No.

Japan International Cooperation Agency

Preparatory Survey for
Renewable Energy Promotion Program in Africa
— Business Promotion and Financial Mechanism —

Final Report

November 2009

Nippon Koei Co., Ltd.

IDD
JR
09-071

No.

Japan International Cooperation Agency

Preparatory Survey for
Renewable Energy Promotion Program in Africa
— Business Promotion and Financial Mechanism —

Final Report

November 2009

Nippon Koei Co., Ltd.

Location Map

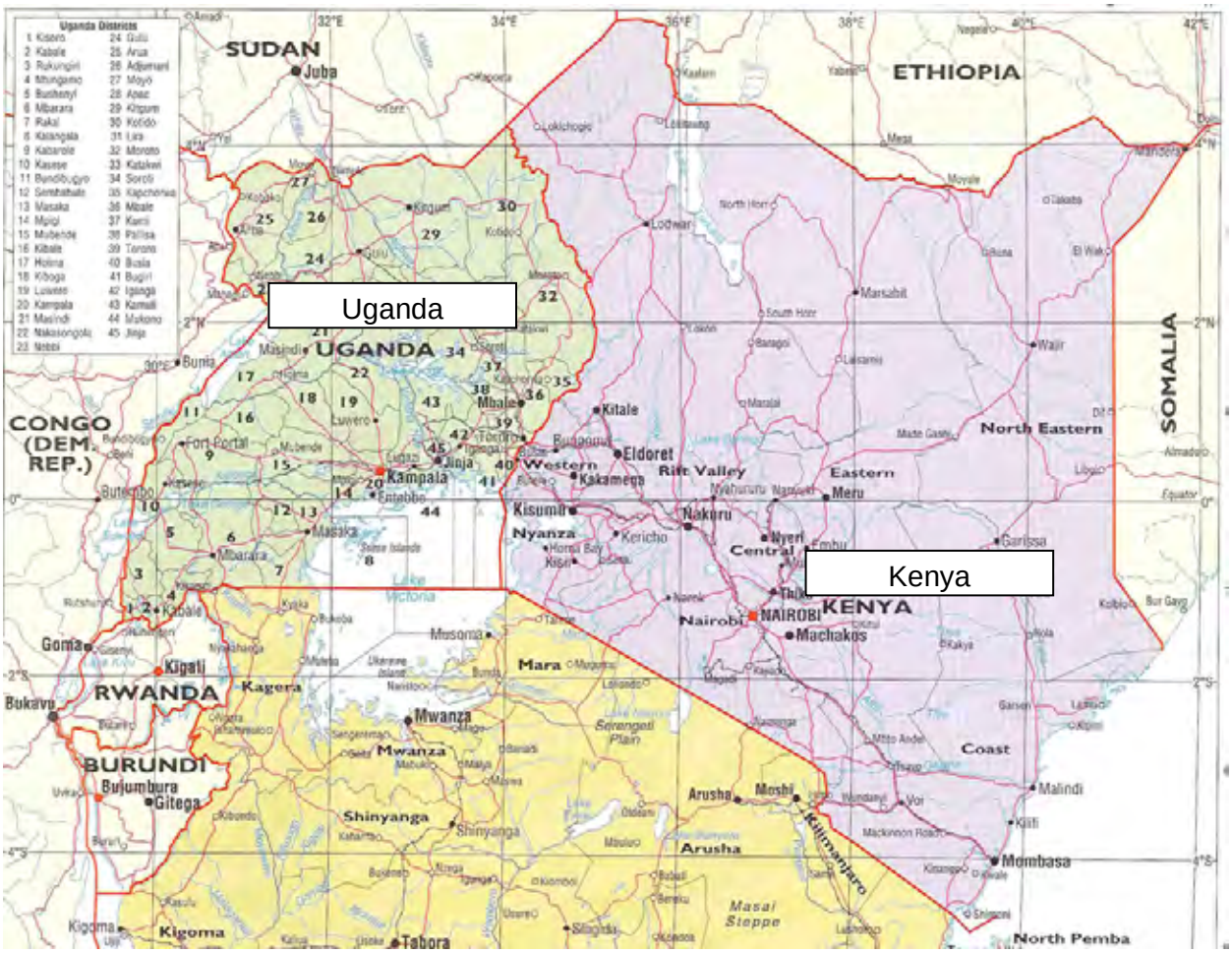


Table of Contents

List of Tables

List of Figures

Abbreviation

AFC	Agriculture Fund Corporation
AFD	Agence Francaise de Developpment
AfDB	African Development Bank
BGR	Bundesanstalt für Geowissenschaften und Rohstoffe (German Geological Study)
BOO	Build-Own-Operate
BoU	Bank of Uganda
CBK	Central Bank of Kenya
CBO	Community-Based Organization
CDC	CDC Group plc (formerly the Commonwealth Development Corporation)
CDF	Constituency Development Fund
CDM	Clean Development Mechanism
CREEC	Center for Research in Energy and Energy Conservation
DAC	Development Assistance Committee
DANIDA	Danish International Development Assistance
DDA	Dutch Development Agency
DEG	Deutsche Investitions- und Entwicklungsgesellschaft mbH (German Investment and Development Company)
DFID	Department for International Development
DSM	Demand Side Management
DWD	Department of Water Development
EAC	East African Community
EADB	East African Development Bank
EIB	European Investment Bank
EPC	Engineering, Procurement, Construction
ERA	Electricity Regulatory Authority
ERB	Electricity Regulatory Board
ERC	Energy Regulatory Commission
ERS	Economic Recovery Strategy for Wealth and Employment Creation
ERT	Energy for Rural Transformation
ESP	Energy Service Provider
ESRP	Energy Sector Recovery Project
EU	European Union
FMO	Nederlandse Financierings-Maatschappij voor Ontwikkelingslanden N.V. (Netherlands Development Finance Company)
F/S	Feasibility Study
GDC	Geothermal Development Company
GEF	Global Environment Facility
GIS	Geographic Information System
GoJ	Government of Japan
GoK	Government of Kenya
GoU	Government of Uganda
GTZ	Deutsche Gesellschaft fur Technische Zusammenarbeit (German Society for Technical Co-operation)
IAEA	International Atomic Energy Agency
IBRD	International Bank for Reconstruction and Development
ICEDA	Icelandic International Development Agency
IDA	International Development Association
IFC	International Finance Cooperation
IMF	International Monetary Fund
IP-ERS	Investment Program for the ERS 2003-2007
IPP	Independent Power Producer
IREMP	Indicative Rural Electrification Master Plan
JBIC	Japan Bank for International Cooperation
JICA	Japan International Cooperation Agency
JKUAT	Jomo Kenyatta University of Agriculture and Technology
KenGen	Kenya Electricity Generating Company Ltd.
KEREA	Kenya Renewable Energy Association
KfW	Kreditanstalt fur Wiederaufbau (Reconstruction Credit Institute)

KIRDI	Kenya Industrial Research and Development Institute
KPC	Kenya Power Corporation
KPLC	Kenya Power & Lighting Company Limited
Ksh	Kenya Shilling
KTDA	Kenya Tea Development Agency Ltd.
KWFT	Kenya Women Finance Trust
LCPDP	Kenya's Least Cost Power Development Plan
LED	Light Emitting Diode
LIBOR	London Inter-Bank Offered Rate
MEMD	Ministry of Energy and Mineral Development
MDIs	Microfinance Depository Institutions
MFIs	Microfinance Institutions
MFPED	Ministry of Finance, Planning and Economic Development
MFSC	Microfinance Support Center Limited
MIS	Management Information System
MoE	Ministry of Energy
MoF	Ministry of Finance
MoU	Minute of Understanding
M/P	Master Plan
MSME	Micro, Small and Medium Enterprises
NARO	National Agricultural Research Organazaion
NDF	Nordic Development Fund
NGO	Non-Governmental Organization
NORAD	Norwegian Agency for Development Cooperation
ODA	Official Development Assistance
OJT	On-the-Job Training
p.a.	per annum
PEAP	Poverty Eradication Action Plan
PPA	Power Purchase Agreement
PPP	Public Private Partnership
Pre-F/S	Pre-Feasibility Study
PRSP	Poverty Reduction Strategy Paper
PSFU	Private Sector Foundation Uganda
PSRP	Power Sector Recovery Project
PSRPS	The Power Sector Reform and Privatization Strategy
PV	Photovoltaic
PVMTI	Photovoltaic Market Transformation Initiative
REA	Rural Electrification Authority (Kenya)
REA	Rural Electrification Agency (Uganda)
REB	Rural Electrification Board
REEEP	Renewable Energy & Energy Efficiency Partnership
REF	Rural Electrification Fund
REM	Rural Electrification Master Plan
REP	Rural Electrification Program
REIP	Renewable Energy Investment Plan for Uganda
RESP	Rural Electrification Strategy and Plan
SACCO	Savings and Credit Cooperative Society
SACCOs	Savings and Credit Cooperative Societies
SADC	Southern African Development Community
SAPP	Southern Africa Power Pool
SCADA	Supervisory Control And Data Acquisition
SHS	Solar Home System
SIDA	Swedish International Development Agency
SME	Small and Medium Enterprises
SMEP	Small and Micro Enterprises
SVO	Straight Vegetable Oil
TICAD	Tokyo International Conference on African Development
UBoS	Uganda Bureau of Statistics
UDB	Uganda Development Bank
UEB	Uganda Electricity Board
UECCC	Uganda Energy Credit Capitalization Company Limited
UEDCL	Uganda Electricity Distribution Co. Ltd.

UEGCL	Uganda Electricity Generation Co. Ltd.
UETCL	Uganda Electricity Transmission Co. Ltd.
ULC	Uganda Land Commission
UNEP	United Nations Environment Programme
UNIDO	United Nations Industrial Development Organization
US$	US Dollar
US¢	US Cent
Ush	Uganda Shilling
UWA	Uganda Wildlife Authority
VAT	Value Added Tax
WENRECO	West Nile Rural Electrical Company

Exchange Rates (as of April 2009)

- US$ 1 = JPY 97.29
- Ksh 1 = JPY 1.258
- US$ 1 = Ksh 77.34
- Ush 1 = JPY 0.046
- US$ 1 = Ush 2,115

Electrical Terminology

- V (Volt) Unit of voltage
- kV (kilovolt) 1,000 volts
- W (Watt) Unit of active power
- kW (kilowatt) 1,000 watts
- MW (Megawatt) 1,000 kW
- Wh (Watt-hour) Unit of Energy
- kWh (kilowatt-hour) 1,000 Wh
- MWh (Mega Watt-hour) 1,000 kWh
- GWh (Giga Watt-hour) 1,000 MWh
- VA (Volt-ampere) Unit of apparent power
- kVA (kilovolt-ampere) 1,000 VA
- MVA (Megavolt-ampere) 1,000 kVA
- Wp (Watt-peak) Unit of PV output[1]
- kWp (kiro Watt-peak) 1,000 Wp
- MWp (Megawatt-peak) 1,000 kWp

[1] Maximum watt of PV module DC output under standard conditions of 1,000 W/m^2 intensity, 25 °C ambient temperature and a spectrum that relates to sunlight that has passed through the atmosphere (AM or Air Mass 1.5).

Chapter 1 INTRODUCTION

1.1 Background

(1) Assistance in Africa

Nowadays, Africa is getting world attention as it leads towards economic development following Asia. The investment to developing natural resources is increasing. Hence, African economy is gaining the opportunity in taking off from long-term stagnation due to shortage in natural resources.

On the other hand, there are a lot of problems and issues to be solved in Africa. African countries are the first to suffer the impacts of food price hike and climate change. Poverty reduction is set as their long-range goal. However, they simultaneously need to respond to meet challenges on climate change. Thus, they need to achieve development with minimum CO_2 emission and environmental impacts to ensure economical development expected in the future.

In such condition, the Government of Japan (GoJ) announced its policy in promoting active assistance to African countries. In the Tokyo International Conference on African Development (TICAD) IV, the GoJ announced its initiative package for the development of Africa, including the commitment to increase Japanese Official Development Assistance (ODA), to double the amount within 5 years.

The GoJ also announced policies like support in promoting renewable energy through the “Cool Earth Partnership”, as countermeasure against climate change.

(2) Assistance to Promote Renewable Energy

The Japan International Cooperation Agency (JICA) has learnt a lesson regarding the importance of condition improvement for the popularization and business promotion of renewable energy. A study[2] held in Kenya and Uganda for four months from July 2008 shows the necessity of such condition improvement as well as promoting electrification of public facilities in rural areas like schools and health facilities.

As a result, JICA conducts this study to gather basic information in formulating new projects, and study the possibility of cooperation in the future. This is executed by grasping and analyzing the current situation on the business promotion of renewable energy.

1.2 Objectives of the Study

The following are the objectives of the study:

- Understand the present situation of business and its environment related to renewable energy in Kenya and Uganda;
- Figure out the barrier or bottleneck in formulating the mechanism with policy and institutional arrangement, to disseminate renewable energy as a private business;

[2] Dissemination of renewable energy to rural communities: study on photovoltaic and small-hydro projects in East Africa, JICA, 2008

- Propose countermeasures to mitigate the barriers or bottlenecks; and
- Explore the possibility for cooperation by Japanese ODA related to the above countermeasures.

1.3 Study Team

The JICA Study Team consists of the following four experts:

- Mr. Tomoyasu FUKUCHI: Team Leader / Promotion Policies and Institution
- Mr. Shisei SAKODA: Renewable Energy Business
- Mr. Hidehito WAKABAYASHI: Financial Policies and Institution / Microfinance
- Mr. Takeshi SAGAWA: Reality of Lending and Issues

1.4 Record of Major Activities

The overall schedule of the study is shown below.

	2009/4	2009/5	2009/6	2009/7	2009/8	2009/9	2009/10	2009/11
Site Survey	Kenya	Uganda						
Report				Draft	* Final Report		Final Report	*

Note: In addition, Mr. Sagawa visited the headquarters of World Bank, International Finance Cooperation (IFC), AfDB (African Development Bank) and UNIDO (United Nations Industrial Development Organization).

Scopes of the study include the following:

1) Deliberation with counterpart organizations
   - Kenya: Ministry of Energy (MoE) and Rural Electrification Agency (REA)
   - Uganda: Ministry of Energy and Mineral Development (MEMD) and Rural Electrification Authority (REA)
2) Interview with organizations concerned on renewable energy business
3) Interview with financial institutions
4) Site Surveys

   Surveys were conducted at the following locations:

   - Kenya:

     (1) Kibae hybrid CPC (Community Power Center) in Kirinyaga District, (2) Kamahuha CPC in Muranga South District, (3) Ngong Hills wind and photovoltaic power (PV) power generation project site and Mbuuni CPC in Machakos District, (4) James Finlays Ltd., Gilgil, (5) Chemosit CPC in Kericho District, (6) Homa Bay CPC, and others.
   - Uganda:

     (1) Bwindi mini-hydro in Kanungu District, (2) Kisiizi mini-hydro in Rukungiri District, (3) Finlays tea factory (biogas power generation) in Kibale District, (4) Gomba Fishing Industry in Jinya District, (5) Kakira sugar works in Jinya District, (6) Hydropower potential site in Mbale District, (7) Hydropower potential sites of Karuma and Ayago hydropower in Masindi District, and others.

