions of efficiency.

The government sees competition and the private sector as playing key roles in enhancing the power sector's efficiency and in minimising required tariff levels. The proposals for the restructuring of the UPS and development of new market relationships which are set out in this New Strategic Plan are aimed at maximising the role of competition and using it as a driver to enhance efficiency. The government has reviewed the different options for the introduction of competition into the different parts of the UPS. These include full fledged competition at the generation level through a power pool, competition for the provision of new capacity (such as IPPs), competition for the provision for the provision of certain services such as billing and collection based on the letting of short term franchises, and full competition a the retail supply level. For the foreseeable future the government considers that the main ways to introduce competition will be through competition for the market and contracting for specified services.

Private sector participation is also seen as being of key importance in improving the sector's efficiency. The private sector faces different incentives than the public sector to improve efficiency.

A pre-condition for PSP is the ability of the distribution entities in Uganda to collect revenues for all kWh sold to final consumers. This is required to remunerate assets under private sector operation or ownership. Action must be taken to address the issues of high system losses, both technical and non-technical, and to improve revenue collection. Unless this is done, Government guarantees to generators will be called and a fundamental objective of reform will not be met. The risk of this is unacceptable to the Government.

Reform of the distribution system, in order to make it financially viable and improve its commercial performance, will be the key to the success of the whole reform programme. The government will therefore initially focus its major reforms on the distribution sector in order to provide strong incentives to collect revenues and minimise losses. To this end of the existing UEB distribution business, and let to the private sector under long term concessions.

Under the government's proposals, the private sector will play the major role in improving reliability of supply and meeting the growing demands for electricity.

4.1 Conflicts between objectives

The government also recognises that not all of the objectives set out above may be realised simultaneously. The objective of ensuring financial viability may conflict with increasing area coverage, particularly in rural areas. Consequently, the government recognises that a policy for explicit subsidies may be required in these areas. However, government will ensure that where subsidies are justified, they are efficient and sustainable, and applied within a market based framework for electrification.

The government recognises that increasing the efficiency of the UEB may conflict with the political and social acceptability of the reform programme. For example, increasing efficiency is likely to require further staff retrenchment at the UEB, and will also require the fundamental restructuring of the UEB. The government will ensure that these actions are implemented carefully to make them acceptable and minimise disruption.

4.2 Performance against objectives

In preparing the New Strategic Plan, the government has reviewed the past and present performance of the power sector against the objectives.

UEB's financial position both has been and is poor. Its cash flow is inadequate to provide a reasonable rate of return and to service its debts. Therefore, it is unable to contribute significantly to the financing of needed investments, with a resulting burden on the government budget.

UEB's commercial performance also has been and is very poor. In 1997 it only received revenue for 58% of the power generated, and in 1998 for around 50%. Technical and non-technical losses exceeded 30% in both years, and accounts receivable exceeded nine months billings in 1998. This meant that in 1997 the UEB lost over Ushs 13 billion of potential revenue. This situation is not sustainable and hence the distribution and other functions must be reformed urgently.

Area coverage in Uganda is poor. At present only around 5% of the population have access to electricity from the grid. The government has set, as a high priority, increasing the number of consumers and extending access to electricity supply in both urban and rural areas. In the latter the initial focus will be on the development of isolated supply systems.

5. Overview of proposed reform programme

In developing its proposals to reform the UPS, the government has reviewed international experience in the reform of power sectors around the world. Through this it has identified the benefits which have been delivered through the reform programmes and the costs associated with

their implementation. It has taken great care to ensure that the proposals presented in this Plan are appropriate for the specific circumstances of the Ugandan power sector.

Many different models have been used to reform power sectors. They cover power systems both large and small, systems dominated by hydro capacity. Many reform programmes have been based on the introduction of competitive power markets, either at generation or at the level of retail supply f electricity to final consumers, or at both. A key feature of these markets, whether or not a pool is established at the generation level, is the ability of distribution companies and large consumers to determine their resource needs and contract directly with generation for power supply. This has been the basis of the reforms in Argentina, Australia, Spain, USA, Great Britain, Norway, Sweden, Bolivia, Dominican Republic and elsewhere. A variation of this model is operating in South Africa with ESKOM's internal market.

Although the power sectors in some developing countries are now moving towards the adoption of this model, the dominant model adopted by developing countries to date has been the Single Buyer Model under which new generating capacity, particularly from independent power projects (IPPs), is contracted competitively to the Single Buyer on behalf of the distribution companies and large consumers. Variants of this model have been widely adopted in Asia, for example, in Pakistan, Thailand and the Philippines and it is also used in Northern Ireland. A number of countries in Africa are presently considering the use of variants of this model. Its main attraction is the facilitation of new investment at least cost by the private sector, with periodic pressures to provide new capacity on a competitive basis.

Government has also noted that, more recently, countries facing similar problems to those in Uganda, have begun to place more emphasis on the reform of the distribution sector. They see this as a necessary requirement to underpin the success of the whole reform programme. The Government is convinced that this is the appropriate way forward in Uganda.

International experience has demonstrated conclusively that the fundamental reform of power sectors to introduce new incentive systems and the private sector can assist in meeting the fundamental objectives which the government has set for the UPS. In particular, the experience has shown that:

- The private sector can meet required investments;
- The commercial performance of utilities can be dramatically improved, particularly by reducing losses and improving collections;
- Efficiency can be raised substantially, whether it is measured in terms of productivity per employee or capital employed;
- The quality and reliability of supply can be improved very quickly; and
- The number of service connections can be increased rapidly.

The government has reviewed numerous alternative models for the organisation of the power industry in Uganda and for the structure of the power market. Based on this review, the government proposes that the industry should be reformed with a number of separate generating companies, a single transmission entity, and as many distribution companies as feasible. Supply in rural areas will be facilitated through a market-based framework for electrification (see section

5.5 below). The role of the private sector will be greatly enhanced in generation, transmission and distribution.

The separation of generation from transmission and retail supply will require the establishment of a structure for the bulk generation market. The government considered the options of introducing some form of competitive wholesale market for electricity (a power pool), distribution companies contracting directly with the generation companies, a single buyer for electricity from the generators, and a single buyer model associated with limited competition at the retail supply level by allowing large consumers to contract directly with generators. The government rejected the competitive model of a power pool since this was unsuitable for Uganda given the dominance of Owen Falls and, in the future, a small number of other major hydro plants. The model of distribution companies contracting directly with the generators was not considered appropriate in the near to medium term because it is though to impede the development of new generating capacity, particularly large scale hydro capacity.

The government has therefore decided that the preferred option is the single buyer model, with limited retail competition to be introduced at a later date.

The government, proposes to actively encourage competition in the electricity industry. Under its proposals new generating capacity will be provided competitively by the private sector through a process organised by the Transmission Company and monitored by the new regulatory authority (see Section 6). To enhance competition the government's proposals for reform of the UPS include allowing co-generators to sell surplus energy and capacity to the grid. Again in the interest of maximising competition in the generation market, in the longer-term government intends to introduce a structure for the generation market whereby distribution companies and large consumers will contract for generation capacity directly with generators (with appropriate regulatory oversight). This market structure will require the transmission network to be operated on an open access basis . Government will require the advisers recruited to implement the privatisation transaction to recommend the appropriate timing for the introduction of this market structure.

In furtherance of its objective to promote competition, the government also considered carefully the possible introduction of some degree of competition into the final retail markets, which was proposed in the 1997 Strategic Plan. The government continues to support this limited form of competition, however, government's priority is to successfully let the distribution concessions by the end of the year 2000, which will be assisted by assuring revenue flows from large consumers. Hence the introduction of limited retail competition will be delayed to the medium term.

The following sections of this New Strategic Plan provide more details on the proposals for generation, transmission and distribution.

5.1 Generation

The government is committed to increasing the scope of competition in the provision of new generating capacity and the running of existing generation assets. The use of competitive bidding procedures for new generating capacity and the operation of existing facilities by the private sector should increase efficiency and minimise costs. This in turn should minimise the prices that consumers must pay, and assist in promoting the economic and social development of Uganda. Under this revised New Strategic Plan.

1. New generating capacity will be provided competitively by the private sector through IPPs. Government will award concessions for the development of new hydro IPP's on competitive basis.
2. Separate Power Purchase Agreements will be developed for Owen Falls Power Station and the Owen Falls Extension. Both the existing power station at Owen Falls and the soon to be commissioned Extension will continue to be owned by the public sector but let to the private sector through concessions. The privatisation transaction advisers will determine whether it is feasible to let separate concessions for the existing power station and the Extension respectively, or whether it is optimal to have both facilities operated and maintained under a single concession.
3. The development of new capacity, including co-generation capacity, by major industrial plants will be encouraged and a tariff will be developed to encourage sales of energy and capacity from existing and new plant to the Transmission Company.

5.2 Transmission

The existing transmission network is a simple one and extends only to the more developed parts of the country, and an extensive transmission network is unlikely for some time. As with generation, the government has considered various options for the restructuring and ownership of transmission. A key consideration in the evaluation of the options against the objectives was recognition of the natural monopoly characteristic of high voltage (HV) transmission, and that the key problems in the sector do not lie with the transmission function. Based on its review and assessment of the present operational efficiency of the HV (132kV and above) transmission system the government has decided that through the interim period responsibility for transmission would remain with the UEB, and would be operated as an independent and profit making business unit. As soon as practical the operation of the transmission system will be let to the private sector under a long-term concession, while ownership of the existing assets will remain in the public sector. The transmission concessionaire will not be allowed to operate either generation or distribution businesses.

The principal functions of the Transmission Company will be as follows:

- operation and maintenance of the existing HV system in a safe and efficient manner;
- planning the expansion of the system in conjunction with generation and distribution companies; and
- system dispatch.

As far as feasible new transmission capacity will be developed, financed, constructed, operated and owned by the private sector, in particular this may be appropriate for dedicated export lines.

The proposed contracts or pricing system for the use of the transmission system will be subject to the approval of the regulator.

Bulk Purchase and Supply

The Transmission Company will also purchase generating capacity from competing providers under long term contracts (power purchase agreements – PPAs). The function of bulk purchase and supply of electricity will be undertaken by a ring-fenced entity within UEB's transmission

business, with separate accounts and its own personnel. It will be the sole purchaser of generation output, and hence hold the first PPAs. In addition, it will manage invoicing and settlement. Robust and reliable settlement procedures will be put in place to ensure that monies are collected from distributors and paid promptly to generators (and later customers) who default on their settlement invoices. This will build the confidence in the reformed power system that is necessary to encourage active private sector participation.

In order to carry out this role the role of bulk purchase and supply the Transmission Company will:

- assess potential generating projects against a least cost expansion plan which takes into account the costs of associated transmission developments.
- suggest to potential generators the location and magnitude of likely generating shortfalls;
- consider both solicited and un-solicited proposals to construct new generating capacity;
- carry out demand forecasting and publish the results;
- arrange for least cost dispatch against the energy call off price in each of the contracts;
- be responsible for cash flow and settlement; and
- arrange for revenue to be collected on an equitable basis to pay for generation and transmission capacity.

The Transmission Company will be regulated by a new independent regulatory authority. Among other things, the regulator will be required to review and approve the bulk supply tariff and contracts for generation and transmission. The proposals for the regulation of the Transmission Company are set out in more detail in Section 6 below.

Third party access

Various studies have identified the presence of relatively large quantities of won generating capacity in Uganda. In order to encourage competition and ensure that electricity demand is met at least cost, the government has decided to permit third party access to the grid. A cost reflective and non-discriminative tariff will be developed to encourage auto generators and others to sell excess energy to the Transmission Company. The tariff will be subject to review and approval by the regulator. Later direct sales to large consumers will also be permitted. The required legislative changes to permit this will be introduced.

5.3 Distribution

As previously noted, reform of the distribution system in order to make it financially viable and improve its commercial performance will be the key to the success of the whole reform programme. The Government has considered carefully retaining distribution as a single entity in the public sector, transferring that entity to the private sector, introducing a number of privately operated distribution entities each with a well defined service area, and other options. For the reasons mentioned earlier, the government is convinced that the private sector must play a major role in distributing and selling electricity if the objectives set for the new power industry are to be met. This will promote efficiency, improve commercial performance and financial viability.

Although the distribution function in Uganda serves a relatively small number of consumers the government believes that it is important to have multiple distribution companies. The government considered a number of options. The final choice was determined by an appropriate balance between a number of objectives, some of which conflict with each other:

- creating business units that are large enough to attract credible and experienced private operators;
- achieving the early and successful private sector participation in a significant part of the power sector in Uganda;
- ensuring substantial and reliable revenue flows to allow developers to finance new generation projects with the minimum of underwriting by the government;
- creating sufficient business units to allow regulation by comparison; and
- separating the treatment of urban areas and rural areas to encourage the development of local initiatives in rural areas.

The maximum number of financially viable distribution companies will be created out of the existing UEB distribution business, and every effort will be made to assign existing UEB customers to the new distribution companies. The privatisation transaction advisers will advise government with regard to the number and scope of the new distribution companies.

Although having relatively small distribution companies may lose some potential economies of scale and require longer concession periods, the government believes that this will be outweighed by the benefits to be derived from benchmark competition in the new regulatory framework.

The distribution companies will contract with the Transmission Company for bulk supply. The distribution companies will then sell to final consumers under retail tariffs that will be subject to approval by the regulatory authority. The regulator will be required to satisfy itself that tariffs are structured to include efficiency and to recover costs. In the medium term government intends to expose the distribution companies to competition in the market by permitting limited retail competition (see section 5.4 below).

5.4 Market Structure

Generation Market

Initially the Transmission Company will hold Power Purchase Agreement (PPA's) for OFPS, OFE, and the IPP's under development. This market structure has been chosen as the most appropriate to promote (i) the development of new generating capacity by the private sector, in particular large hydroelectric IPP's and (ii) least cost expansion of generating capacity.

However, in the longer-term government intends to enhance competition in the generation market by introducing a market structure whereby distribution companies and large consumers will contract for generation capacity directly with generators (with appropriate regulatory oversight). Generators and distribution companies will therefore determine the size and timing of new capacity needs. Under this arrangement the market risk would be borne by generators when they build new capacity speculatively, and by distribution companies where they contract generators to supply a given amount of capacity. The transmission network would then be operated on a non-discriminatory and open access basis.