Chapter 2 KENYA: PRESENT SITUATION OF RENEWABLE ENERGY SECTOR

2.1 Institutional Support and Related Plans for Renewable Energy Promotion

2.1.1 National Policy on Renewable Energy

There is no comprehensive policy in positively promoting renewable energy in Kenya at present, although there are preferential taxation system and feed-in tariff.

When the Sessional Paper No. 4 was passed in the parliament in October 2004, Kenya was operating without a comprehensive energy policy. By implementing this paper, Kenya recognizes the importance of renewable energy as well as energy efficiency.

The Energy Act 2006 sets out the national policies and strategies for short to long-term energy development. The broad objective of the new energy policy is to ensure the provision of adequate, quality, cost-effective, affordable supply of energy while ascertaining environmental conservation.

In Vision 2030, Kenya set the country's new development blueprint covering the period 2008 to 2030. It aims to transform Kenya into an industrialized, middle-income country providing high quality life to all its citizens by the year 2030. This long-term development plan will directly lead to the availability of energy and provision of related services. The Government of Kenya (GoK) recognized that without adequate and affordable energy services, Vision 2030 will not be achieved. Moreover, the importance of renewable energy and its efficiency will not be realized.

2.1.2 Outline of Institutional Support for Renewable Energy Promotion

Historically, GoK has not actively supported renewable energy by not allotting the necessary budget for its promotion. Several measures which provided basic support to renewable energy are as follows:

- Removal of duties and Value Added Tax (VAT) on solar energy equipment and removal of duties on renewable energy equipment
- Development of feed-in tariffs
- Provision of renewable energy systems through the REA

2.1.3 Preferential Taxation System

Regarding the solar PV and equipment, VAT is rated as zero. Said rated tax is different from being either non-taxable or exempted. The solar equipment is taxable but rated zero in order to promote the trade of solar PV. The East African Customs Common External Tariff regulates zero rated tax for customs in Kenya as well. The United Nations Industrial Development Organization (UNIDO) in Kenya promotes energy kiosk with imported solar PV systems.

The staff of UNIDO, which is implementing the energy kiosk project using the imported renewable energy systems such as solar PV, complains of said taxation scheme for imported solar equipment. Zero rating is not applicable to equipment of solar PV that is imported individually, since the tax authority is supposed to be concerned only on the individual

equipment to be used for other purposes, other than solar PV systems.

2.1.4 Subsidy System

(1) Rural Electrification Fund (REF)

In Kenya, there are several subsidy schemes for the promotion of the renewable energy systems and conventional electrification. REA manages the REF according to the Energy Act of Kenya. 5% of the power consumption is the comprehensive levy from the power subscribers. The funds from donors are the source of REF designed to promote implementation of rural electrification where it is regarded by the power business as unprofitable.

(2) Constituency Development Fund (CDF)

CDF is managed and controlled by the central government, whereas REF is by the Ministry of Energy (MoE). CDF is intended to promote the development of rural infrastructure for supporting the poorer communities and is operated as follows:

The government allocates the fund to 210 constituencies in the country. The annual amount of CDF will be authorized according to congress approval on the national budget. CDF is also intended for grid extension in the rural areas. It is also aimed at other rural development concerns such as road, health and education. Committees are organized at each constituency for the management of CDF.

(3) Local Authority Transfer Funds (LATF)

The LATF is managed and controlled by the Ministry of Local Government as the subsidy for off-grid electrification, including renewable energy projects.

2.1.5 Lending Mechanism

The Kenya Power & Lighting Company Limited (KPLC) maximizes the recovery of the investment cost through the collection of the power bills from the subscribers of electricity. There are many Kenyans who cannot afford to pay their power bills and thus do not avail of the supplied electricity. The electricity tariff is too expensive for ordinary households. KPLC therefore, will attempt to further promote connection of more population to the grid, through the financial scheme jointly provided by the cooperation and the financial institutions. Households may benefit with the useful information on loans for the connection fee provided by the commercial banks and small business, and for agricultural business attending the workshops organized by KPLC. The following lending mechanisms are identified:

(1) Umeme Pamoja

According to the regulation of KPLC, the connection fee is Ksh 35,000[3] for those who live within 600 meters[4] from the transformer installed at the grid end. Those who live further than said distance are charged higher tariff, i.e., Ksh 100,000 is charged for those 700 meters away and Ksh 1 million for those 1 km or more. Umeme Pamoja is the scheme to motivate more

[3] Connection fee is Ksh 32,480 and meter cost is Ksh 2,500.
[4] Households within 600 meters need not pay extra fee. Households beyond 600 meters will have to pay more for the additional cost for extra transformers or increased capacity of transformers.

subscribers through group financing to share a single connection fee. Umeme Pamoja is organized through collaboration between KPLC and the financial institutions, which increased the subscription contracts to 1.2 million households by the year of 2008 from 400,000 households in 2004.

(2) Stima[5] Loan

Similar to Umeme Pamoja, Stima Loan is also a lending mechanism provided through the partnership between KPLC and the financial institutions, for promoting connection to the grid and subscription of the energy services to individual households. While Umeme Pamoja aims to promote to a group of households, Stima Loan, which are funds obtained from financial institutions, lends the amount to individual households to cover their connection fees. The procedure to avail said loan is as follows:

- A bank offers stable condition to customer who requests connection to grid. The customer transfers equivalent money to KPLC's account as connection fee, if agreement is concluded with the bank.
- The customer who requests connection through the loan will be required to open a bank account and deposit a suitable amount for certain duration or, in some cases, offers their house or land as collateral. Payment to KPLC is done if conditions above are met and after the customer gets connection within 30 days.
- There is no specific law for the loan; however, a partnership agreement shall be exchanged between KPLC and the bank for purposes of fairly sharing risks and responsibility.
- KPLC and the banks appraise people in the rural area to determine their eligibility for the Stima Loan. They will then be motivated to connect to the grid. KPLC and the banks conduct marketing surveys to collect related information and advise the appropriate interest rates and repayment periods.
- People in rural areas who visit KPLC branch office are asked about the connection to grid and grid extension. Alternatively, KPLC also provide information to the people during workshops on business or agriculture.

2.1.6 Support by Power Utilities

The power utilities of Kenya are categorized into the following three types:

- Kenya Electricity Generating Company Ltd. (KenGen)
- Kenya Power & Lighting Company Limited (KPLC)
- Independent Power Producers (IPPs)

KenGen is the leading electric power generation company in Kenya, producing about 80 percent of electricity consumed in the country. The company utilizes various sources to generate electricity, such as hydro, geothermal, thermal and wind. In addition, KenGen intends to develop biomass energy in the future.

KPLC has the sole responsibility of transmitting electricity in Kenya. All the electricity

[5] Stima means Electricity in Swahili.

transmission and distribution facilities in Kenya are KPLC's properties. It is very instrumental in the feed-in tariff, which is the regulation for purchasing electricity generated by renewable energy sources that are connected to the grid at a fixed rate. This regulation helps in the exploitation of renewable resources in Kenya.

Independent Power Producers (IPPs) are private generation companies. They do not have any support measures to promote renewable energy.

2.1.7 Comparison with Support Facilities of Neighboring Countries

Regarding policies and institutions for promoting renewable energy, neighboring Uganda has established a clear policy to introduce and promote renewable energy. Therefore, it can be said that Uganda is a step ahead of Kenya in terms of related policies and institutions. However, looking at the performance of introducing renewable energy, Kenya is considered to be more ahead than its neighboring countries such as Uganda and Tanzania. This is based on the fact that the introduced capacity of PV system in Kenya is larger than that of the neighboring countries. Moreover, geothermal and wind power systems have already been realized in Kenya. This difference of performance seems to be caused by the larger endowment of renewable energy potential in Kenya. The progressing economic development in Kenya is motivating private sector activities for introducing the PV system.

2.1.8 Related Plans

There are rural electrification plans related to familiarization and promotion of renewable energy. Although MoE previously managed rural electrification in Kenya, REA established in 2007 actually manages rural electrification matters since 2009.

The following are plans on rural electrification.

- Rural Electrification Program
- Rural Electrification Authority Strategic Plan 2008-2012
- Rural Electrification Master Plan (REM)

The Rural Electrification Program was published in 1973. It sets government supports for rural electrification due to low economic efficiency and lack of progress in terms of business. Subsequently, Energy Act No.12 was published in 2006 to enhance the rural electrification project and hence, REA was established under the act. REA formulated the Rural Electrification Authority Strategic Plan to realize its mission.

About 100% electrified area coverage is targeted by 2012. By 2030, the current 10% household electrification is planned to be improved to 100%, which also include 100% electrification of public facilities like trading centers, schools, health facilities, public water supply systems and administrative offices.

Draft final report of the REM being prepared since 2007, was submitted in May 2009. It shows plans for ten years from 2009 to 2018, and detailed action plans for five years from 2009 to 2013. According to the action plan, the target by 2013 is to improve the rural electrification

ratio, including off-grid, to 22%.

In Kenya, it is now possible to extend grid and electrify rural villages because of the improved trunk transmission network. However, there are many households that could not connect to the grid even in grid-connected areas because of shortage of power caused by delays in power source development and expensive connection fees. For this reason, the necessity for off-grid electrification by PV systems or mini hydropower is still high.

Other than this, the Community Power Center (Energy Kiosk) program by UNIDO is a notable project in Kenya. This covers installation of off-grid power generation systems like PV, mini-hydro, biomass, and wind power in non-electrified villages, and verifies the possibility of energy supply by renewable energy. Furthermore, the project aims to improve living standards by developing local industries and providing charging services to mobile phones and lanterns. The program has already started demonstration projects at various sites in Kenya.

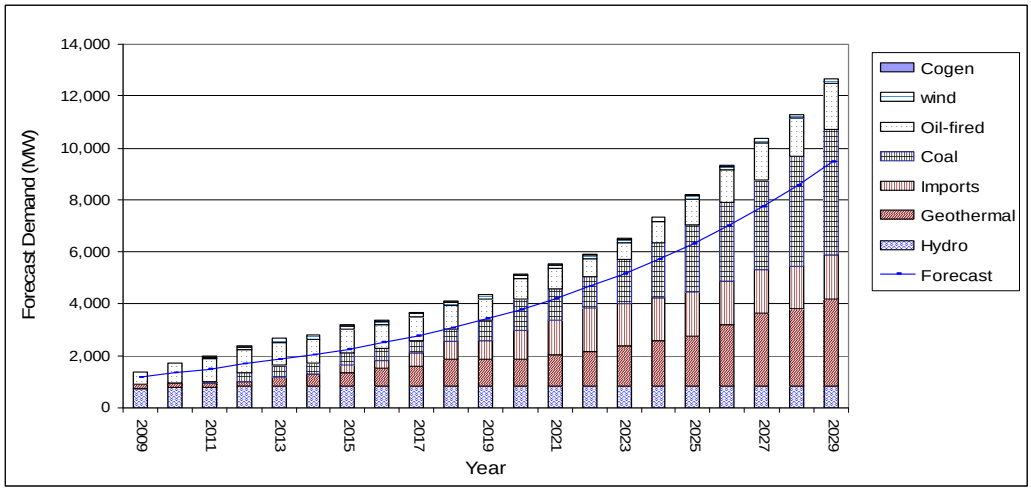
2.2 Present Situation of Renewable Energy Market

2.2.1 Overview of the Present Energy Market of Kenya

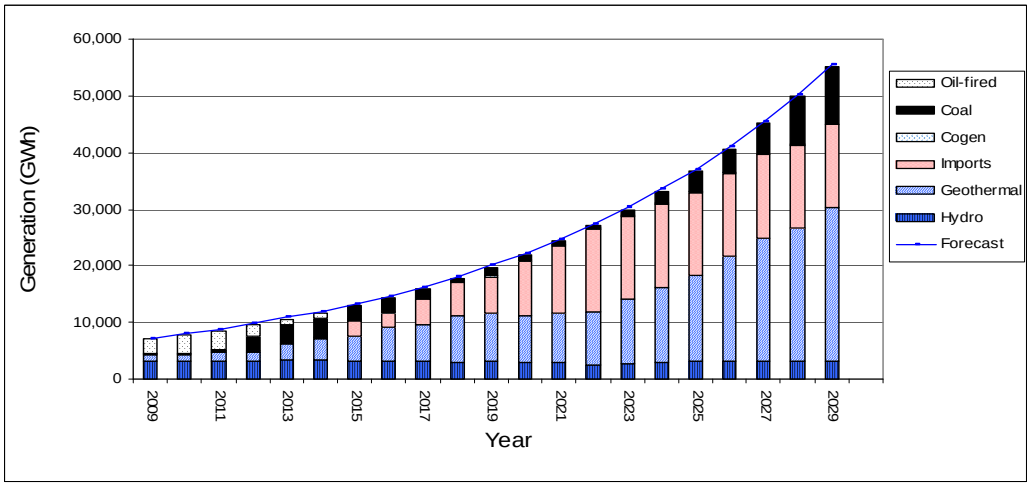
Based on the Least Cost Power Development Plan, Kenya (LCPDP)[6], an overview of the present power demand and supply is initially described below.

The “Kenya Vision 2030” projects an annual economic growth of more than 10%. To achieve this, the LCPDP estimates the power demand and required supply as shown in **Figure 2.2.1-1** and proposed the least power development plan from 2009 to 2029. The plan estimates the peak power demand at 1,188 MW and 9,480 MW in 2008/09 and 2028/29, respectively. The annual energy demand, on the other hand, is estimated at 7,032 GWh and 55,544 GWh in 2008/09 and 2028/29, respectively.

[6] UPDATE OF THE LEAST COST POWER DEVELOPMENT PLAN 2009- 2029, First Report, September 2008, Ministry of Energy and The Kenya Power & Lighting Company Limited



Power Demand and Supply Estimates



Energy Demand and Supply Estimates

Source: Update of the Least Cost Power Development Plan 2009-2029

Figure 2.2.1-1 Estimate of Demand and Supply of Power and Energy in Kenya

The power demand estimation is based on the growth of customers by about 200,000 annually in the next five years, targeted in the Energy Sector Recovery Project (ESRP) and the Rural Electrification Program. The present power generation capacity is 1,296 MW in the entire national grid system, consisting of 737 MW from hydropower plants, 128 MW from geothermal power plants, 0.4 MW from wind power plants, 279 MW from thermal plants, 150 MW from emergency diesel power plants and 2 MW from cogeneration plants. Capacity of independent power systems is 11.3 MW.

To meet the required power capacity of 12,597 MW, it is planned to construct additional power generation facilities and transmission lines of 11,968 MW in total, consisting of hydropower of 225 MW, geothermal of 3,373 MW, wind of 155 MW, thermal of 6,069 MW (coal of 4,370 MW, diesel of 799 MW and gas of 900 MW), cogeneration of 26 MW and imported power of 2,120 MW from Ethiopia.

2.2.2 Development Road Map of Renewable Energy Market up to Present

Based on the REM (Draft Final Report), March 2009, the development road map for renewable energy such as PV, small hydropower, wind power and bio-energy is described below.

(1) PV System

There are about 6.06 million households in the rural areas of Kenya as of 2007/08. Among these, there are 360,000 electrified households, equivalent to about 5% of the total households. Households electrified with PV are about 200,000, (3.3%), and is increasing at a rate of 20,000 per annum (p.a.). It means electrification in the rural areas is provided with PV system for 56% of electrified households. The facility consists of PV modules, car batteries, and so on.