Government will require the privatisation transaction advisers to recommend the appropriate timing for the introduction of a market structure where distributors and large consumers contract directly with generators.

Retail Market

In furtherance of its objective to promote competition, government has also considered carefully the possible introduction of some degree of competition into the final retail markets, in particular permitting large consumers to contract directly with the Transmission Company for bulk supply. In the medium term the government continues to support this limited form of competition. However, governments priority is to successfully let concessions by the of the year 2000, which will be assisted by assuring revenue flows from large consumers. Hence the introduction of limited retail competition will be delayed to the medium term. Government will require the privatisation transaction advisers to recommend the appropriate timing for the introduction of limited retail competition.

5.5 Rural electrification

A key objective of the government is to improve access to commercial electricity supplies by the population in peri-urban and rural areas. At present only around 1% of the rural population which has access to electricity does so through such sources as car batteries, with very high implicit prices per kWh(see section 3.2). This is evidence of the potential demand for electricity by the rural population to meet their basic needs, and of some consumers having a high willingness to pay for small quantities of electricity per month.

The government's proposals for the reform of the UPS focus on promoting private sector participation as a means of delivering an efficient and growing electricity industry to meet consumers' demands. The main proposals set out in this New Strategic Plan concern the reform of the UPS and PSP in grid electricity. The government also proposes to promote PSP in the development of electricity in decentralised power systems and in rural electrification. It will lay the legal basis through the 1999 Electricity Bill. It will also promote it through the implementation of relatively simple contracting/licensing procedures, the removal of bureaucratic obstacles to private investment, and allowing tariffs to be set to ensure financial viability for each decentralised system. Evidence from around the world indicates that such tariffs will be at substantially lower levels than the costs of electricity from the batteries currently being used by most households.

The government has reviewed experience in rural electrification in other countries. It has noted the success of the programmes in Bangladesh, Philippines and Bolivia, and the emerging programme in Mozambique, which have developed responsibility for electricity distribution and sales to the local area.

The government's long term aim is that rural communities should have access to continuous and reliable supplies of electricity, either from the interconnected system or from isolated systems, whichever is least cost in local circumstances. The government's strategy for rural electrification is based on:

- development of markets in services, equipment and credit for electrification;
- a simple and non-bureaucratic licensing framework in order to encourage small independent enterprises to develop;
- retail tariffs will be set at the levels required to ensure financial viability of the local electricity enterprises;
- ensuring that rural electrification schemes are appropriately engineered and costs are minimised;

- lower technical standards in the early days of a distribution system's life are probably acceptable, and save money.

The strategy for rural electrification is based on minimising costs and hence tariffs. In many parts of Uganda this will be done through the development of isolated local generation and distribution system rather than extending the grid. This is because:

- lightly loaded lines over long distances are expensive;
- modern small scale generation is relatively cheap, efficient and easy to maintain;
- networks can grow more closely in line with customer demand; and
- lower technical standards in the early days of a distribution system's life are probably acceptable, and save money

In the longer term, it might be desirable to seek the interconnection of these isolated systems to each other and eventually to the main grid. This is likely to happen through the natural evolution of the network.

The 1999 Electricity Bill will provide the legal basis for the development of generation and distribution at the local level. The government in association with the African Rural and Renewable Energy Initiative (AFFREI) of the World Bank is presently preparing a detailed policy and institutional framework for electrification. The electrification framework will be premised upon a demand driven approach which encourages the development of local initiatives for rural electrification. This framework for electrification will be the subject of a separate policy paper which will be finalised and approved in the near future.

6 Regulation

A key component of the reforms being put in place by the government will be a new regulatory system for the UPS. Although the role of competition will be greatly enhanced in the industry a new system of economic regulation will be required. This will give confidence to both the private sector participants and to consumers that the new UPS will function under an agreed and transparent set of rules and procedures.

The government has reviewed international experience in regulation and is determined to put in place a regulatory system which is consistent with the proposed industry and market structures which are outlined in this New Strategic Plan, and to seek to ensure that from the beginning the regulatory system is appropriate for the new UPS and Uganda.

Institutions

The economic regulation of the electricity industry will be undertaken by an authority to be established in 1999 under legislation that ensures its independence form political influence. The objectives of the regulation will be to:

- protect consumers;
- ensure the financial viability of companies;
- promote competition; and
- collect and disseminate information.

The regulatory authority's broad responsibilities in he power sector will be set out in the new Electricity Bill. The system of regulation will be initially through the various contracts to be entered

into for distribution and generation. The key responsibilities of the regulator will be monitoring compliance with the various contracts and establishing the guidelines for and undertaking periodic price reviews. The government will ensure that the regulator has the professional staff required to undertake these functions, but allows for the possibility that in the early years the regulator may need to contract out some of the required services.

The new Electricity Bill will set out the procedures to be used to settle any disputes arising from the application of the new regulatory system. This will include a provision for international dispute resolution, again with the aim of building confidence in the private sector for the new UPS. The government recognises the importance of consumers and intends to empower them through the creation of appropriate consumer representation bodies, which will be given legal enforcement through the appropriate legislation.

The electricity industry regulator will have an important responsibility of co-ordination with other entities which are responsible for the non-economic regulation of the UPS, including regulation of technical standards and environmental standards. When developing the details of the proposed regulatory system the Government will ensure that the roles and responsibilities of the different entities concerned with regulation are clearly defined and do not overlap.

Functions of the regulator

A key function of the regulator will be the development of incentive based systems which will ensure that the contracts which underpin the proposed reform of the UPS will assist in meeting the government's basic objectives for the power system. The regulator will be responsible for reviewing and approving all contracts, ranging from short term management contracts through to long term concession contracts and PPAs. Reviews and approvals will be in accordance with procedures that assure transparency, timeliness and effectiveness, as defined in the sector legislation and corresponding regulations. It will also be responsible for the development of a process for letting contracts. Further, it will be responsible for monitoring compliance with the contract terms, and enforcing any bonus or penalty payments, as appropriate.

The regulator will undertake the periodic review of the prices which are set in the contracts for transmission and distribution/retail supply in accordance with the principles and parameter values which are agreed in the contracts at the time of signature.

The regulator will also have the following responsibilities, in accordance with general procedures defined in the sector legislation and the corresponding regulations:

- establish its rules of practice and procedure in conformity with the governing legislation
- oversee demand and supply conditions to ensure adequate generation and transmission and capacity is being contracted and constructed;
- grant and revoke licences
- periodically evaluate transmission and distribution performance
- monitor and mediate the domestic contracting process between bulk suppliers and purchasers in situations where contracting parties fail to agree, or when public complaints occur which warrant regulatory oversight
- establish and monitor adherence to rules on reservoir regulation and discharge of water from hydro facilities.

Role of government

Government's key roles in the reformed power sector will be principally to:

- Prepare and obtain necessary approvals for legislation;
- prepare and approve regulations;
- prepare the national energy strategy
- develop GoU electricity policy; and
- prepare indicative generation plans

7 Implementation Plan

The government would draw attention to a number of points about the programme, particularly:

- the programme comprises a number of integrated dated actions, and the failure to meet any of the major actions by the due date would inevitably introduce significant slippages into the whole programme; and
- a number of consultancies must be procured to support the programme-work must commence immediately on agreeing the terms of reference and mobilising finance for the consultancies
- from the outset an interactive process with the market will be pursued, permitting flexibility to package the various transactions to reflect market feedback
- a consortium of advisers led by a management consultants will be appointed by September 1999 to advise government with regard to the implementation of the full set of power sector privatisation transactions.
- the reform of distribution and the letting of the concessions for the areas that account for the majority of the sectors revenues will be the key to the whole reform programme;
- building on the work to be undertaken for the asset valuation study, the government aims to establish the new distribution entities by December 1999;
- an investor conference for the distribution concessions will be held in January 2000;
- the government will issue requests for concessionaires in February 2000;
- final bids for distribution concessions should be received by July 1st 2000; and negotiations with preferred bidders should be concluded, and contracts awarded in October 2000.

ANNEX 2: FURTHER HYDROPOWER NOTES

Twenty-two sites, each with potential of over 500 kW, have been identified since the early-1980s. Another 71 "micro" and "mini" hydropower sites have been identified elsewhere. The following sources of information have been developed over the past ten years:

- **UNTCD:** UN Technical Cooperation Department carried out a study of small hydropower options in north-western and south-western Uganda. The study recommended that small hydro power, where the potential is available, can play a significant role for electrification of areas remote from the national grid. They went further to prioritise the following sites for implementation in respective order: Paidha in the Northwest, Ishasha and Nyamabuye in the Southwest (2 - 5MW). Twenty-two sites with between 0.5 and 5 MW capacity were visited and evaluated.
- **World Bank & UNDP**: Reviewed the potential to rehabilitate the Kikigati mini-hydropower plant on the Kagera River in late-1980s. Funding was not available to carry out rehabilitation.
- **Rehabilitate Existing Power Plants:** The Governments of Sweden (SIDA), China, Federal Republic of Germany (KFW) financed a study to rehabilitate and develop small power stations to improve system reliability and to improve the distribution of power in the country at Maziba Power Station (for Kabale), for which rehabilitation is complete, and the development of electrification project in Ssese Islands, for which funding has not been secured.
- **Paidha-Nebbi District:** US Trade Development Agency and UN studied small hydropower options.
- **Paidha- Nyagak River:** Preliminary studies were carried out by the Koreans (PDRK) and Uganda on developing two sites (1 MW and 2 MW) on the River Nyagak. Preliminary engineering design for two sites (1 MW and 2 MW) undertaken and financing proposal developed for the 1 MW site.
- Ishasha: An Austrian team carried out a detailed feasibility study of developing the Ishasha small hydropower plant in Rukungiri District, south-western Uganda.
- **Paidha-Nebbi, Muzizi-Kibale & Nyamabuye-Kisoro:** Norconsult International, ABB Energy A.S., and Kvaerner Hydropower A.S. carried out pre-investment studies for hydropower development at Paidha in Nebbi district (North Uganda), Muzizi in Kabale District (Western Uganda) and Nyamabuye in Kisoro District (south-western Uganda). Potential at these sites ranged between 3 and 80 MW.
- Sipi, Mitano and Siti: The government of India carried out initial studies of small hydropower sites in eastern and south-western Uganda. They recommended that Sipi (2 MW) in eastern Uganda, Mitano (9 MW) in south-western Uganda, and Siti (1 MW) in eastern Uganda should be implemented, with the highest priority on Sipi.
- **Biseruka and Nyamabuye**: The Government of Uganda has requested assistance from the Japanese Government to determine the financial, economic and technical; feasibility of hydropower development at Biseruka (10 MW) and Nyamabuye (3-5 MW).

ANNEX 3: CASE STUDY OF CHARCOAL STOVES IN KAMPALA, JINJA AND ENTEBBE (EC Funded Uganda Woody Biomass Study- 1995)

Ten charcoal stoves (sigiri) were purchased from the market to test for charcoal efficiency. Additionally, a new prototype multi-fuel stove, developed for refugees in Northern Uganda, was tested. Three ceramic stoves from USIKA Ltd. were purchased in Kampala, while two "improved" ceramic stoves of unknown make were also purchased in Kampala markets. Three traditional round metal "sigiri" charcoal stoves were purchased in Kampala stove markets, as were two "heavy metal" stoves (which are advertised by their producers as “improved” stoves) from the same markets. The latter are being touted by producers as "improved" stoves. High and low power tests were conducted for these stoves.

A stove market survey was carried out in Kampala, Jinja and Entebbe. Numerous markets were visited, and many producers were interviewed to determine their costs of production, sources of supply, outlets, prices, constraints, among others. Additionally, volume of sales and employment were noted to make a determination of the importance of stove production in urban Uganda.

It should be noted that the HEPP carried out far more extensive market surveys of stoves during 1989 than could be carried out during the current Study. They also carried out stove testing on more stoves than was conducted during the present Study. The present Study was designed primarily to update earlier information, to verify earlier results, and to note any major changes in the market place. This forms the basis for recommendations regarding stoves.

A: Market Surveys

Given the size of Kampala and Jinja, a complete census of producers was not possible during the course of the Study. However, all producers were covered in Entebbe. Kampala and Jinja interviews cover a representative sample of stove producers of all types of stoves in these three urban areas. One very disturbing note was found in Kampala; a so-called "improved" all-metal stove has recently appeared in the market place. It is made of heavy-gauge metal and has heavy bars. The stove's "improvement" is based on the fact that it potentially lasts twice as long or longer as the traditional sigiri, while only costing 40-50% more.

In point of fact, the stove is one of the most energy inefficient stoves tested by the Team. The fact that it is selling very well (according to artisans and people interviewed in the market place) further demonstrates that, while the nominal price of charcoal has gone up (and perceptions are strong that charcoal prices are "high"), in reality, the real or relative price of charcoal to many households has declined to the point where efficiency plays very little role in decision making when selecting a stove. That is, many consumers’ perceptions of an “improved” stove rest more with their views of how long the stove lasts (its durability), how the stove looks (its aesthetic appeal) and other features, at least as much as whether or not the stove is more energy efficient. This should not be surprising. The success of improved stoves throughout the world (both developing and developed) rests more with marketing and promotion than with actual efficiency improvements. The fact that people are willing to purchase a stove which consumes considerably more charcoal illustrates both their perceptions of the stove’s appeal, as well as their perceptions of the relative value of charcoal.

Kampala Stove Survey

Ten market producers and producer groups were visited in Kampala. Additionally, the Usika Ltd. improved stove works was also visited. The ten employ some 66 artisans on a full-time basis. Their production is on the order of just over 40,000 stoves per annum. Almost all stoves are produced from scrap metal, although the "improved" metal-ceramic stoves use a higher quality metal, and are assembled with a fired clay liner.

Given the estimated number of Kampala households, this production represents approximately 15% of Kampala's annual charcoal household stove demand (assuming a life span for a traditional charcoal stove of about one year). The Study Team's interviews suggest that there are more than 440 artisans employed in charcoal stove production in Kampala. They generate nearly UShs 1 billion (approximately US$ 1 million) in revenue per annum from the production of metal charcoal stoves in Kampala. This demonstrates the importance of the charcoal stove business in Kampala, and corresponds well to other African cities with comparable population sizes and levels of development.