PV is widely used in telecommunication, irrigation, pumping, small business and non-commercial facilities. The GoK has commenced electrification of educational and health facilities with PV in arid and semi-arid areas under the Rural Electrification Program since 2005/06. The electrification is completed for 15 schools and is continued for 92 schools. Furthermore, electrification will be provided for 100 health centers and 500 clinics through the 2007/08 and 2008/09 budget. In addition to these, MoE has a plan on the electrification of 150 public facilities with PV (360 kW) in 2004 to 2009. As the results of PV promotional campaign by GoK, and participation of Non-Governmental Organizations (NGOs), the private sector, and financial donors, the PV facilities in the rural areas is estimated to reach to 6 MW in total capacity, including the above 360 kW.

Separately the information from the GoK and NGO's, another estimate is made in accordance with data from a leading wholesale dealer, Davis & Shirtliff Limited (D&S). PV sold in Kenya was 1.2 MW in total in 2008 including PV of 240 kW sold by D&S. D&S estimates that sales of PV in Kenya will be 2 MW and 10 MW in total capacity in 2009 and 2013, respectively. This increase of PV sales corresponds to a 50% increase p.a. The dealer expects that PV installation will increase significantly.

As mentioned in Section 2.1.3, special provisions on import duty and VAT are applied to PV facilities.

(2) Hydropower

Out of the hydropower potential of 3,000 MW to 6,000 MW in Kenya, hydropower of 700 MW has been developed. Those with installed capacity of less than 10 MW are defined as small hydropower in Kenya. From the economic point of view, the GoK has developed large-scale hydropower to connect with the national grid rather than small hydropower. Some communities developed several small hydropower facilities by themselves. The United Nations Environment Programme (UNEP) and Global Environment Facility (GEF) commenced the "Small Hydro for Greening the Tea Industry in East Africa Project" in 2007 to assist hydropower development projects of 10 MW to 82 MW.

The JICA Study Team visited three small hydropower stations operated by communities. Power is generated at small hydropower stations of 1 kW and 2 kW (1 kW x 2 units) for energy kiosks

at Kibae and Cheptabaach which are supported by UNIDO, and 1.5 kW for mini-grid at Mdea. An additional small hydropower station of 2 kW is under construction through the Community Development Fund and own fund, aimed to expand the mini-grid at Mdea. The NGO Greenpower and communities in Kirinyaga district established a company to construct and operate power stations and distribute electricity to the community. They are constructing 11 small hydropower stations consisting of 100 kW stations at ten locations and 60 kW station at one location. Local newspapers reported that there are 39 small hydropower stations with 5 to 900 kW installed capacity in the foothills of the Mt. Kenya.

Tea factories have developed and are operating small hydropower stations. James Finlays, Ltd. at Kericho is operating hydropower stations of 175 to 1,340 kW, and planning to improve these stations to increase efficiency of power generation. Imenti tea factory in the Kenya Tea Development Agency Ltd. (KTDA) constructed a hydropower station of 0.7 MW installed capacity and commenced its operation in 2008. Four tea factories at Nieli are planning to construct a hydropower station of 2.8 MW installed capacity in 2009, with support from UNEP and GEF.

As mentioned above, there are many small hydropower stations constructed at various places in Kenya. However, the renewable energy section in the MoE does not grasp the status of existing small hydropower stations. Hence, the Energy Regulatory Commission (ERC) established in 2007 plans to identify the status of small hydropower stations by utilizing the system on reporting and application for license of hydropower stations.

(3) Wind Power

The wind power stations under operation in Kenya consists of one unit of 200 kW and 150 kW at Ngong Hills by KenGen and one unit of 200 kW at Marsabet by KPLC. D&S sold 25 sets of wind power units of 400 W to 5 kW for well pumps and telecommunication relay stations.

The JICA Study Team visited a wind power station constructed with the support of Pennsylvania University and Nairobi University at Western Kenya in 2007. The blades and turbine/generators for wind power of 2.5 kW were manufactured by a local technician at Nairobi. Although the tail of the turbine has been broken and not yet repaired, the JICA Study Team learned that power generation is provided for three to four hours, in the morning and evening.

A wind power station of 5.1 MW, consisting of 6 units of 850 kW in installed capacity, is under construction at Ngong Hills with the Belgian loan. According to the information at site, this wind power station started operation in August 2009. Another wind power station of 10 MW is also planned to be constructed with the Belgian loan. In addition, other wind power stations are planned by IPPs such as the 100 MW at Turkana/Marsabet, 50 MW at Kinangop, and another 100 MW at Ngong Hills.

(4) Bio-energy

a) Bio-fuel

Bio-ethanol has not yet been produced in Kenya. However, jatropha as material for biodiesel is cultivated on a large scale. It is grown in a 1,000 ha area in Kajiado District. There is a plan to extend said area to 26,000 ha in the future. It is likewise planned to construct a refinery to produce 7,000 liters of biodiesel per day. Two Japanese enterprises also intend to start a jatropha farm with 15,000 ha in initial stage and two million ha in the final stage.

Jomo Kenyatta University of Agriculture and Technology is researching on the possible extraction of biodiesel from croton seed and testing it for the operation of diesel power generator.

b) Biogas power generation

Biogas production system with dung was introduced to 1,000 households in the 1980s. About 30 to 50% of the existing systems are presently out of order. The reason is seemed to be lack of maintenance technology. Fixed dome type system is recently adopted.

Biogas is now produced from organic wastes from agricultural or agro-industrial processes and wastes from slaughterhouses. According to the REM, there is a 150 kW power generation plant that use biogas produced from waste of sisal and dung in Kilifi district, and 10 kW power generation plant with biogas from banana trunks in Muranga South district.

c) Bagasse cogeneration

There is a potential for bagasse cogeneration of 500,000 ton p.a. from seven sugar factories. Mumias sugar factory has generated 2 MW power since 2005 and has a project which involves selling of 26 MW power to KPLC, out of its total generated power of 35 MW in May 2009. This project was approved by GoJ in 2006[7] as a CDM project of Japan Carbon Finance, Ltd.

MoE estimates the potential of power generation of 193 MW from sugar factories. UNEP and GEF commenced a project called “Cogeneration for Africa” in 2006, which plans cogeneration of 60 MW power during the initial stage and 200 MW in the future.

d) Biogas power generation with other wastes

There are potentials for biogas production and power generation using wastes from flower and fruit farms, rice husks, coffee husks and similar agricultural residues, wastes from municipalities and hotels, water hyalines, dung in cattle farms, and so on. However, these have not been made to full use for biogas production.

2.2.3 Present Situation of Private Entities related to Renewable Energy

The present status of private power producers, power distributors, manufacturers, equipment dealers, battery charging business enterprises, engineering service providers and consultants are described below.

[7] The project is “35 MW Bagasse Based Cogeneration Project” by Mumias Sugar Company Limited (MSCL), which was registered in 3rd September 2008 and its host country is Kenya. Estimated amount of reductions of CO_2 is 129,591 metric tonnes and the project was applied by Japan Carbon Finance Limited. The project was approved by the Government of Japan as investor country. CER (Certified Emission Reductions) has not been issued. (Source: http://www.kyomecha.org/cdm.html)

(1) Power Producers

Power producers are divided into two kinds. The first are those who generate and sell power to the distributors who supply power to customers through the national power grid. The second are producers that generate power and sell power directly to customers. In Kenya the former type of producer that sells power to KPLC are KenGen and IPPs as the main shareholders. Although there are projects on power generation for mini-grids operated by communities, there are no power producers that sell power to customers through independent power grids.

KenGen is generating power of 1,006 MW in total, consisting of 737 MW from hydropower, 154 MW from thermal (diesel engine and gas turbine), 115 MW from geothermal, and 0.4 MW from wind power. IPPs are producing power of 145 MW in total, which includes Iberafrica of 56 MW (diesel engine), Tsavo of 74.0 MW (diesel engine), OrPower4 of 13.0 MW (geothermal), and Mumias of 2.0 MW (cogeneration).

The commercial power producers are now making use of renewable energy such as hydropower, geo-thermal and wind power for power generation, but not yet PV and biogas.

(2) Power Distributors

The only power distributor in Kenya is KPLC. It transmits power purchased at power stations from the producers to customers via high transmission lines and low voltage distribution lines, and collects electricity charges. There is no power distributor which especially supplies power produced with renewable energy sources.

(3) Manufacturers

The following are manufacturers involved in renewable energy:

- PV: Chloride Exide Kenya Limited produces PV batteries by modifying vehicle batteries in Kenya. Other products such as PV modules and inverters are imported.
- Hydropower: Most equipment for hydropower such as turbines, generators and electricity control system are imported. The NGO Greenpower manufactures parts of hydraulic turbines and fabricates turbines with imported generator of 100 kW in Nairobi.
- Wind power: Most equipment for wind power such as brads, generator and electricity control system are imported. There is a case where wind power equipment is manufactured by a local smith guided by Nairobi University. Actually, there are no manufacturers of wind power equipment.
- Bio-energy: There is no manufacturer of bio-energy equipment.

(4) Equipment Dealers

Main equipment handled by respective dealers involved in renewable energy is related to PV. There are many importers engaged in such business since most equipment for PV is imported. These include wholesale dealers, shops and installation contractors. Among them, Chloride Exide Kenya Limited and D&S deal with most PV equipment installed in Kenya. Supermarkets are also selling PV modules, PV batteries and accessories related to PV.

Dealers of PV equipment also sell wind power equipment for power source in communication

relay stations and solar pumps for water supply. Diesel engine generators necessary for biogas generation are available in electrical shops in cities.

(5) Battery-Charging Business Enterprises

There are many battery businesses in various places who offer charging services for mobile telephones, torches, lanterns, batteries for TV (with electricity supplied by KPLC), power generated by small hydro, wind and PV. Such businesses are in various forms such as a private enterprise, community group, shop or an enterprise which is small-scale.

(6) Engineering Service Providers

The engineering service providers offer continuous engineering services for designing, manufacturing, installation, operation and maintenance of a project. The NGO Greenpower may be categorized as an engineering service provider engaged in renewable energy, since it is supporting a community company in the construction and operation of small hydropower stations to provide power to local customers. UNIDO may likewise be considered as among the providers as it supports a Community Based Organization (CBO) engaged in business on PV and small hydropower. However, there are no private enterprises involved as engineering service providers.

Equipment dealers like D&S provide services such as design, installation, operation assistance, maintenance and repair of PV, to enterprises and private owners of PV. These dealers may be called engineering service providers.

(7) Consultants

There are no consultant companies specializing in renewable energy with PV, hydropower, wind power, biogas and biogas generation. However, there are many independent experts and consultant companies involved in PV engineering fields such as electrical, civil and mechanical. Renewable energy development projects are implemented by local experts and consultants themselves or in cooperation with foreign consultants.

2.2.4 Organizing Activities for Dissemination of Renewable Energy

The Kenya Renewable Energy Association (KEREA) is a private organization established with the aim to promote renewable energy in 2002. KEREA consists of 52 members, including equipment dealers, contractors, shop owners, trading companies, consultants, and universities concerned in renewable energy. KEREA implements the following activities:

- Training to technicians for installation, operation, maintenance and repair of PV
- Preparation of technical specifications of PV (in addition to Kenyan Standards) and future preparation of those for wind power and biogas)
- Publicity of PV such as “PV Day” and organizing PV exhibits
- Preparation and distribution of manuals of PV for dealers, contractors, users in English and future preparation of such manuals in Swahili version.
- Promotion of production of equipment for renewable energy
- Appeal to the Parliament regarding renewable energy issues

2.2.5 Business Financing of Private Entities and Users' Funding Source

Because there are no private enterprises manufacturing and selling equipment for hydropower and bio-energy, the funding source of private enterprises dealing with PV and wind power equipment is described below.

As for the supply side of PV and wind power, there are importers, wholesale dealers, shops, and installation and repair contractors. Meanwhile, users of PV are the public facilities, private houses and lodges / hotels, telecommunication companies utilizing PV and wind power at relay stations, and battery charging business shops.

There are no special financing systems for private entities on renewable energy. Private entities on both supply and user sides generally get financing from banks on a commercial basis. Private users can get loans from micro financing systems, Savings and Credit Cooperative Society (SACCO)[8], and others.

2.2.6 Samples of Existing Business Engaged in Renewable Energy

(a) PV Equipment Sales Business (Photo K-16 in Appendix 1)

An example of PV equipment sales business of D&S is described below.

D&S imports PV modules, batteries, inverters, charging controllers, solar pumps and other related accessories from Japan, Germany, USA, Denmark, China, India, Indonesia and other countries. It directly orders goods and receives them at its stores after agencies clear custom at Mombasa Port, and transport them to Nairobi. Its head office is in Nairobi while its branches are located in West Nairobi, Mombasa, Eldred, Kisumu and Nakuru. It sells PV equipment to shops, NGOs, and contractors at wholesale prices and also install and maintain/repair PV equipment directly through its permanent and temporary staff. For the promotion of PV equipment sales, it conducts training to technicians regarding installation and maintenance/repair.

D&S has subsidiary companies in Uganda, Tanzania, Zambia, Rwanda and Ethiopia, and widely does business in East African countries. It makes an effort to promote renewable energy, acting as the vice-president of KEREA. The JICA Study Team learned that D&S has no special problems regarding funds since it has its own source and can avail of loans from commercial banks for payment of imported goods and as working funds.

(b) Battery Charging Business with PV (Photo K-1 and K-12 in Appendix 1)

Battery charging business for mobile telephones is being done with PV in off-grid areas. Battery charging fee is generally Ksh 20 per time in Kenya. In case frequency of charging is 10 to 20 times per day, the monthly income reaches Ksh 6,000 to 12,000, which is equivalent to 1.3 to 2.5 times of minimum wage (Ksh 4,792) in rural areas in Kenya. The battery business is sufficiently profitable because the initial investment required is only around Ksh 40,000 for a simple system without battery, consisting of a PV module of 50 Wp, cable and socket.

[8] SACCO is organized by the each member, who contributes the fund as the resources for mutual finance among the members.

The UNIDO-supported energy kiosk at Kibae in the foot hills of Mt. Kenya does business related to battery charging for mobile telephones and rechargeable Light Emitting Diode (LED) lanterns, computer and internet services, photocopy, and TV and video theaters.

An example is given below to demonstrate profitability of the battery charging business although it is does not utilize renewable energy.

A battery charging shop at Homa Bay in Western Kenya charges mobile telephones, torches and TV batteries at Ksh 15, 20 and 30 per time, respectively. The shop earns Ksh 6,000 per month and pays Ksh 500 monthly for electricity fee. It has two battery chargers costing Ksh 16,000 (local made) and Ksh 30,000 (imported). Initial investment of this shop only covers the battery chargers. The shop pays room rental charge, electricity fee and personnel expenses. A battery charging business is also observed in Baringo District which also gains profit similar to that in Homa Bay.

(c) Battery Charging Business with Small Hydropower (Photo K-5 in Appendix 1)

Battery charging business with small hydropower is made by the community at Boito near Kericho in Western Kenya. UNIDO donated two sets of turbine and generator, while the community did the construction works. The community intends to start business on internet service and charging of rechargeable lanterns. They want to expand the generation capacity and construct a mini-grid.