Unfortunately, no reliable figures on "improved" ceramic-metal stove production are available in Kampala. In addition to Usika Ltd., there are at least three other ceramic-metal "improved" stove producers in Kampala who produce at least on an occasional basis. None of these producers were able to estimate their production for the Study Team. Previous work under the HEPP and the ESMAP February 1994 study puts household penetration of ceramic-metal stoves in Kampala at around 15% (see Section 4, above, and Annex 5).

If these stoves have a lifetime of two years (which is contested by many households who maintain that the stoves last no more than one year), this would imply that there are now on the order of 40,000 of these stoves in Kampala alone. In turn, this would indicate production of these stoves on the order of 20,000 per year. This latter figure seems realistic, given the Study's survey, and given previous work.

Jinja Stove Survey

Four stove markets were surveyed in Jinja township. These employ some 21 artisans. The stove smiths produce approximately 8,250 stoves per annum, with a total value of UShs 16.6 million (approximately US$ 18,000). Given the fact that there are an estimated 22,000 households in Jinja, the surveyed producers produce over one third of all stoves sold in 1994 in Jinja.

Entebbe Stove Survey

Four markets were surveyed in Entebbe. These producers employ some 22 artisans on a full-time basis. They produce approximately 17,500 stoves with a value of over UShs 60 million (US$ 65,000) per annum. Given the fact that Entebbe has approximately 14,000 households, these producers appear to "export" as much as a quarter of their production to other areas around Entebbe and probably to Kampala.

B: Stove Tests 2

Eleven stoves were tested during the course of the Study. These included five "improved" metal-ceramic stoves, five all-metal sigiris (including two of the heavy metal "improved" stoves available on the Kampala market) and the all-metal, multi-purpose, multi-fuel "Refugee" stove developed for refugee camps in Uganda. This funnel stove is made of light-weight materials and has been developed by a gentleman for refugees in Uganda. The Woody Biomass Survey Team requested the stove be included in the Study's stove tests. This stove should be tested on its own merits as it has considerable potential, and it is much more versatile stove than those currently in use for charcoal in Uganda. Simple water boiling tests (WBT) were performed on these stoves. The methodology is set out in more detail in Annex 6 (Household Stove

Tests). Eleven standard-sized moulded metal pots ("sufurias" in the vernacular) were used for the tests. These were rotated amongst the different stoves over four test series in order that the variable for different quality pots was minimised amongst the different stoves. The same quantity of charcoal was measured for each stove (500g), as was the same quantity of water (1 litre) at the same ambient temperature.

Both high and low power tests were conducted. The charcoal charges were lit, times were recorded when fires were lit, when water was boiled and when water either stopped boiling or entirely evaporated. Water and fuel were weighed on digital scales when the water came to a boil. They were then placed back in the stoves for the low power test. The low power test continued until either all water evaporated or until all water was boiled off.

C: Comparison of Results

As should have been expected, the five ceramic-metal stoves performed better overall than the five metal stoves available on the market place. One ceramic-metal stove (non-Usika) performed best of all the stoves, both during the high and low power tests. The two heavy-metal stoves fared worse of all. They failed to boil water on two of the four tests. Their charcoal consumption was highest of all, and, therefore, their efficiency was lowest for both the high and low power tests. The three Usika Ltd. stoves did well on the low-power tests, while the three traditional all-metal sigiris performed well on the high power tests, but performed very poorly on the low power test.

Table AA: Comparison of Stove Results for Eleven Stoves Tested: May 1995

	Ceramic-Metal Stoves			**All Metal Stoves**			
Activity	**Usika**	**Other**	**Avg Metal-Ceram**	**Trade Sigiri**	**New Heavy Metal**	**Average Metal**	**"Refugee"**
Total time:							
* Ignition to cooking	0.2	0:15	0:18	0:09	0:10	0:90	0:04
* To Boil	00:25	0.18	0:22	0:18	np	0:18	0:07
Weight of:							
* Boiling Water (g)	896	914	903	902	np	902	944
* Hot fuel (g)	275	281	277	282	np	282	na
Total Time end of:							
* fire on stove	na	Na	na	1:52	2:07	2:00	0:44
* water in sufuria	1:10	1:07	1:09	na	na	na	na
Weight of remaining:							
* water in sufuria (g)	0	0	0	165	318	242	562
* charcoal (g)	93	82	88	0	0	0	0

Note: Three tests were run on the "Refugee" stove using grass and two with papyrus. The abbreviation "np" means the stove did not perform, while "na" means not applicable.

The "Refugee" stove, brought water to a boil faster than any of the other stoves, but, given the quantity and type of fuel (grass and papyrus), its power performance on the low power test was low due to the limited charge of fuel. There was no fuel left at the end of each of the five firings (i.e., combustion of the grass

and papyrus was complete). Were a denser fuel used on the "Refugee" stove, or were lighter fuels mixed with denser fuels, then it would surely have had a better performance on the low power test.

These results basically support similar tests carried out during the HEPP, and those carried out on “traditional” all-metal stoves and the Kenya Ceramic Jiko (KCJ) metal and ceramic varieties such as the “usika”. The metal-ceramic stoves reduce fuel consumption through good insulation. However, the quality of these stoves available on the Kampala market varies widely. The performance of the metal-ceramic stove depends upon a number of factors, including the ceramic quality and the number of holes in the ceramic liner.

There appears to be no standard for the metal-ceramic stoves. Stove vendors in Kampala, Entebbe and Jinja complained of frequent ceramic cracking and customer complaints. They also complained about the quality of craftsmanship (e.g., ceramic liners not securely fitted within the metal cladding). As noted in Section 4, this doubtless accounts for the poor market penetration of these stoves. The HEPP tests and the stove tests conducted during this Study both point to the fact that very little can say about how much fuel is being saved by the “improved” stoves found in 15% of the households by the HEPP and the ESMAP 1994 studies.

ANNEX 4: ADDRESSES OF CURRENT ACTIVE PROMOTERS OF IMPROVED STOVES IN UGANDA

Full Name	:	Fred Rwashana
Job Title	:	Managing Director
Company	:	Rwashana and Associates Co. Ltd
Business Address	:	Rwashana and Associates Company Ltd P.O. Box 5183 Kampala Uganda
Business	:	256-41-235628

Makes institutional Stoves price from 150,000/= to 1,000,000/= depending on size; Commercial stoves price 200,000/= to 500,000/=; Selina domestic stoves for 30,000/=; Baking Ovens for 400,000/=; Incinerators for 1m/= to 10m/=.

Full Name	:	Albino Oteka
Job Title	:	Senior Instructor
Company	:	Nakawa Vocational Institute
Business Address	:	P.O. Box 20121 Nakawa Kampala, Uganda
Business	:	256-41-220935

Full Name	:	Youssef Arfaoui
Job Title	:	Energy Advisor
Department	:	Health Technology Development Centre
Company	:	Ministry of Health
Business Address	:	HTDC P.O. Box 20014 Wabigalo Kampala, Uganda
Business	:	256-41341611
Business Fax	:	256-41-346714

End of 7th Street, Industrial Area, Wabigalo
Energy Saving Stoves, Rain Water Harvesting, Solar System Installation, biogas, micro hydropower, water filtration and pasteurization.

Full Name	:	Eva Kiwanuka
Job Title	:	Director
Company	:	JEEP
Business Address	:	P.O. Box 4264 Kampala, Uganda
Business	:	256-41267303

Offices at Kansanga – just after junction to Muyenga on the right side of the road
Household energy experts
- improved stoves, sustainable agriculture

Full Name	:	George Kyazze (RIP)
Job Title	:	Managing Director
Company	:	Black Power Ltd
Business Address	:	Black Power Ltd P.O. Box 19018 13 km Gayaza Road Kasangati, Mpigi Uganda
Business	:	256-41-567892/567911 ext. 28

Stove producer – charcoal, firewood and briquette stoves, Institutional stoves
Charcoal briquetting from coffee husks

Involved in the DFID funded rural energy project as a stove producer. Institutional Stoves used at Station Restaurant, Jinja Rd; Eagen House, Kampala Rd; New Mulago Hospital; Mengo Senior Sec. Sch.; Sanyu Babies Home; Karamoja Maternity Hospital; Mityana Hospital; Taibah High School; Katalemwa Chesshire Home Bundibugyo Hospital etc. Household stoves sold at Swan D.C. Ltd Plot 22A Namirembe Rd; Bwakeddempulira, Kissekka Market; Nakasero Market Shop 36 facing car park.

Full Name	:	
Job Title	:	Director
Company	:	Bahesi Company
Business Address	:	Baheesi Company P.O. Box 815, Masaka, Uganda

Make charcoal briquettes, Improved stoves for charcoal and firewood (120,000/=). Institutional stoves.

Full Name	:	John Munyansanga
Job Title	:	Managing Director
Company	:	Appropriate Technology School For Environment
Business Address	:	Appropriate Technology School for Environment P.O. Box 804 Kampala, Uganda
Business	:	256-41-221063

Makes institutional stoves

Full Name	:	

Job Title : Principal
Company : Ministry of Education and Sports
Business Address : Busitema Agricultural College
P.O. Box 236
Kampala, Uganda
Business : 256-41-50818
Business 2: 256-77-412805
Plans to start making institutional stoves

ANNEX 5: UGANDA PHOTOVOLTAIC PILOT PROJECT FOR RURAL ELECTRIFICATION (UPPPRE)

PROJECT SUMMARY

The UPPPRE is a three year pilot project to demonstrate and establish the financial and institutional mechanisms to provide solar photovoltaic (PV) – based electrical services on a commercial basis to households, businesses and communities in rural and peri urban areas of the country which are not projected to have access to grid-based electricity in the foreseable future and which have both the ability and willingness to pay the unsubsidised cost of the systems.

In support of the UPPPRE, the UNDP/Global Environment Facility (GEF) has provided US $1.8 million for the provision of technical assistance, training, information collection and dissemination. The Government of Uganda is providing $200,000 to cover certain local costs. In addition, a PV credit fund (PCF) is being established to provide loans to communities, businesses and households for the purchase of solar systems. UNDP/Uganda has provided an additional $1 million to initially capitalise the fund which, it is anticipated, will operate both during and after the project. Additional donor contributions to the PV credit fund are being sought to increase the scale of solar lending under the project and introduce equipment suppliers from Asia, America, Europe and elsewhere in Africa to the markets in Uganda.

It is expected that the UPPPRE will lead to a large-scale national program to promote PV-based rural electrification involving additional capital from local financial institutions, development agencies, and/or private investors.

In keeping with the Government of Uganda's policies of fostering market-driven, private sector-oriented, economic development as well as environmental conservation, the specific goals oaf the UPRRE are to:

Confirm the demand for the increased use of PV technologies to provide electricity in rural areas of the country through the expanded involvement of the private sector to provide energy services;

Develop strategies to overcome the policy, technical, financial, social and institutional constraints to the expansion of markets for PV systems on a demand-driven, full cost-recovery basis;

Strengthen the capacity of the private sector to design, install, service and, eventually, manufacture PV systems on a commercial basis and of the public sector to promote, monitor and provide the policy framework for the expanded use of PV systems;

Provide electricity to at least 2,000 households and 4 communities in areas not presently served by the grid;

Subscribe to global efforts to combat the build-up of CO_2 in the atmosphere and contribute to the curbing of greenhouse gas emissions from the use of kerosene and diesel generators;

Develop mechanisms to market smaller PV systems (i.e. solar lanterns) for low income households, larger systems for high income households and custom-designed systems for economically productive applications which generate employment.

Prepare an investment plan and identify the financial resources to provide PV-based rural electrification services on a national scale using one or more proven implementation strategies.

The project will achieve the above promoting and strengthening linkages between local industry, banking and training institutions, government agencies, end-users and communities. It will be demand-driven and PV systems will be purchased on a commercial basis through the establishment of credit mechanisms involving local financial institutions. Existing community-based organisations, NGOs, and local authorities will be asked to participate as appropriate.

Activities to be carried out under the project will focus on local capacity building and will include:

1. Assisting the Ministry of Energy and Mineral Development in formulating renewable energy policies which promote private sector-based rural electrification services, overcome policy-related constraints and safeguard Uganda's environment.

2. Assisting the government and private sector in establishing ongoing public awareness campaigns to inform people in both rural and urban areas about the availability, cost, advantages and limitations of PV systems,.

3. Enabling the private sector and local financial institutions to design, test and expand the operation of financing mechanisms to increase the scale of PV lending throughout the country to enable a significant portion of the population to gain access to private sector-based electrification services at the lowest possible cost.

4. Providing training, both in Uganda and overseas, for Ministry and private sector personnel to enable them to plan and carry out expanded PV commercialisation activities.

5. providing information and technical assistance to Uganda's two battery manufactures to enable them to produce and market deep-cycle batteries for use in conjunction with PV systems in Uganda and in the region. Support will also be provided to evaluate if the procedures followed by Ugandan battery manufacturers for battery recycling/disposal can be made more environmentally sound.

6. Strengthening the capacity of the recently-established Uganda Renewable Energy Association (UREA).

7. Assisting the Uganda National Bureau of Standards in establishing and enforcing PV equipment standards and codes oaf professional practice including the establishment of a basic PV component test facility.

8. Assessing the need to strengthen the data collection and analysis capabilities of the Department of Meteorology of the Ministry of Energy and Mineral Development.

9. Assisting the Ministry of Energy and Mineral Development in monitoring the rate of expansion of PV-based rural electrification services through the establishment of a data base of renewable energy installations in Uganda using a geographic information system.

For further information about the project contact UPRRE Project Manager Godfrey Turyahkayo or Chief Technical Advisor Steve Hirsch, tel. 256-41-257863 or 235889 or e-mail: upppre@inforcom.co.ug.

ANNEX 6: GTZ ENERGY ADVISORY PROJECT

February 1999

Federal Ministry for Economics
Cooperation and Development
-Division 214, East Africa –

Technical Co-operation with Uganda

Brief description of the project
"Energy Policy Consultancy"

Now that the Ugandan Government has deregulated the energy sub-sectors electricity and liquid fuels. It sees its further role in the energy sector to be in elaborating and implementing energy policy and energy development strategies, as well as in creating general conditions for improved energy supply. The competent Energy Department in the Ministry of Energy and Minerals is not, however, equipped with sufficient human resources and sector-specific capacities to be able to perform this role efficiently. Management consultancy in structural and regulatory policy areas of central importance, such as energy policy, is a focal area oaf the German-Uganda Development co-operation.