(d) Mini-Grid Business with Small Hydropower (Photo K-3 in Appendix 1)

There are many small hydropower stations and mini-grids constructed by communities in the foothills of Mt. Kenya. The hydropower capacity ranges from 1 kW to 100 kW. A power station is supplying 1.5 kW power to 120 households with mini-grid in Mdea for two hours each morning and evening, which is located 2 to 3 km away from the national grid. The average electricity consumption is 12.5 W per household. Monthly electricity charges are Ksh 50 and Ksh 80 for households with one light and socket, and households with two lights and one socket, respectively.

(e) Electricity Cost-Reduction Business with Small Hydropower in Tea Factories (Photo K-19 in Appendix 1)

Tea factories develop and operate small hydropower stations. The tea factory of James Finlays Ltd. at Kericho operates five power stations of 175 kW to 1,340 kW in capacity and plans to increase generation efficiency by improving its power stations. It estimates the improvement cost at Ksh 6.1 million.

Tea factories of KTDA consume 0.7 MW per factory in average. The Imenti tea factory constructed and operates a hydropower station of 0.7 MW installed capacity, to reduce cost of purchasing electricity since 2008. Four tea factories in Nyeri District plan to construct a hydropower station of 2.8 MW installed capacity. The construction costs of the hydropower stations are US$ 1.9 million and US$ 7.8 million for the Imenti and four tea factories, respectively.

(f) Battery Charging Business with Wind Power (Photo K-7 in Appendix 1)

The Kochia development group at Homa Bay in Western Kenya is doing battery charging business for mobile telephones with wind power. The wind power facility was constructed by the Nairobi University and Pennsylvania University in U.S. in 2007, and operated the Kochia development group. It is not operated as planned because of the unusable tail of the wind turbine. UNIDO is intending to support the required repairs.

(g) Biogas Supply and Biogas Power Generation Business (Photo K-2 and K-8 in Appendix 1)

A CBO at Kamahuha in Muranga South district is operating a community power center with assistance from UNIDO. As shown in the photo, the CBO had a plan to produce biogas from banana trunks and utilize said gas for power generation and as cooking gas. However, since distribution lines were constructed in the area of the CBO before the completion of the biogas production facilities, the CBO plans to provide its main gas supply for cooking purposes to a high school dormitory 200 meters from the community power center. The CBO has success in its business of charging mobile telephones and rechargeable lanterns, computer training classes, package collecting, and shipping of bananas and milk to sell to brokers.

A biogas production facility at Homa Bay in Western Kenya ,which intends to use wastes from a slaughterhouse, is under construction and will be completed by around July 2009. The produced gas will be used for frying and drying fishes in the fish process plant near the biogas production facility.

(h) Manufacturing and Fabrication Business of Turbine and Generator (Photo K-4 in Appendix 1)

NGO Greenpower is assisting a project of a community-based company to construct and operate small hydropower stations of 100 kW installed capacity in Kirinyaga district in the foothills of Mt. Kenya. As shown in the photo, Greenpower is manufacturing Kaplan type turbines and assembling them with imported generators for the plant discharging 1.2 m^3/sec with head of 11 to 22 meters in Nairobi. Greenpower said they manufacture a unit every 3.5 months. The cost of small hydropower generation units in this project is reduced since manufacturing and assembling of units were made in Nairobi.

(i) Reducing Electricity Cost in Tourist Lodges (Photo K-6 in Appendix 1)

Tourist lodges and camps far from the national grid are using PV and solar water heaters. They advertise that their facilities are eco-lodges which do not use diesel engine generators. The Malewa wildlife lodge of 142 km^2 at Gilgil near Nakuru has PV facilities of 150 W, 1,280 W and 800 W for electric fences, lighting in lodges, and refrigerators in kitchen, respectively.

2.3 Present Situation of Financial Market related to Renewable Energy

2.3.1 Overview of Present Development Financial Market

There are two cases of development for financial markets. One is through governmental financial institutions. The other is by donors contracting with financial institutions for loan

schemes both for business entities and individuals. Donors contract with concerned ministries, financial institutions and private companies, under governmental guarantee endorsed by the Ministry of Finance (MoF). JICA financed a maintenance project for the Kenyan Port Authority. Kreditanstalt fur Wiederaufbau (KfW) provided financial support to KenGen for the rehabilitation scheme of a hydropower station. These are soft loans for the long-term, with guarantee by the GoK, and financed directly to the government corporations.

2.3.2 Present Financial Scheme and Past Performance

As referred in Section 2.3.1, long-term finance is not available in Kenya. Hence, soft loans and grants provided by donors are indispensable financial schemes for the social development projects. Under the Ministry of Agriculture, AFC is one of the government financial institutions, which is a non-bank entity. The JICA Study Team identified that AFC seems to be the appropriate financial institution for the grants or two-step loan from the Japanese government assistance.

AFC has its own fund sources, government budget, and donors' funds to promote agricultural development through financial assistance schemes. AFC applies an interest rate of 10% p.a. for financing the development.

AFC is the active organization to promote the agriculture sector with donors' assistance, as follows;

- Grants program by the Japanese government
  - ✓ Year: 2005
  - ✓ Program: Non-Project Grants
  - ✓ Project cost: US$ 10 million
  - ✓ Financial scheme
    - ・Loan term: 12 months
    - ・Objective: To promote and assist cultivation of agriculture crops
    - ・Interest rate: 10% p.a.
    - ・Repayment: One time after the annual crop
    - ・The amount repaid by the borrowers is utilized as a revolving fund to develop agriculture business.
- Soft loans by Deutsche Gesellschaft fur Technische Zusammenarbeit (German Society for Technical Co-operation) (GTZ)[9]
  - ✓ Year: 2008
  - ✓ Program: Soft loan
  - ✓ Project cost: Ksh 1 million
  - ✓ Financial scheme
  - ✓ Objective: To promote and assist agriculture business in the manufacture and sales of improved cooking stoves developing the local new businesses
  - ✓ Schemes: Capacity building and loan for the new business

[9] See Section 2.3.5 "Incentive and Penalty of Financial Scheme for Renewable Energy Promotion".

・Manufacturers

・Retailers

As discussed above, AFC is promoting improved cooking stoves as a new industry in the rural communities with the assistance of GTZ. The JICA Study Team identified AFC as one of the potential candidates to serve as counterpart in Kenya for both program of grants and two-step-loan for the promotion of LED (Light Emitting Diode) lantern business intended to develop rural communities and renewable energy.

2.3.3 Status of Lending and Issues on Renewable Energy

(1) Status of Lending

Renewable energy projects developed in Kenya so far include geothermal, hydro, wind, biomass and PV power generation.

In the area of geothermal energy development:

- In addition to KenGen, which is generating power in Olkaria, getting loans from Japan (Yen loans) and World Bank, there is an IPP by Ormat Technologies from Israel. This IPP, Olkaria III, with a total capacity of 48 MW, was developed using Ormat's own funds. However, US$ 105 million, out of the total US$ 150 million, was refinanced by a group of European development financial institutions (including Deutsche Investitions- und Entwicklungsgesellschaft mbH or DEG and German Investment and Development Company), FMO Nederlandse Financierings - Maatschappij voor Ontwikkelingslanden N.V. (Netherlands Development Finance Company) and KfW) in March 2009;
- By now, the framework for geothermal utilization has been modified to the one where the government has risk of geothermal steam supply. Moreover, since firms, not limited to KenGen, can engage in the power generation aspect, it is expected that private business opportunities will expand eventually.

In the area of wind power development,

- African Development Bank (AfDB) arranged a total EUR 300 million finance for 300 MW power generation project by IPP (JV of Netherlands and a local company), including the Lake Turkana Project in May 2009. There are also projects proposed to be developed in other areas.

In the area of hydropower development,

- There is potential for large-scale hydro resources. The Sondu Miriu Project has been developed by KenGen under a Yen loan;
- KTDA and foreign-owned tea factories are promoting medium-scale hydro power development as the electricity supplied by KPLC is expensive. In the case of KTDA, financing has been procured from Cooperative Bank without any problems. The main conditions of the loan are as follows:
  - ✓ Amount: US$ 2 million

- ✓ Interest rate: LIBOR + 2%
- ✓ Term to maturity: 8 years

- Micro and pico hydro projects have been developed for communities together with mini-grid. However, main facilities financed mostly through grants make the actual cost for residents relatively affordable such as US$ 70 for initial domestic line installation and lighting equipment, and a monthly payment of US$ 1. Private financing has not been extensively adopted. If a mechanism can be established whereby the repayment period can be longer, with lower interest rate level, and reasonable monthly installment amount, micro and pico hydro resources seem to have more potential for utilization.

As for PV generation,

- The system promoted so far is the Solar Home System (SHS). Its cost is rather high as shown in the table below, and its utilization has not expanded rapidly.

Table 2.3.3-1 Price Range of Solar Home Systems

Capacity (Wp)	Price Range		No. of bulbs	Source
	(Ksh)	(US$)		
5	6,000	85	2	SMEP
12	9,500	135	2	SMEP
20	24,000	340	2	KWFT
30	25,000 / 28,000	355 / 400	3 / 5	SMEP / KWFT
40	34,000	485	4	KWFT

Source: Interviews by JICA Study Team members

- There are no financial institutions offering specific programs for SHS purchases, and thus, financing scheme for such purpose should be prepared accordingly.
- LED lanterns are getting attention for pre-electrification, the stage before grid connection, although there are no clear policies related to the product. In the Energy Kiosk projects promoted by UNIDO on an experimental basis, a LED lantern with 3 W capacity made in India is sold for US$ 25. Financial institutions offering a loan program are awaited.

(2) Issues

Financial institutions can be divided into the following categories. It is noted that many are not responding to the expansion of renewable energy utilization.

1) Government-owned commercial banks (IDC Capital, Kenya Development Bank, Kenya Commercial Bank)
2) Foreign-owned banks (Barclays Bank, HSBC, Stanbic Bank)
3) Private commercial banks[10] (Diamond Trust Bank, Fina Bank, Equity Bank, K-Rep Bank)
4) SACCOs and microfinance institutions

The banks in the second category lend to corporate with collaterals. However, there are no large scale projects like IPPs on a project finance basis. As for the banks in the third category, Equity

[10] The original business was to provide rural households with microfinance.

Bank[11] and K-Rep Bank started originally from small scale lending, while Diamond Trust Bank and Fina Bank are trying to enter into small scale markets, calling the strategy as downstreaming. Microfinancing businesses including SACCOs are lending in the framework where a borrower forms a group and the members guarantee the borrower on a joint and several basis. However, their lending is intended for income-generating businesses in order to secure funds for debt services (repayment and interest payment).

Issues are as follows when the roles of financial intermediaries to private businesses are considered:

- Short repayment period
- High interest rate
- Requirement of collateral

Some institutions are getting the following assistance from donors to improve the benefits of their customers:

- Long term loans as funds for on-lending; and
- Low cost loans and guarantee facility for reducing interest cost to customers while reducing risk to the recipient financial institutions.

In connection with the issue on collaterals, financial institutions have programs where they exempt collaterals by way of group lending, and monitoring and guidance through regular meetings with group members. In such instances, there are examples of IFCs and other international organizations providing guarantee facility to cover the risk of lending.

A credit reference bureau is being established after the Banking Act was amended to exempt the obligations of confidentiality so that credit information of customers can be shared among them. After this system becomes effective, borrowing based on individual's credit is expected to increase.

A credit scoring system is also being developed, by which potential customers are evaluated by 5Cs, i.e., character (past transaction record), capacity (cash flow), capital (assets), condition (SWOT analysis on internal and external situation), and collateral. Decision-making on credits can be facilitated through the results of such analysis. This system is based on the correlation analysis of lending data of member banks in the three countries in East African Community, with assistance from IFC and EU. The introduction of this system is being considered by some banks in Kenya, and can be a good trigger for moving out of collateral-based lending.

The framework for IPPs is in place and feed-in tariff system has been introduced in Kenya. The tool of project finance may be more practically used for projects such as power generation of medium- and small-scale, with revenue and agreements as security, from the era of lending to projects owned by a borrowing entity (like a tea company, corporate finance).

[11] Building Society was the original organization: Poor family those who were not able to afford bank accounts, organized society to provide its members with mutual financial assistance to build houses.

2.3.4 Possibility of Micro-credit in Rural Areas

In microfinance operations, groups of 5 to 20 persons guaranteeing jointly and severally, are formed and risks are spread out when individual borrowers do not have credit capacity. The number of members of such groups is changed based on income level. Moreover, each member is interviewed to minimize risks. K-Rep Bank seems to have accumulated significant know-how in this area.

As for SACCOs, many are doing business in rural areas. They have governance issues and bad credits according to a consultant engaged by IFC as advisor to a medium-class commercial bank in Kenya. Furthermore, they may have challenges before dealing with the operation of credit analysis and decision-making.

The same consultant explained the following about commercial banks:

- At bigger banks, high level management is capable but middle management level is not. Capable staff are subject to enticement by competitors;
- Ordinary staffs have issues on capacity and integrity in all the categories of banks, and hence, it is not possible to completely prevent them from colluding with senior and junior colleagues in the branch offices, and/or with customers through stricter control system.

Based on the situation of commercial banks above, much may not be expected in the area of governance at SACCOs.

As referred to in Section 2.1.5, there is a loan scheme by commercial banks for promoting the energy program among the households in Kenya. This is a type of micro-credit provided by commercial banks. In cooperation with KPLC, the Equity Bank and K-Rep Bank promote STIMA Loan[12], which aims to offer micro-credit to those who cannot afford to pay the full amount of fee for grid connection to the main grid. The commercial banks start the microfinance for the rural communities as the new scheme of banking business to promote the conventional power energy. The business model of the microfinance executed by the banks is the same as the one promoted by the risk management of Micro Finance Institutions (MFIs), i.e., group-basis joint responsibilities co-signed by the members of the group for risk alleviation.

Regarding renewable energy schemes, whereas commercial banks still hesitate to provide loans because of its risk, MFIs are identified to grant microfinance for households who purchase solar PV systems. The Kenya Woman's Financial Trust (KWFT)[13], which consists of only females over eighteen years old, is planning the microfinance for SHS. Small and Micro Enterprise (SMEP) provides microfinance of 100% of the price of SHS, i.e. no downpayment is required, with an interest rate of 20% through repayment terms of six months. Both MFIs have lending schemes without any subsidy, i.e.,100% commercial basis.

Through the activities of financial assistance for the rural communities, Gramin Bank in Bangladesh created the origin of microfinance, which is replicated in Kenya. Microfinance is

[12] 2.1.5. Lending Mechanism (2)
[13] Non governmental organization founded by Ford Foundation

promoted only with the identification of the well balanced status of guarantee and credit between borrowers and lenders. It is the financial scheme adopted by MFIs to make non-bank loans available to those without sufficient credit for regular bank loans for small investments. In order to further promote microfinance, MFIs conduct some risk management methods such as conducting frequent and regular interviews with group members and rendering advices. For instance, it promotes increase of more group members with less income for the risk alleviation. Micro-credit is available to the members of some group with credible joint responsibilities co-signed by the other members. The members of the group guarantee to repay on behalf of the borrower, who cannot repay the loan and interest. The borrower does not offer any collateral to MFIs, but offer the collateral to the co-signing group member. If the borrower does not repay, the co-signing member will repay by selling the collateral. In microfinance, the mutual checking system by a female is reported to promote repayment more effectively than the one by a male in the group.

The purpose of small-scale finance is usually for small new flotation and existing business fund. However, it is noted that KWFT lends woman's group fund to purchase SHS. Women will benefit the most with the purchase of SHS since they will feel safe for their children who can use the lamp for night study and they will be relieved from gathering firewood with their children. PV module of SHS will be kept as collateral which makes the situation on lending easier because the risk from the bank side will be reduced. Recently, small-scale finance related to renewable energy for general consumers has started. This is the new step to be taken as a measure for future trend. Usually, SHS itself hardly contributes in increasing the house income. However, it can be considered to contribute in gaining the fund source for repayment due to the increasing price of kerosene, and the consumption of kerosene and dry battery will be reduced.

2.3.5 Incentive and Penalty of Financial Scheme for Renewable Energy Promotion

Financial scheme provided by private financial institutions for the promotion of the renewable energy is identified only for small-scale finance[14] by MFIs to promote the purchase of SHS. Since renewable energy, except hydro power, is a new technology and costs high, financial institutions hesitate to loan for the purpose. This is because the demand for renewable energy is limited. It is also difficult in general for investors to borrow money for renewable energy, which requires long-term loans. However, the government allows private financial institutions to provide short-term loans and prohibits long-term loans with high risks. The government is concerned with the bankruptcy of said institutions, which may not return the fund of the account holders due to default.

The Energy Act regulates the promotion of renewable energy, which refers to energy conservation as well. However, the contents of such act are not substantial enough to facilitate the practical implementation on a commercial basis, by the concerned sectors for renewable energy. This is partly because of the insufficient authority of REA. To realize private investments for renewable energy, REA should be authorized to have legislative power for regulating and implementing the lending mechanism. Such recommendation should be advised

[14] Refer to Section 2.3.4 Possibility of Micro-credit in Rural Area

to the GoK.

At present, it seems that the assistance by donors is one of the practical and effective solutions for the government in order to proceed. In this respect, GTZ has a unique funding mechanism to assist and develop the agriculture business[15] in cooperation with the private bank, i.e. Equity Bank. The fund is named as Risk Guarantee Fund[16], which may benefit small investments from GTZ[17] and promote more lending to investors from the commercial bank. When the terms of repayment from investors are due, the Risk Guarantee Fund is available for the working capital, which provides further lending from Equity Bank to investors. Risk Guarantee Fund is expected to facilitate Equity Bank in financing and promoting energy projects. GTZ loans to AFC under the Ministry of Agriculture. It consists of a two-step-loan offered to households in the rural areas, industries and entrepreneurs, with a low interest rate of 10% p.a.

2.3.6 Usable Policy Finance Institutions for Renewable Energy

In Kenya, there are no policy finance institutions for the promotion of renewable energy utilization. This may be due to the fact that the GoK did not have a pre-electrification strategy while focusing on grid extension to improve the electrification rate.

Individual financial institutions are granting loans for purchases of SHS for commercial and household use, by utilizing their own funds. Some donors such as AFD and IFC provide assistance to Equity Bank and K-Rep Bank, operating also in the market of ordinary households. However, they do not support renewable energy, but mainly provide assistance to other concerns such as young and female entrepreneurs.

There are banks which are owned by GoK, such as IDC Capital, Kenya Development Bank, and Kenya Commercial Bank. However, their main activities are commercial banking. If the GoK becomes more involved in off-grid electrification with facilities and equipment such as PV panels and LED lamps, there will be an option to provide yen loans as funds for on-lending or two-step loans from these government-owned banks (in case grant is not possible).

The fourth largest bank, Co-operative Bank, may also have roles in some assistance provided by Japan. This is considering the fact that they lent to a hydropower project by KTDA, and many rural financial institutions, including SACCOs, are its members even after they listed their shares at the end of 2008. Because of the latter, Co-operative Bank seems well-positioned in terms of operations for lending to small- and medium-scale generation projects for communities and rural consumers.

[15] Both governments of Germany and Kenya agree for the agriculture project. Germany, EU and Holland pooled the government fund to implement the project. GTZ is the local organization in Kenya to coordinate with the Kenyan government, i.e. the Ministry of Agriculture.

[16] GTZ agreed with the commercial bank to pay 50% for the bad debt transaction, which may lower the risk so that the lower interest rate is applied to the investors, i.e, 18% to 12%

[17] Whereas the bad debt ratio by the government financial institutions is 20%, the bad debt ratio with this project is reported as only 5%.

2.4 Existing and Potential Business Opportunities in Renewable Energy Field

2.4.1 Needs of Renewable Energy

Taking into consideration the present situation of private enterprises related to renewable energy, business needs in each field is described below based on the REM, March 2009.

(1) Needs in Each Field in the REM

REP set numerical values shown in **Table 2.4.1-1** to achieve the rural electrification target of 20% and 40% in 2010 and 2020, respectively. Households electrified by REP and non-REP are estimated at 1,848,000 and 546,000, respectively.

Table 2.4.1-1 Rural Electrification Master Plan in Kenya (2008-2020)

(Unit: Numbers of Households)

	Actual (REP)			Target (REM)			Increase
Fiscal Year (July-June)	2005/2006	2006/2007	2007/2008	2008/2013	2013/2018	2018/2020	2008-2020
Households electrified by REP/REM	110,724	133,047	161,354	812,446	1,667,446	2,009,446	1,848,000
Annual HH Increase	8,931	22,323	28,307	651,092	855,000	342,000	
Households electrified other than REP/REM (*)	249,665	300,000	363,828	464,347	538,305	909,736	546,000
Annual HH Increase		50,335	63,828	100,519	73,958	371,431	
Total Households electrified	360,389	433,047	525,182	1,276,793	2,205,751	2,919,182	2,394,000
Households in Rural Area	5,881,773	5,970,000	6,059,550	6,527,856	7,032,355	7,244,908	1,185,000
Rural Electrification (%)	6%	7%	9%	20%	31%	40%	

Note:
(*) Local community, informal grid connection and informal electrification
REM: Rural Electrification Programme / REM: Rural Electrification Master Plan / HH: Households
Source: Executive Presentation of the 5 year Master Plan(2009-2013) 31st March, 2009

The REM up to 2012 plans to electrify 18 district headquarters, 5,200 trading centers, 3,300 public schools and 1,500 health centers. As shown in **Table 2.4.1-2**. nos. of connection for the period of 2008 to 2013 is planned at 648,000 in total and power supply capacity of 318 MW and energy rate of 830 GWh/year will be necessary for this electrification.

Table 2.4.1-2 Rural Electrification Master Plan in Kenya (2008-2013)

Item	Off Grid	On Grid	Total
No. of Connections	97,329	551,000	648,329
Peak Demand (MW)	16	302	318
Electricity Use (GWh)	39	793	832

Source: Rural Electrification Master Plan, Draft Final Report, Vol. 1 Main Report Table ES-2

The REM estimated the peak power demand of off-grid at 41 MW in 2013 and planned to supply the required power with the following generating facilities by 2013:

- Diesel engine generators: 74 locations, 20 to 500 kW/location and 32.3 MW in total
- Wind power: 16 locations, 20 to 200 kW/location and 7.1 MW in total
- PV: 22 locations, 10 to 100 kW/location and 2.0 MW in total

Wind power at the west coast of Lake Turkana is applicable to one of the hybrid power generation facilities. Large-scale wind power of 200 kW will supply power to several areas. PV can also be used as among the hybrid power generation facilities with diesel engine generators. For example in the northeastern Kenyan area, it can supply power to independent grid or

mini-grid. Hybrid generation system consisting of wind power, PV and diesel engine generators will be applied to the areas of northwestern, north and northeastern Kenya.

The potential of small hydropower is high. However, areas to be electrified are far from the hydropower sites and distribution lines have been constructed in the areas where small hydropower can be developed. Therefore, small hydropower is not counted as a power source for rural electrification. The REM reports that there is a possibility to develop small hydropower in the foothills of Mt. Kenya to supply power to the national grid or independent grid. A detailed study is therefore necessary for this development.

(2) Sales Business for Wind Power Facilities

D&S in Nairobi sells wind power facility of 400 W to 1 kW in capacity. As the facility of 20 to 200 kW planned to be used for the rural electrification is much bigger than those sold in general shops, designers and contractors with a special knowledge on wind power are required.

There is a possibility that wind power for pumps will be widely used. It is necessary for enterprises to make efforts to develop and advertise wind power system.

(3) Sales Business for PV Facilities

The REM intends to install PV facilities of 2.0 MW in the coming five years. It is estimated that the demand of PV will increase with rural electrification by the GoK through private and NGO's support. Sales business for PV facilities is expected to increase significantly.

(4) Hydropower

There are 260 potential sites for the development of small hydropower. The total hydropower potential is estimated as 600 MW. It needs detailed study and collection of information in order to actually develop hydropower at the sites.

Average development cost of hydropower is generally US$ 3,000 per kW in installed capacity. The project cost for hydropower development of one to 10 MW in installed capacity is US$ 3 million to 30 million. If funding for these costs is available, hydropower development becomes a promising business as it is not affected by the price of fuel oil.

UNEP and GEF commenced the "Small Hydro for Greening the Tea Industry in East Africa Project" to assist tea factories in developing hydropower of 0.2 to 5 MW in installed capacity in East African countries in 2007 for four years. With this Project, it is expected that tea factories will be encouraged to construct hydropower stations.

(5) Bio-energy

The promising bio-energy businesses are cogeneration and ethanol production in sugar factories, and biogas production from wastes of slaughterhouses.

a) Cogeneration and ethanol production in sugar factories

The feed-in-tariff policy of MoE, March 2008, mentions the potential of cogeneration of about 200 MW in total, at six sugar factories in Western Kenya.

UNEP and GEF commenced "Cogeneration for Africa" to assist sugar factories in developing said cogeneration in East African countries in 2007 for six years. It will facilitate funding for construction of cogeneration with financial assistance by the Project.
As the cogeneration project of Mumias Sugar Company Limited is approved as a CDM project, there is a high possibility that other similar projects will also be approved.

The Mumias Sugar Company Limited produces 265,000 tons of sugar per year, corresponding to 60% of production of Kenya at present. It has a plan to increase production capacity to 300,000 tons/year in 2012 and start ethanol production of 65 m^3 per day from molasses. The expansion of ethanol production is also expected to be promising.

b) Biogas production from wastes of slaughterhouses

Kenya Industrial Research and Development Institute (KIRDI) and UNIDO are assisting in the construction of biogas production facility from wastes from slaughterhouses at Homa Bay, Siaya and Bungoma. As the waste water from slaughterhouses causes environmental issues, the utilization of wastes for production of biogas (as alternative for firewood) will be appreciated from the view point of forest conservation. The design and operation technology of biogas production facilities under construction can be applied to other 65 slaughterhouses existing in Kenya. The standardization of the design and operation technology will make cost lower than at present. Private enterprises obtaining know-how on design and operation can develop their business for biogas energy development.

The biogas facility construction and gas supply business from banana trunks supported by UNIDO may be a promising business for private enterprises.

(6) Battery Charging Business with PV for Mobile Telephones and Rechargeable LED Lanterns

The battery charging business in non-electrified rural areas is promising as mentioned in Section 2.2.6. It is said that 80% of adults in Kenya are using mobile telephones. In these non-electrified areas, demand of charging mobile telephones is considerable, and thus, small charging business is popular at present. People in the areas go to towns where electricity is available from the national grid to charge their mobile phones, paying transportation cost and spending time. As described in Section 2.2.6, the charging business with PV only needs a small initial investment but often earns profit easily.

The World Bank and IFC are promoting the use of rechargeable LED lanterns through the "Lighting Africa" project. UNIDO in Kenya is supplying lanterns shown in Photo K-18 in Appendix 1 to an energy kiosk for promotion of rechargeable LED lanterns. Various kinds of rechargeable LED lanterns made in China, India and Australia shown in the photo are sold in Kenya.

People in non-electrified areas, who live with candles and kerosene lamps, expressed strong interest in availing the rechargeable LED lanterns. The Study Team believe that in a short time, the lanterns may be widely used in Kenya, too. Similar to the battery charging business for mobile phones, it is considered that the charging business for LED lanterns will be popular in

near future.

The battery charging business is promising, with power sources connected with the national grid in electrified areas and PV in non-electrified areas. In case of the PV business, with only PV modules and connection cables, business time is limited to daytime in which power generation can be made with PV but business can be stated simply. The business will become full time by adding batteries and charge controller.

(7) Energy Saving Business at Tourist Lodges with PV

There are lots of tourist lodges and camps located far from the national grid in Kenya. Because energy saving by reducing fuel for diesel engine generators and advertisement of eco-lodge is effective, it is expected that PV will be advantageous to the tourist lodges and camps in the near future.

2.4.2 Sector-wise Business Opportunities in Renewable Energy Field

Possibilities of business related to renewable energy are described below for each field of private power producers, power distributors, manufacturers, equipment dealers, battery charging business enterprises, engineering service providers and consultants.

(1) Power Producers

As mentioned in Section 2.2.1, development of renewable energy of 225 MW hydropower, 3,373 MW geothermal, 155 MW wind and 26 MW cogeneration, is planned to be implemented within 20 years from now. It is necessary to positively develop many small-scale power projects in addition to developing large-scale power projects to achieve the development target.

GoK enacted the feed-in-tariffs system to encourage private enterprises in joining the business related to hydropower, wind power and biomass power generation shown in **Table 2.4.2-1**. This feed-in-tariffs system may make private business on operation of hydropower, wind power and biomass power generation profitable.

Table 2.4.2-1 Feed-In-Tariffs Policy in Kenya

	Power	Effective Capacity	Power Tariff (US¢/kWh)	Maximum Capacity (MW)		Period from Start (years)
				Individual	Country	
1	Wind		9.0	50	150	15
2	Biomass	Firm	7.0	40	150	15
		Non-firm	4.5	40	50	15
3	Small hydro	Firm				
		< 1 MW	12.0	0.5 - 10	100	15
		1 - 5 MW	10.0	0.5 - 10	100	15
		5 - 10 MW	8.0	0.5 - 10	100	15
		Non-firm				
		< 1 MW	10.0	0.5 - 10	50	15
		1 - 5 MW	8.0	0.5 - 10	50	15
		5 - 10 MW	6.0	0.5 - 10	50	15

Source: Feed-in -Tariffs Policy on Wind, Biomass and Small-hydro Resource Generated Electricity, March 2008, MoE

(2) Power Distributors

It is considered that the power distribution business is expanding with the increase in rural electrification and power demand. There is a possibility of establishing power distributors in

independent grids utilizing PV, hydropower and wind power as power source in off-grid areas. However, it seems difficult for the business to succeed due to existing unresolved issues such as funding power sources and tariff collection from electricity customers.

(3) Manufacturers

For manufacturers, potential business ventures related to renewable energy are described below.