The objective of the project, for which the government of the Federal Republic of Germany has provided DM 2 million for a first phases, is to support Energy Department personnel through consultancy, upgrading and organisational development in such a manner that they can effectively perform their policy-development, planning, co-ordination and supervision tasks in the energy sector. For this purpose it is planned to second an international long-term expert, to assign international, regional and local short-term experts, to finance upgrading measures and to equip the Energy Department with electronic data processing and office equipment, as well as a vehicle.

Within the energy sector, the World Bank and UNDP are promoting rehabilitation and consolidation of the electricity supply in the electricity sub-sector. The government of Norway is supporting the elaboration of new electricity legislation. The Dutch government is supporting improved use of biomass in domestic households and industry. UNDP (Global Environmental Facility) is preparing to promote a project for small-scale solar energy units. The provision of systematic consultancy to the overall energy sector at macro level has not yet been promoted by any donor. The project is to make a significant contribution here and make use of the global experience of German Technical Co-operation in the fields of energy policy consultancy, renewable energies and energy efficiency.

The success of the project stand and falls with the human resources of the Energy Department. The Government of the Federal Republic of Germany therefore expects of the Ugandan Government that it will guarantee staffing levels at the Energy Department. The success of the project also depends essentially on the Ugandan Government consistently continuing the reform of the legal and regulatory framework conditions for participation of private investors in the energy sector.

GTZ - ENERGY ADVISORY PROJECT

COUNTERPART ORGANISATION: Ministry of Energy & Minerals (MEM): Energy Department.

STATUS QUO: Energy Sector

- Few people have access to modern energy supplies and the country has one of the lowest per capital consumption levels of modern energy in sub-Saharan Africa.
- Energy demand is growing
- Biomass represents 95% of the national energy balance which tends to reduce the country's forest stock.
- Uganda is richly endowed with renewable energy sources (Solar, Biomass, Small-scale Hydropower), but they are not yet very much disseminated.
- Energy strategies don't yet exist and population revenues are very low.

Project Purpose

- The Energy Department efficiently and effectively fulfils it s policy development, planning, co-ordination, information and monitoring & evaluation functions.

Target Groups

- Private (Households) and industrial (industries, artisans) energy consumers

COMPONENT: Main planned activities

1. Energy policy, sub-sector strategies, appropriate legislation

- Draft energy policy prepared through a consultative process
- Development of sub-sector strategies for Renewable Energies (RE) and Energy Efficiency (EE).
- Preparation of a legislative framework for RE and EE
- Review Petroleum Act and amend or repeal.

2. Energy system analysis, monitoring and information methods.

- Assessment and introduction of energy system analysis methods, Monitoring and Information systems.
- Data collection and update
- Evaluation and publication of Energy information (Energy balance, statistics).

3. Identification of measures for improved rural energy supply

- Evaluation of RE projects taking into consideration economic, environmental, social and gender relevant aspects.
- Identification of incentives for commercial dissemination of RE.
- Enhancement of co-operation between institutions active in the area of RE and EE.

4. Identification of measures for energy efficiency improvement

- Analysis of the energy conservation potential in various sub-sectors
- Development of standards for energy technologies
- Design energy efficiency measures.

5. Energy sector organisation and co-ordination

- Capacity building of the ED to fulfil 1st functions effectively
- Improvement of the co-ordination in the energy sector
- Support of the Sectrol Planning Department of MPED and the Planning Unit in MEM in appraisal of energy projects.
- Strengthening of the Co-operation between central and local authorities.

6. Counterpart training

- Review staff development programme and assess training needs
- Design and organisation of advanced training.
- Identification of the needs for complementary staff.

ANNEX 7: THE DEPARTMENT FOR INTERNATIONAL DEVELOPMENT (DFID)

The DFID has Uganda as its 4th largest programme world-wide. At the moment DFID is addressing the renewables and rural energy the issues through knowledge and research (KAR) grants administered through the KAR Engineering section. DFID hopes to support the energy sector by integrating energy components in their other projects i.e. education/health, agriculture and fisheries etc.

Policy Markers for DFID supported projects:

1. Protection and better management of the natural and physical environment

- National strategies for sustainable development
- Integrated management of water resources
- Efficient use of productive capacity
- Protection of the global environment
- Urban development
- Energy efficiency
- Sustainable forest management
- Bio-diversity
- Sustainable agriculture
- Sustainable agriculture
- Desertification, land degradation and drought mitigation

2. Better education, health and opportunities for poor people

- Lower child mortality
- Lower maternal mortality
- Essential health care
- Reproductive health service
- Effective universal primary education
- Literacy, access to information and life skills
- Safe drinking water and adequate sanitation
- Food security
- Emergency and humanitarian needs
- HIV/Aids
- Post primary education

3. Policies and actions which promote sustainable livelihoods

- Sound social and economic policies
- Direct assistance to the private sector
- Access of poor people to land, resources and markets
- Good governance
- Human Right
- The prevention and resolution of conflicts
- The removal of gender discrimination
- Business partnership

A selection of DFID –KAR Projects

1. Improving efficient woody biomass energy production and utilisation being implemented in Uganda and Zimbabwe. The project purpose being to demonstrate to key stakeholders the important contribution commercial woody biomass energy makes towards rural poverty alleviation and to the national economy.
   Status: Ongoing.

2. Poverty Alleviation Aspects of susccessful improved household stones programmes being implemented in Kenya, Ethiopia and Uganda. The purpose being to determine the poverty alleviation aspects of successful commercial stoves programmes on producers, consumers and others associated with the household fuel and stove supply and end-use business.
   Status: Ongoing.

3. Community Microhydro in LDC's: Adoption, Management and Poverty impacts. Being implemented in Ethiopia, Uganda Nepal and Sri-Lank. The purpose being to develop methodologies and action plans through consultation, by which community based Microhydro can be implemented in African countries through the study of successful adoption of Microhydro in Nepal and Sri-Lanka.
   Status: Complete

4. Deployment of Improved Institutional Stoves Implemented in Kenya, Uganda, Tanzania and Ethiopia. The purpose being to encourage commercial and institutional makers and users respectively of improved stoves.
   Status: Complete.

5. Accelerated Rural Electrification through East African SME Co-operation – implemented in Ethiopia, Kenya and Uganda. The project purpose being to increase off-grid electridication by improving the business, commercial, financial and technical, skills of Uganda, Kenyan aid Ethiopian Small and Medium Enterprises (SME's)
   Status: Complete

ANNEX 8: DUTCH FUNDED - SUSTAINABLE ENERGY USE IN HOUSEHOLDS AND INDUSTRY (SEUHI) PROJECT

Through Interventions by Ministry of Energy & Mineral Development & NGOs.

The major intervention is on demand – side management, involving the dissemination of improved efficiency stoves both for charcoal and wood.

Under Dutch funding the Sustainable Energy use in households and industry (SEUHI) is carrying out Training of Trainers programmes in the design and construction of improved efficiency, mud stoves (Lorena) in the districts of Kabale, Tororo, Soroti and Adjumani.