- PV: It is difficult to manufacture PV modules in Kenya since high quality of electricity and advance technical knowledge are essential. Business manufacturing PV batteries may be promising as they are manufactured in Kenya already. It also may be possible for manufacturing enterprises to produce equipment related to PV such as invertors and controllers in licensed factory or with technical guidance.
- Hydropower: Turbines such as 100 kW class can be manufactured in Kenya as already done in Nairobi. There is a possibility that turbine manufacturing business will succeed if small hydropower is developed continuously every year.
- Wind power: Manufacture of small wind power facilities is already initiated in Kenya. This may become a promising business if there is demand for wind power.
- Bio-energy: It is possible for private enterprises to develop business related to biogas production from wastes in slaughterhouses by gaining know-how on design, construction and operation from the project under construction. The business will be supported from viewpoints of environment protection.

(4) Equipment Dealers

Equipment dealers on renewable energy, especially PV, are considering to expand in non-electrified areas. From the viewpoints of preventing global warming and demand of electrification for households in Kenya, importers, wholesalers, sales shops, contractors, repair shops and others concerned in PV have a chance in expanding their business now.

(5) Battery Charging Business

Because the electrification target rate in 2010 is still as low as 20%, battery charging business may expand by utilizing power from KPLC, small hydro, wind power and PV for charging mobile telephones in non-electrified areas. In addition, charging business for rechargeable lanterns will become more popular depending on the lanterns widely used. Private small and medium-sized enterprises may easily venture in the recharging business.

(6) Engineering Service Providers

There is a high possibility for engineering service providers to offer overall services from planning to maintenance of PV system to tourist lodges. Engineering service may become a business targeting many existing tourist facilities in Kenya. This promotes the shift of power sources to renewable energy to save fuel cost, prevention of global warming and promotion of ecotourism.

In addition to the above, equipment dealers may expand their business services from planning to maintenance of PV owned by general users.

(7) Consultants

It is expected that consultants will expand their business related with renewable energy as professional services on planning, design, construction and maintenance of related facilities will be required more than before.

2.5 Human Resources for Renewable Energy Promotion

2.5.1 Human Resources of Renewable Energy in Business Sector

(1) PV Equipment Sales Business

Wholesalers and sales shops carry out design, sale, installation, repair and other services for PV system. They are expected to design PV system and select modules, charge controllers, batteries, invertors, etc., to meet the purpose and requirements of users. They install PV equipment including wiring and provide guidance on how to operate and maintain the equipment, if necessary.

According to the JICA Study Team of the "Preparatory Survey for Renewable Energy Promotion Program in Africa - Public Facility Electrification -", the survey on actual use of PV reveals that sales shops and electrical technicians in Kenya do not sufficiently understand the electrical aspects of PV and proper use of battery. For example, the PV module and battery is directly connected without a charge controller. This implies that the charge controller was out of order, and therefore, PV module and battery were directly connected. In this case, uncontrolled electricity shortens the battery life.

There is lack of shop staff and electrical technicians who have sufficient knowledge from design to operation and repair of PV system. Moreover, activities for renewable energy including PV by KEREA, which can train shop staff and technicians, are limited due to insufficient funds. This is an issue on capacity building of human resources for promoting PV.

(2) Small Hydropower

The REM prepared a database for renewable energy, including small hydropower utilizing Geographic Information System (GIS). Human resource to study small hydropower sites in detail is very limited in the renewable energy section of MoE and the REA. It is essential to train experts for hydropower in order to promote small hydropower development.

Since it was foreign engineers who have been engaged in implementing hydropower projects in Kenya, local human resource in private enterprises remain insufficient in carrying out such projects.

(3) Wind Power and Bio-energy

As there are few businesses in wind power and bio-energy, human resource with specialized techniques on such fields are very limited.

2.5.2 Human Resources of Renewable Energy in Financial Sector

The area where Kenyan banks are providing loans appear to be limited to medium-sized projects, if renewable energy projects are categorized as large, medium and small. In the case of

mini hydro, there is a case where Co-operative Bank became the sole lender for KTDA's own generation project. On the other hand, there are large and small-scale projects as shown below where Kenyan banks cannot participate, and human resources are not being trained.

- Large scale geothermal and wind power generation, mainly financed by donor funding (soft loans).
- Small scale projects including those for community use, mainly funded by grant since private finance is expensive and corresponding project economics is not justified.

Even in the medium scale project area, there are not so many projects participated by domestic banks. Hence, human resources are not sufficient in terms of quality and quantity.

Equity Bank has been lending to individuals. Meanwhile, medium to smaller banks like Diamond Trust Bank and FINA Bank have started lending to small scale manufacturing companies. According to Central Bank of Kenya (CBK), these banks have capacity on conducting risk analysis. (However, it was also mentioned at a meeting with CBK that these banks' customers do not have sufficient capacity in preparing business plans. Thus, it signifies that there are some challenges on the customer side to make their business viable.)

Despite the positive comment from CBK, the areas where some donors provide financial institutions with assistance include the following: It is noted that these are just limited to banking fundamentals (prior to specifics related to renewable energy project lending), and necessity does seem to exist for assistance on human capacity development.

- Training on loan processing, loan portfolio management, loan agreements;
- Introduction of credit scoring system that can facilitate credit evaluation that is not dependent solely on collaterals
- Providing PCs to customers so that customers can easily manage cash flow, etc.

2.5.3 Human Resources for Renewable Energy in Public and Academic Sectors

(1) Public and Academic Sector

Human resources for renewable energy are very limited in the public sector currently. In the academic sector meanwhile, quantity and quality of human resource is also low although several universities are dealing in renewable energy as part of their research fields.

In particular, Jomo Kenyatta University of Agriculture and Technology (JKUAT) is doing research on renewable energy. It has around ten researchers on PV, wind power, geothermal and bio fuel. The stage of research is still in the early phase and JKUAT intends to receive technical assistance, and financial assistance from donors. University of Nairobi is doing research works on wind power and cooperated building of wind power station in Homa Bay, however the scope of research is small. The websites of University of Nairobi and Egerton University states that they are doing research on biogas.

(2) Research Fields

The energy division of KIRDI is doing research on PV, wind power, geothermal, bio energy,

energy conservation and CDM, and it has experts for each field. They reported that they need human capacity development for researchers and for transferring new technology. They intend to initiate significant technical developments on PV, biofuel, biogass and mini-hydro in the near future.

2.5.4 Present Situation of Capacity Building and Educational Campaign

A lot of educational campaigns on renewable energy have been done in various levels, especially for PV system. However, this has been only small-scale. There is no systematic and extensive capacity-building program and educational campaign implemented by the GoK.

Wholesalers or suppliers of PV system hold workshops to train technicians individually through private sector initiative. KEREA made and published manual on PV systems for suppliers, technicians and users, and holds workshops on PV system. KEREA does educational campaigns and display PV system advertisements during farmers festival held every year at local cities.

Activities by donors and NGO are the following:

- Photovoltaic Market Transformation Initiative (PVMTI) by IFC executed educational campaign and formulation activity for marketing of PV.
- “Lighting Africa” by IFC after PVMTI is doing an educational campaign on LED lamp instead of kerosene lamp.
- GTZ is doing an educational campaign on biogas stove.
- The Embassy of Finland, Embassy of France and other embassies are supporting educational campaigns on renewable energy.
- Solarnet, a local NGO, does educational activities on renewable energy through quarterly issues of informative magazines and holds an event entitled “Solar Day”.
- Solar Aid, a charity organization of U.K., does educational campaigns on PV through installation of PV system at schools and selling of said system in the market.

2.6 Other Donors’ Activities and Funds for Renewable Energy in Business Sector

2.6.1 Other Donors' Policies, Activities, and Performance

Other donors who provide assistance in renewable energy area are as follows. However, their activities are rather limited. This is deemed mainly because the GoK did not actively submit requests for assistance for renewable energy development.

- United Nations Industrial Development Organization (UNIDO)
- United Nations Environment Programme (UNEP)
- United Nations Development Programme (UNDP)
- German Government through GTZ and KfW
- Australian Government
- Swedish Government though Swedish International Development Agency (SIDA)
- U.S. Government
- Italian Government
- The World Bank

Each donor's clear policy on assistance could not be confirmed, but the scale of their budget and ranking of potentials among renewable energy sources are thought to be the bases of their decision-making on the fields of assistance.

Main activities of major international organizations are as follows:

(1) UNIDO

- Demonstration projects of Energy Kiosk at seven to eight sites are developed, attracting donors' interest. Currently, feasibility studies for 75 sites are being conducted and project documents are being prepared. Total amount is around EUR 6 million.
- Basic concept of Energy Kiosk is to provide power from micro hydro and PV to the three areas, namely, 1) production activities, 2) social area (Vaccine refrigeration and mobile charging), and 3) leisure use, like TV. UNIDO also introduced rechargeable LED lamps (US$ 30 to 50/unit, made in China)
- Co-operative organizations in the villages are the primary entity for the demonstration projects. Energy service providers (ESP) tasked to recharge and deliver to individual homes do not exist yet.
- Primary concepts of the Energy Kiosk are as follows:
  - ✓ To establish as a business model without depending on grant funding
  - ✓ To target the areas where grid-based electrification will not be made in 20 to 30 years time, and to target a lower cost of power supply compared to diesel generation, where cost is a comparable parameter
  - ✓ To create revolving facility for funds and promote its acceptable circulation using repaid funds from generated income for developing other sites.

(2) IFC

- In the past two years, IFC engaged consultants in assisting the following banks in the region:
  - ✓ Diamond Trust Bank: Kenya, Uganda Tanzania
  - ✓ Fina Bank: Kenya Uganda, Rwanda
  - ✓ Bank of Africa: Kenya, Uganda Tanzania, Burundi
- IFC has been providing capacity-building assistance to local banks in the following areas:
  - ✓ Introduction of management information system (MIS)
  - ✓ Introduction of credit scoring system, including evaluation of capability and experience of top management of the customers
  - ✓ Introduction of new products such as factoring and invoice discounting

(3) East African Development Bank (EADB)

- Provided two-step loans to Micro Africa Ltd.
- Established the Business Partners International Fund to SMEs with IFC, CDC, EIB and TransCentury (a Kenyan private company) in 2005. The fund provides not only equity and loans but technical assistance in such areas as financial management. General Partner is a South Africa-based Business Partners, which also created a similar fund in Madagascar.

(4) AFD

- A program by AFD with K-Rep Bank is for four years between 2008 and 2011, It cost Ksh 20 million for training and Ksh 20 million for funding of on-lending, at an interest rate lower than 10%. Loans of up to three years can be offered during the 4-year program period.
- The training courses include loan processing, loan portfolio management, and loan agreements. AFD's assistance includes providing borrowers with PCs and software as these are required for cash flow management.

(5) Department for International Development (DFID)

- DFID provided assistance towards the establishment of Financial Sector Deepening Trust, which supports financial sector reform.
- Providing assistance to Equity Bank in the areas of computer system and management, as well as ideas on aspects such as weather insurance and grain warehouse warrants.

(6) FMO

- FMO provides credit to Bank of Africa and GroFin East Africa (based in South Africa). GroFin provides loans in the range of US$ 50 thousand to US$ 1 million based on cash flows, instead of collaterals. CDC is providing assistance in US$ and Ksh currency loans to GroFin and other institutions such as AfDB, Norfund, and Shell Foundation. (www.grofin.com)

2.6.2 Existing Funds and Performance

Since 2006 until 2011, the World Bank and IFC provide funds as grants to implement the project of Lighting Africa. Together with nine other donors, they contributed US$ 12 million as trust fund which is planned for identification of the potential private organizations, marketing and establishment of the new industry through capacity building. The main objective of Lighting Africa is to create the demand for LED lanterns and establish its market in Kenya, Uganda, Ghana, Tanzania and Sudan. As the first phase of the undertaking is to initiate pilot projects in Ghana and Kenya, further activities such as manufacturing and retailing of LED lantern require more funds[18].

Consumer awareness of the value and function of LED lantern is considered an important measure to achieve substantial sales. Otherwise, even the rural population who purchase mobile phones will be reluctant to use the LED lantern instead of the kerosene lamps. The logic mentioned above is introduced as lessons learned from the experience with PVMTI, which was implemented by IFC for the dissemination of SHS.

For the promotion of the project on LED lantern, the JICA Study Team pays attention to the following:

- The comments from IFC: The price of SHS, US$ 500 to 600/system, was not affordable for majority of the consumers in the rural area.

[18] The program manager of IFC comments on the necessity of the fund from JICA for Lighting Africa.

- Successful project will be followed by large-scale sales business such as mobile phones.
- LED lantern is supposed to be promoted with large-scale business like mobile phones, subject to the price involved.
- UNIDO initiated the marketing of LED lantern with the project Energy Kiosk to prove the prospects for LED lanterns

Chapter 3 UGANDA: PRESENT SITUATION OF RENEWABLE ENERGY SECTOR

3.1 Institutional Support and Related Plans for Renewable Energy Promotion

3.1.1 National Policy of Renewable Energy

Uganda is one of the very few countries in Sub-Saharan Africa, which has come out with an elaborate national policy and strategy for renewable energy development, as well as created the necessary infrastructure needed for its implementation. On April 2nd, 2007, the Ministry of Energy and Mineral Development (MEMD) published a Renewable Energy Policy, which was approved by the Cabinet on March 29th, 2007. This document sets out targets for power generation, rural and urban-poor electrification access, modern energy services, biofuel, wastes to energy, and energy efficiency.

The overall government policy vision for the role of renewable energy in the national energy economy is to make modern renewable energy a substantial part of the national energy consumption. The overall renewable energy policy goal aims to increase the use of modern renewable energy from the current 4% to 61% of the total energy consumption by the year 2017.

The need for an appropriate energy policy is also recognized by the Constitution of the Republic of Uganda (1995) which states: “The State shall promote and implement energy policies that will ensure that people’s basic needs and those of environmental preservation are met”. The Energy Policy was announced in September 2002.

3.1.2 Outline of Institutional Support for Renewable Energy Promotion

The overall responsibility for renewable energy promotion lies with MEMD. It has the mechanisms to oversee and coordinate the implementation of the renewable energy policy of various stakeholders. For this, the following activities have been done.

1) A renewable energy section is created in MEMD to specifically focus on the promotion of renewable energy and related technologies.

2) In MEMD, an Energy Efficiency and Conservation Department is also established.

3) MEMD has also constituted a National Energy Committee to provide strategic policy guidance to the energy sector.

4) MEMD works with the municipal authorities and industries that generate lots of waste, which are included in the policy as renewable energy sources.

The major institutional supports for renewable energy promotion are as follows:

- Removal of duties and value-added tax (VAT) on solar energy equipment
- Development of feed-in tariffs
- Subsidy for renewable energy promotion
- Financial support for renewable energy promotion

3.1.3 Preferential Taxation System

VAT on solar PV system, including battery and equipments, is zero rated since 2006. The renewable energy systems other than solar PV are taxable. Customs tax on solar PV system is zero rated as well. Customs is regulated by the taxation scheme with East African Community (EAC)[19].

As part of the Rural Electrification Strategy and Plan (RESP), preferential taxation system is applied to the investment on renewable energy projects for rural electrification. The government policy for the electrical energy service is open equally to every nation. In addition to the zero rated VAT and customs tax for solar PV system, depreciation is allowed with the accelerated calculation method[20].