So far 2,500 household9s here installed stoves under the programme. It has a multiplier effect in that those who acquire the skills pass them on to others.

Under the same programme, improved efficiency lime …. And training of lime producer is going on in the districts of Tororo, Kasese and Kisoro. The present kilns produce one kg of lime using a kg of fuel wood whereas improve ones can produce 5 kg, using a kg of wood.

Charcoal production is also targeted, with the dissemination of improved portable kiln in the districts of Luwero, Masindi and Nakasongola.

Charcoal stoves especially the ceramic ones in Kabale ore also disseminated.

It is noteworthy that there are also various NOG involved in stove dissemination both for households and institutions. Others are involved in Tree planting.

SUMMARY

Sustainable Energy Use in Households and Industry (SEUHI) Project carried out the following output on the course of the reporting period 1st quarter; July to September 1999;

Output 1: Cookstoves dissemination in the districts of Kabale, Tororo and Soroti.

Output 2: Afforestation activities in Adjumani and Tororo districts.

Output 3: Charcoal Production Improvement and Marketing in Luwero, Masindi and Nakasongola district

Output 4: Lime Production Improvement in Tororo district.

Output 5: Awareness Campaigns on energy conservation in households and industry

Output 6: Monitoring and Evaluation of Project activities.

The project progress, (Technical) based on outputs and earlier set targets is outlined in table 1. Details of the report are in Annex.

Table AB: Sustainable Energy Use In Households And Industry (Seuhi) Project Progress Report June – September 1999

OUTPUT	TARGETS	ACHIEVEMENTS	COMMENTS
Output 01: Cookstove Dissemination	• 6 training w/shops for Soroti; 180 people trained • 6 local certified stove trainers commissioned in Soroti • 24 model stoves to be constructed • Draft cookstove/rational energy use manual ready by September. • Commission an NGO to carry out cookstove dissemination in Adjumani	• 6 workshops held; 150 people trained • 4 trainers commissioned • 24 model stoves were built in kitchens participants • 1st Draft ready • ACORD Commissioned in August to carry out the assignment	• Some invited candidates did not show up. • They can ably conduct a rural workshop on their own • This was part of the hands-on-training for w/shop participants. • The activity commenced a monitoring team is to travel to Adjumani in December
Output 02: Afforestation	• Commission agency to carry out offorestation in Adjumani • Develop 5 nurseries at 5 sub-county headquarters in Tororo district as models.	• ACORD was commissioned in August and commenced with the activity • 3 Nurseries developed at Rubongi, Molo and Butalya • Inputs like seeds watering cans, etc provided to he sub-counties	Retraining to be carried in the sub-counties lagging behind to achieve goal in Nov/Dec. nursery season
Output 03: Charcoal production improvement	• 4 Training workshops for charcoalers • 50 trained charcoalers • 2 charcoalers groups mobilised in to marketing society	• I workshop held in Luwero 3 in Masindi; 3 in Nakasongola • 25 trained in Luwero district; 25 in Masindi; 30 in Nakasongola • 90 bags of high quality charcoal was produced during training. • 280 litres of pyroligenous acid were produced • 2 groups mobilised in Masindi; 1 group in Nakasongola	• The charcoalers involved so far have begun appreciating some of advantages attached to the New Technology. • Anticipate to involve more charcoalers on procurement of ore training (order made) • Some charcoalers have tried out the pryoligenous acid for meat seasons. More training to be carried out. • There was some resistance from Luwero charcoalers due to earlier involvement of the DFO's staff had poor working relations with the charcoalers. The problem has been overcome. • Dealers with capacity to purchase a lorry load of 120 bags. Propose to

	• Survey for charcoal markets in Kampala	• Identified 47 major charcoal dealers in Kampala; Nakawa, Bwaise, Katwe, etc.	install revolving fund to assist charcoalers to transport product to the market at the beginning of the cycle then guide them to proceed on their own
Output 4: Lime Production Improvement	• Visit Homa Lime Company, Kisumu, Kenya • Commissioning of the lime kiln by end of September	• 2 Project staff and members of lime Producers Association visited Homa Lime Co. in July 1999. • Material schedule done and procurement commenced	• A lot of experience gained in mode of operation of a vertical saft kiln identical to the proposed Tororo kiln. • An agreement was struck with the Ministry of Works, Housing and Telecommunications to work jointly on lime production improvement in Tororo, Kisoro and Kasese.
Output 5: Awareness Campaigns	• Production of Radio programmes and brochures	• Easy to read materials produced for cookstoves, charcoal production • 10 Radio programmes on both FM and Radio Uganda.	• The public has started responding by paying visits to the Ministry for advice and guidance.
Output 6: Monitoring and Evaluation	• Set up a continuous monitoring and evaluation mechanism.	• Sub-county project co-ordinators have picked the skill in taking inventory of progress of activities and documentation. • Women members of Parliament, District Forestry Officers are playing a key role in this endeavour.	• Up todate information is available most of the time

ANNEX 9: UGANDA RENEWABLE ENERGY ASSOCIATION (UREA)

UREA was formed in 1995 and it comprises an association of about 25 private Ugandan companies, Training institutions, and consultants promoting the development and use of Renewable Energy Technologies (RETs). The Association brings together the key players in the new and renewable energy sources field. It s members are committed to the strengthening and expanding of the use of RETs in Uganda through commercial Channels.

Interests

RETs publicity and quality regulation in Uganda.

Activities

UREA is largely in its formative stages, however it has a great potential. Key activities include the sourcing and distribution of RET Journals, information dissemination, the establishment of a RET Code OF Conduct and the publication of quarterly newsletter.

UREA is to facilitate its members to organize and participate in expositions, trade fairs, and public events aimed at demonstrating and explaining PV technology. It is also hoped that UREA would play a regulatory role in vendor/installer licensing and technician certification and co-ordinating, liaison, and lobbying role on behalf of its members with the Government, donor agencies, NGOs and financial institutions.

MEMBERS OF UGANDA RENEWABLE ENERGY ASSOCIATION

COMPANY	**CONTACT PERSONS**
Afro-Kai Solar (U) Ltd. P.O. Box 3460, Kampala Tel: 256-41-532 547 Fax: 256-41-532 547 Mobile: 075 691 237 E-Mail jsabiiti@infocom.co.ug	Enock Sabiiti Sale and installation of PV system
AIP P.O. Box 12376, Kampala Tel: 256-41-220 526 Fax: 256-41-413071 Mobile: 077 413 071 E-Mail gakwya@avumuk.ac.ug	Hellen Gakwaya RE Consultant
Boomer Systems (U) Ltd. Plot 12 Wampewo Avenue P.O. Box 7742, Kampala Tel: 256-41-233479/235083/259679 Fax: 256-41-235083	Musoke Kivumbi PV Systems Sale

Mobile: 077 455 401 E-Mail: ymrug@starcom.co.ug.	and Installation
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Centre for Renewabel Energy & Environment Programme P.O. Box 29, Kyambogo Tel: 256-41-349 220/285 211/3 Fax: 256-41 345 597 Mobile: 075 691 237	Wilson Okaka RE Consultant
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Mulindwa Christopher
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Johnson Irumba

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