3.1.4 Subsidy System

As the renewable energy system is required for rural electrification, the GoU (Government of Uganda) established the subsidy scheme as follows:

- Grid connected power plant
- Stand-alone mini grid power plant to be connected to the national grid
- Grid extension without power plant
- Stand-alone small-scale power systems, i.e. PV system, small-scale diesel power plants and small hydro power)

The subsidy scheme for rural electrification is applicable only outside the main grid of Kampala, Entebbe and Jinja.

The IREMP[21], authorized in January 2009, regulates the subsidy amount. The Energy for Rural Transformation (ERT)[22] executed by the World Bank appointed Private Sector Foundation in Uganda (PSFU) as the implementing organization for the subsidy scheme. PSFU is semi-public organization, which consists of private companies which negotiate with the GoU for the policy in promoting the private business. The following are the members of PSFU:

- Private companies: Barclays Bank, Standard Chartered Bank, Simba Telcom, Simba Group of Companies
- Associations: Association of Farmers, Uganda Association of Bankers, Uganda Association of Manufactures and etc.

PSFU is operating the following subsidy scheme in ERT:

- Subsidy for the installation of the power plants operated by industries
  - ✓ Kakira sugar factory
    - ・System: Bagasse co-generation system to be connected to the grid

[19] East African Customs Common External Tariff
[20] Vide Section 27 of Income Tax Act Chapter 340 of the Laws of Uganda
[21] Indicative Rural Electrification Master Plan - January 2009
[22] Section 3.6.1. Other-Donors' Policies, Activities and Performance

・Capacity: 19 MW (7 MW for own use, 12 MW for power sale)
・Scheme: IPP by feed-in tariff to sell surplus energy
・PPA: Contracted with Uganda Electricity Transmission Co. Ltd.(UETCL)
・Finance: US$ 8.6 million (Loan from BoU), US $3.3 million (Subsidy from REA)
・Tariff: up to 6 MW - US¢ 4.9/kWh, over 6 MW - US¢ 6.15/kWh

- ✓ West Nile Rural Electrical Company (WENRECO)
  ・System: Mini hydro to replace diesel power plant to reduce the cost of fuel
  ・Finance: US$ 3.735 (Loan from BoU)
  ・Status: Project is suspended because of the delayed construction of the dam
  ・Scheme: Build Own Operate (BOO)

- Subsidy for installation of solar PV systems
  - ✓ Subsidy: up to 500 W at a unit price of US$ 3/W
  - ✓ System: Solar PV systems for public facilities (schools, clinics and water pump)
  - ✓ Number of the projects: 800
- Subsidy for end-users to purchase SHS
  - ✓ System: Solar PV systems
  - ✓ Subsidy: up to 50 W at a unit price of US$ 5/W
  - ✓ Finance: own fund - 20% of purchasing price, Loan from MFIs - 50% of the remaining
- Subsidy for working capital of suppliers and dealers to promote installation of solar PV systems
  - ✓ Performance-based subsidy: Subsidy is by the number of installed capacity
  - ✓ Subsidy: up to 30 W at a unit price of US$ 2.5/W and 30 W to 50 W at a unit price of US$ 1.5/W
  - ✓ System: Solar PV systems for public facilities (schools, clinics and water pump)
  - ✓ Number of the projects: 800
- Grants for market development
  - ✓ Grants: Business plan for bank loan - free of charge
  - ✓ Subsidy: Expenses for business promotion and capacity building is to be 50% subsidized

3.1.5 Lending Mechanism

In Uganda, long-term loans are not available as expected on commercial basis. The following are the typical hindrances:

- Interest rate is high: 18 to 36% per annum (p.a.)
- Terms of repayment: Maximum 4 to 5 years

As the technology and products of renewable energy systems are yet to be sufficiently disseminated in the market, related financial services are not easily available on commercial basis. Observing the status in Uganda, the World Bank decided to introduce a soft loan by IDA, together with the grants by GEF, for execution of ERT, which promotes the renewable energy projects for rural electrification in Uganda. ERT provides a reasonable financial mechanism to

supply funds with private sectors investing in small-scale hydro power plants and biomass power plants. These designed projects, which cost US$5 million and over, shall be financed by AfDB and EADB under the development financial scheme. ERT organizes the financial scheme with small-scale renewable energy systems for suppliers and dealers of solar PV systems and end-users for the purchase of SHS.

Global Trust Bank offers loans to suppliers and dealers of solar PV systems, with low interest rates and longer repayment terms. For the loan to end-users of SHS, PostBank[23] organizes reasonable financial services together with its branch offices and business affiliates, i.e. SACCOs and MFIs all over the rural areas in Uganda. Microfinance Support Center Limited (MFSC)[24] is recently appointed as the financial service provider for end-users like PostBank, financing the fund to purchase SHS. The corresponding financial schemes are as follows;

- Finance of working capital for suppliers and dealers
  - ✓ Terms of repayment: 12 months
  - ✓ Interest rate: 15% p.a.
  - ✓ Cash flow: IDA - BoU - Global Trust Bank - Suppliers and Dealers
- Loan to end-users to purchase SHS
  - ✓ Terms of repayment: 3 years
  - ✓ Interest rate: 20 to 30% p.a.
  - ✓ Cash flow: IDA - BoU - PostBank/MFSC - SACCOs & MFIs - End users

3.1.6 Support by Power Utilities

The organizations related to the power supply business are as follows:

- The Electricity Regulatory Authority (ERA), which sets the tariffs and issues licenses for studies, generation and distribution, according to the Electricity Act 1999.
- The Rural Electrification Agency (REA), which is the secretariat of the Rural Electrification Board (REB) that manages the Rural Electrification Fund (REF).
- The REF provides subsidies to support rural electrification projects.
- The Uganda Electricity Transmission Company (UETCL) is the system operator and owns the transmission mains of above 33 kV on behalf of GoU.
- The Uganda Electricity Distribution Company (UEDCL) is the owner of the electricity distribution network, which is being managed by UMEME Limited.
- The Uganda Electricity Generation Company (UEGCL) is the owner of the Kiira and Nalubaale Power Stations at Owen Falls.

It is noted that UETCL, UEDCL, and UEGCL are power utilities in Uganda. These power utilities are not in a position to directly assist in the renewable energy promotion activities. However, the transmission grid which is currently 100% owned as a public sector facility is

[23] PostBank was originally established as a comprehensive government corporation for post and communications, including financial services, and operating 26 branches in the rural areas.
[24] MFSC is 100% subsidiary of the Ministry of Finance, which provides funds with SACCOs and MFIs to operate viable businesses.

supplementing the grid-connected renewable energy generations. It supports receiving power from the power producers of renewable energy at feed-in tariffs which are attractive to renewable energy producers.

3.1.7 Comparison with Support Facilities of Neighboring Countries

When compared to the neighboring countries, in terms of policies and establishments implementing the policies as well as chalking out a clear strategy and plan of implementation, Uganda stands out as number one in the region. In Kenya, where the total production of energy, industrialization, etc far exceeds that of Uganda, a separate renewable energy policy is yet to be proclaimed. However, Kenya has much more vivid success stories on rural electrification based on solar PV. This success resulted mainly from private sector activities. The higher economic level of Kenya seems to encourage the private sector and the drive promotion of solar PV.

3.1.8 Related Plans

There are rural electrification plans related to familiarization and promotion of renewable energy. Electricity Act is published in 1999 and it states that promotion of electrification in non-electrified area by grid or off-grid is the role of GoU. The following are plans related to rural electrification.

- Rural Electrification Strategy and Plan (RESP)
- Rural Electrification Fund (REF)
- Energy for Rural Transformation (ERT)
- Indicative Rural Electrification Master Plan (IREMP)

The RESP, prepared in 2001, is a framework plan based on Electricity Act 1999. This is intended for big policy targets such as correcting imbalance between the urban and the rural communities, increasing opportunity of income generation and effective utilization of existing renewable energy resources in rural areas. Additionally, RESP shows that the target electrification ratio in 2010[25] is 10% in rural area. RESP also shows that the GoU provides necessary subsidy to rural electrification project from REF.

The REF, established in 2001, is a financial support mechanism for promoting rural electrification project to improve rural electrification ratio. Fund sources of REF are a levy of 5% on transmission bulk purchases of electricity from generation stations, money appropriated by parliament and funds from donors. The REA was established in 2003 to manage related projects using REF.

The ERT is a rural electrification program by the World Bank. The program aims to promote rural electrification and development of information and communication technology sector. It is implemented under corroboration with REA to achieve 10% target rural electrification ratio of RESP in the electrification sector. The program implements and supports various projects related to energy development and utilization, such as power source development, grid extension and off-grid electrification including public facility electrification.

[25] The target year is changed to 2012 from 2012 according to subsidy policy published later.

A report shows 2,120 PV systems, with 1.22 MWp capacity in total, were installed in ERT Phase I (ERT 1) and completed on February 28th, 2009[26]. Dissemination of PV is still a big theme and the installation plan of PV system to schools, health and water supply facilities has been prepared in ERT Phase II (ERT 2). About 2,054 PV systems with 1.50 MWp capacity will be installed in ERT 2.

The IREMP completed in 2009 is prepared as the ERT. In IREMP, electrification ratio in household basis is considered as 10% in the national level. However it is noted that this is only equivalent to 3% in the rural area in Uganda. IREMP shows specific drafts of rural electrification projects to minimize project cost considering factors like extension plan of transmission line, population and geological conditions, and prompt investments to the projects.

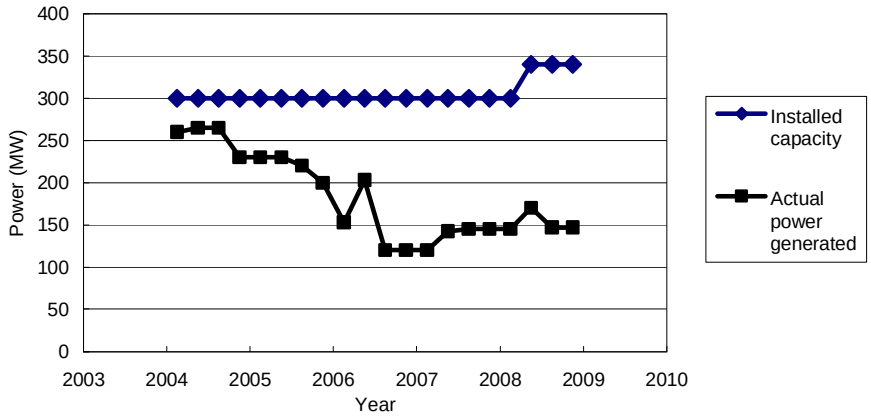
3.2 Present Situation of Renewable Energy Market

3.2.1 Overview of the Present Energy Market of Uganda

At first power demand and supply status in Uganda is briefed below.

In Uganda, 90% of the energy source is biomass consisting mainly of firewood. Most of the electric power is supplied by the Owen Falls power station with 340 MW in total installed capacity. It is located at the most upstream place of the Nile River, which consists of Nalubaale and Kiira power stations with capacities of 180 MW and 160 MW, respectively. In addition, there are cogenerations of 12 MW and small hydropower of 16 MW in installed capacity as electricity power sources.

Because water level of Lake Victoria became low and power generation was 142 MW against the demand of 360 MW since 2005, power rationing was implemented in Uganda. **Figure 3.2.1-1** shows the installed capacity and actual power generation of Owen Falls power station. As this power shortage may continue until the completion of Bujagali Power Station in 2011, diesel engine generators of 150 MW are provided to meet the power demands.



Prepared by JICA Study Team based on data provided by UMEME

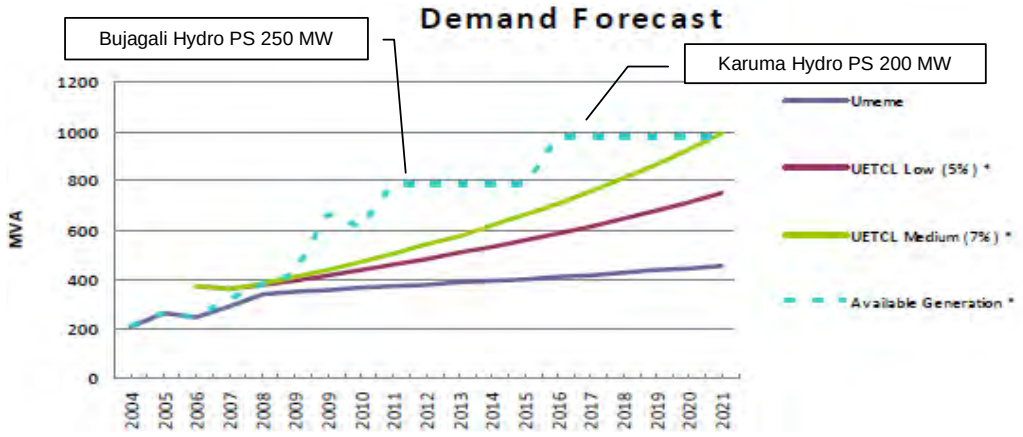
Figure 3.2.1-1 Installed Capacity and Actual Power Generation of Owen Falls Power Station

[26] Project Appraisal Document No. 47183-UG, the World Bank, May 2009

The IREMP estimates the balance of power demand and supply as shown in **Figure 3.2.1-2**, in which UMEME estimates a power demand growth of 0.7% p.a. UETLC meanwhile estimates lower and middle power demand growth of 5% and 7%, respectively. UMEME estimates a peak power demand of 418 MW, while that of UETLC is 758 MW (5% growth) and 1,000 MW (7% growth) in 2021. Reserve ratio of power supply capacity of 1,000 MW in 2021 corresponds to 20% of the power demand of 758 MW estimated by UETLC.

The total installed capacity of power stations in the Nile River will be 830 MW when the Bujagali power station of 250 MW and Karma power station of 200 MW are completed in 2011 and 2016, respectively. The installed capacity including other power generation plans will reach 1,000 MW and meet the power demand of 758 MW estimated with annual power demand growth of 7%.

In case the scheduled construction of the Karma power station is delayed while the power demand growth is at 7% p.a., other power generation facilities should be provided as input. Power demand estimation and development plan was under review at the time of this study and finalized in the sector investment plan in July 2009.



Source: Indicative Rural Electrification Master Plan Report, MEMD, January 2009

Figure 3.2.1-2 Power Demand Supply Estimate in Uganda

The electrification rates as of 2002 and 2007 in the IREMP are shown in **Table 3.2.1-1**. The electrification rates in 2007 are 33% in urban areas and 3% in rural areas. The rates are increased by 10% and 2% in urban and rural areas, respectively, for 5 years. It shows that the electrification policy contributed to the effects.

Table 3.2.1-1 Electrification Rates in 2002 and 2007 in Uganda

Census in 2002

	Urban Areas	Rural Areas	Total
Population	3,000,000	21,700,000	24,700,000
Households	1,100,000	4,045,833	5,145,833
Electrified Households	250,000	50,000	300,000
Electrification Rate (%)	23%	1%	6%

Estimation in 2007

	Urban Areas	Rural Areas	Total
Population	3,511,719	25,401,433	28,913,152
Households	1,287,630	4,735,943	6,023,573
Electrified Households	420,000	165,000	585,000
Electrification Rate (%)	33%	3%	10%

Source: Indicative Rural Electrification Master Plan Report, MEMD, January 2009

According to the appraisal report on ERT 2 by World Bank entitled Project Appraisal Document No. 47183-UG, ERT 1 electrified 1,600 and 200 households by the West Nile and Kisiizi electrification projects, respectively, for nine years from 2001 to 2009. Through PV, ERT 1 also electrified households and public facilities with 186 kWp and 1.22 MWp, respectively.

Utilization of renewable energy such as PV, small hydropower, biomass power generation, and biogas production actually commenced in the 2000s and is still in the initial stage. The development of renewable energy is described in the following section.

3.2.2 Development Road Map of Renewable Energy Market up to Present

Based on the Renewable Energy Investment Plan (REIP) for Uganda, March 2009, the development road map of renewable energy such as PV, small hydropower, wind power, bio-energy and geothermal power are described below.

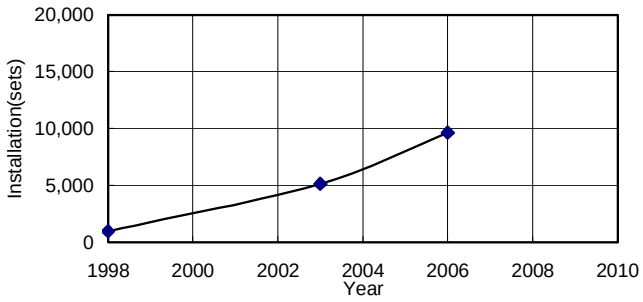
(1) PV (Photovoltaic)

The average solar insolation in Uganda is about 5.1 kWh/m^2 and PV potential is estimated at 230 MW. The REIP estimates annual new installation of PV with 200 kWp for private houses, enterprises and commercial use.

According to the Annual Rural Electrification Report[27], ERT 1 installed 3,500 sets of PV with 370 kWp in two years from 2004 to 2006, at a cost of US$ 650,000 as shown in **Figure 3.2.2-1**.

Prepared by the JICA Study Team

Period	PV (Set)
Before 1998 (Estimate)	1,000
1998-2003	
- By UPPPRE (*)	3,150
- Other than UPPPRE (estimate)	1,000
2004-2006	
- By BUDS-ERT (**)	3,500
- Other than BUDS-ERT (Estimate)	1,000
Total	9,650



Note:
(*) UPPPRE: UNDP-funded Uganda Photovoltaic Pilot Project for Rural Electrification
(**) BUDS-ERT: Business Uganda Development Scheme-Energy for Rural Transformation
Prepared by JICA Study Team

Figure 3.2.2-1 PV installed by ERT

The PV sold and installed by private enterprises in Kampala and Mbale, interviewed by the Study Team are shown in **Table 3.2.2-1**.

[27] Annual Rural Electrification Report, REA, July 2005 to June 2006

Table 3.2.2-1 PV Installed by Private Enterprises

No.	Unit	Year	Company			Survey
			A	B	C	D
A.	(set)	2004	602			
		2005	804			
		2006	819			
		2007	1,187			3,500
		2008	1,808	500	4,000	
B.	(kW)	2008	90	25	200	

A: Solar Power Agencies Ltd., Mbale
B: Incafex Solar System Ltd., Kampala
C: AB Matro Uganda Ltd., Kampala
D: Survey of the Ugandan Solar PV Indusytry, 2007 (not included A and C)

Prepared by JICA Study Team

Solar Power Agencies (U) Ltd. which sells and installs PV facilities in Mbale has increased its sales significantly since 2007. According to Incafex Solar System Ltd. in Kampala, annual growth rate of sales of PV is about 50% since 2000, with PV facilities of 50 Wp being sold out. AB Matro Uganda Ltd. in Kampala reported the same situation.

There were 14 shops in the Ugandan Solar PV Industry[28] which were surveyed. It was reported that 3,500 PV sets were annually sold and sales of PV facilities for 600,000 households are still expected in the years ahead.

(2) Hydropower

Hydropower potential in Uganda is estimated at about 2,600 MW for large hydropower in the Nile River, and about 200 MW for small hydropower in other rivers.

1) Large hydropower development

The hydropower potential and sites in the Nile River are shown in **Table 3.2.2-2**. Up to now, 340 MW has been developed while 250 MW will be developed by Bujagali hydropower station, which is under construction and planned to be completed in 2011.

Table 3.2.2-2 Hydropower Potential and Status of Development in the River Nile

No.	Power Station	Location	Installed (MW)	Potential (MW)	Note/Status
1	Nalubale	Jinja	180	180	(Owen Falls PS) Under operation
2	Kiira	Jinja	160	200	(Owen Falls Addit. PS) Under operation
3	Bujagali	Jinja	250	320	Under construction, completion in 2011
4	Kalagala	Jinja		350	Completed Feasibility Study
5	Karuma	Masindi/Apac		200	Norpak Power withdrew in 2008
6	Ayago South	South Gulu/Masindi		234	Completed preliminary study
7	Ayago North	North Gulu/Masindi		304	Completed preliminary study
8	Murchison	Gulu/Masindi		642	Preliminary study, Environmental issues
9	Isimba	Kamuli		87	Estimated
10	Bugumira	Kamuli		109	Estimated
	Total		590	2,626	

Source: The Renewable Energy Policy 2007 and Addition by the JICA Study Team

2) Small hydropower development

Hydropower with installed capacity of less than 20 MW is defined as small hydropower in Uganda. The renewable energy section in the MEMD is conducting field reconnaissance to add new development sites for small hydropower to the 64 sites shown in the Renewable Energy

[28] Survey of the Ugandan Solar PV Industry, 2007, Energy Advisory Project (EAP), July 2007

Policy, 2007.

Out of said sites, 14 sites of 17.4 MW have been developed. There are many applications for approval of feasibility study for small hydropower developments to the REA. However, construction of power stations commenced at only 13 sites after completion of the study. Obtained approval for construction and operation of said power stations are shown in **Table 3.2.2-3**. There are four power stations which are under study or have not been commenced construction, four are under construction, and five 16.43 MW power stations already operational.

In addition to the above projects, there are some hydropower development projects. The Nyagak hydropower project of 3.5 MW being developed by WENRECO and subsidized through the REF has not been completed.

The Kisiizi hospital power company subsidized by the REF completed the construction of a power station of 350 kW in February 2009 and is presently installing distribution lines.

GTZ is constructing Bwindi small hydropower station of 60 kW targeting completion in September 2009. The power generated will be distributed to hospital, shops and the community via mini-grid.

Table 3.2.2-3 Development Status of Approved Small Hydropower Projects

No	Name	Installed (MW)	Potential (MW)	Status
1	Ishasha	0	5.00	Delay to Start Construction
2	Kikagati	0	10.00	Delay to Start Construction
3	Waki	0	5.10	Studies completed
4	Nengo Ridge	0	7.50	Studies yet to start
5	Buseruka	0	9.00	Under Construction
6	Mpanga	0	18.00	Under Construction
7	Nyagak I	0	3.50	Under Construction
8	Bugoye (Mobuku II)	0	13.00	Under Construction, Compl. in 2009
9	Kagando	0.06	1.00	Under operation
10	Kuluva	0.12	1.00	Under operation
11	Kisiizi	0.35	0.30	Under operation (Comp. Feb 2009)
12	Mobuku I	5.40	5.40	Under operation to to grid
13	Mobuku III	10.50	10.50	Under operation to to grid
	Total	16.43	89.30	

Prepared by the JICA Study Team based on ERA Report 2008 and the Renewable Energy Policy for Uganda, 2007

Since 2008, GTZ is preparing the pre-feasibility study of hydropower projects smaller than 100 kW in installed capacity in the foothills of Mt. Elgon. It commenced procurement of a contractor for the construction of a mini-grid system with a small hydropower station, which will be owned and operated by the CBO.

(3) Wind Power

Average wind velocity in Uganda is 2 to 4 m/sec. There is a possibility of utilizing wind power to operate small-scale pump in the Kamolamoja areas. It is reported that it would likely utilize wind power generation of 2.5 to 10 kW for small industry and rural areas. However, wind power station has actually not yet been constructed.

(4) Bio-energy

Around 90% of energy source in Uganda is biomass such as firewood, glasses, forest industry waste, agro-residues, and so on. The forest area in Uganda is decreasing at an annual rate of 6% due to use of firewood and charcoal. The GoU, NGOs and private organizations are promoting use of energy-saving cooking stoves for conservation of forest.

Bio-energy other than the above source is described below.

a) Biofuel

Small quantity of bio-ethanol is produced from cereals and molasses, by-product in sugar factories. Production of jatropha for raw material of bio-diesel and straight oil production for bio-diesel were not found by the Study Team while in Uganda.

b) Biogas

Private enterprises, NGOs, GoU and donors are encouraging construction of biogas production facilities at homes, since 1980. Around 500 facilities are presently operational in Uganda.

c) Cogeneration with bagasse

About 240,000 tons of sugar was produced in Uganda in 2008. Major sugar factories are Kakira Sugar Works Ltd., Kinyara Sugar Works Ltd., and Sugar Corporation of Uganda Limited.

Kakira Sugar Works Ltd. owns a cogeneration facility and sells part of generated power to UETCL. It constructed said facility with subsidiary of US$ 3.3 million by ERT, loan and own funds, and sells electricity of 12 MW since 2007. The cogeneration is made for 10.5 months except during rainy season when harvesting of sugarcanes are not executed. The installed capacity of cogeneration facility is 23.5 MW. Selling price of electricity is US¢ 4.9 /kWh for the 1st phase of 6 MW and US¢ 6.15 /kWh for the 2nd phase of 12 MW.

Other sugar factories have plans to sell power produced by cogeneration in their factories.

d) Power generation with biogas gasification plant

Research works on gasification plant for generating power with biomass are being made in Nyabyeya Forestry College for 100 kW and 50 kW plants, Kyambogo University for 10 kW plant and CREEC (Center for Research in Energy and Energy Conservation in Makerere University) for 10 kW plant.

Since 2006, the Muzizi tea factory of James Finlays Ltd. is operating a gasification plant of 205 kW made in India. The actual power output is 100 to 185 kW.

e) Biogas power generation using other wastes

The Renewable Energy Policy plans to utilize agro-residues for energy as shown in **Table 3.2.2-4**. However, those have not actually been used except for cogeneration in sugar factories.

Table 3.2.2-4 Energy Production Potential from Agro-residues

Biomass Type	Annual Production ('000 tons/yr)	MWe average
Bagasse	590	
Bagasse Surplus, (available immediately)		67
Rice husks	25 - 30	16
Rice straw	45 - 55	30
Sunflower hulls	17	20
Cotton seed hulls	50	1
Tobacco dust	2 - 4	2
Maize cobs	234	139
Coffee husks	160	95
Groundnut shells	63	37
Total		407

Prepared by JICA Study Team based on the Renewable Energy Policy 2007

(5) Geothermal Power Generation

There are some geothermal potential sites along Lake Bunyonyi, Lake Edward and Lake Albert in Western Uganda and at the western end of Great Rift Valley. Most promising geothermal sites at present are Katwe in Queen Elizabeth National Park, Buranga in Semliki National Park and Kibiro. The total power potential is estimated at 450 MW. As of date, the following investigations were undertaken:

- 1999 and 2003: GoU in cooperation with International Atomic Energy Agency (IAEA) made geothermal potential study at Katwe, Kibiro and Buranga sites with isotope. This study was made to obtain basic information for deep boring exploration. Fifty-five water samples are obtained for isotope analysis in 2005.
- 2005 to 2007: The MEMD assisted by the German Geological Study (BGR) executed geophysical and geochemical surveys, and seismic prospecting investigation at Buranga site. The investigation concluded that detailed surface reconnaissance and deep boring exploration shall be executed at the South Buranga site.
- 2005 to 2008: The MEMD assisted by the World Bank and Icelandic International Development Agency (ICEDA) conducted geothermal generation potential survey in the whole country. Shallow borings of 200 m to 300 m deep were executed in 2005 at seven locations each at Katwe and Kibiro sites, and two locations at Buranga sites . Chemical test was carried out on water sampled at 25 locations in 2006.

It is proposed to execute deep boring exploration at Katwe and Kibiro sites for feasibility study, and further study at Buranga site.

3.2.3 Present Situation of Private Entities related to Renewable Energy

The present status of private power producers, power distributors, manufacturers, equipment dealers, battery charging business enterprises, engineering service providers and consultants is described below.

(1) Power Producers

There are two kinds of power producers. The first are those who generate power and sell such to the power distributors who supply power to the customers through the national power grid. The second are those that generate power, which they sell directly to customers. In Uganda,

UEGCL and IPPs belong to the latter kind of producers who sell power to UEDCL. WENRECO's business meanwhile is to generate power which they directly sell to customers. There are no power producers who sell power to independent grids.

UEGCL owns power stations of 530 MW in total installed capacity consisting of hydropower stations of 380 MW and diesel engine generators of 150 MW. Due to the low water level of Lake Victoria, hydropower generated is currently limited to 142 MW. IPPs such as Kakira Sugar Works Ltd. sells 12 MW of power through cogeneration. Meanwhile, Mobuku I, Mobuku III and Kisiizi hydropower stations generate 5.40 MW, 10.50 MW、0.35 MW, respectively. Total power generated by IPPs is 142 MW.

(2) Power Distributors

The power distributors in Uganda are UETCL and UMEME. The former transmits power purchased from the power producers' power stations to the UMEME, through high transmission lines. The latter distributes the power to customers through low voltage distribution lines, and collects electricity charges. There are no power distributors which supply special power produced with renewable energy sources.

(3) Manufacturers

The following are manufacturers engaged in renewable energy business in Uganda:

- PV: PV batteries are sold by modifying vehicle batteries. Other products such as PV modules and inverters are imported.
- Hydropower: In the past, there was one manufacturer fabricating a set of hydraulic turbine. All equipment for hydropower such as turbines, generators and electricity control system are imported.
- Wind power: No manufacturer of wind power equipment.
- Bio-energy: No manufacturer of bio-energy equipment.

(4) Equipment Dealers

Equipment handled by dealers involved in renewable energy is only for PV system. There are many available importers since most equipment for PV are purchased abroad. There are also a number of wholesale dealers, shops and installation contractors. Supermarkets also sell PV modules, PV batteries and related accessories.

(5) Battery Charging Business Enterprises

There are many battery businessmen in various places who are engaged in charging mobile telephones, torches, lanterns, batteries for TV, with electricity supplied by UMEME and PV. The business is made in various forms such as a private enterprise, a shop and an enterprise.

(6) Engineering Service Providers

There are no engineering service providers which provide continuous engineering services, such as design, manufacturing, installation, operation and maintenance, for a project. Equipment dealers provide design, installation, operation assistance, maintenance and repair

services of PV to enterprises and private owners of PV. These dealers may be called engineering service providers.

(7) Consultants

There are no consultancy firms which specialize in renewable energy such as PV, hydropower, wind power, biogas and biogas generation. However, there are lots of independent experts and consultant companies that offer electrical, civil, and mechanical engineering related to PV. The renewable energy development projects are implemented by local experts and consultants themselves or in cooperation with foreign consultants.

3.2.4 Organizing Activities for Dissemination of Renewable Energy

There are two private organizations engaged in renewable energy in Uganda:

(a) Uganda Renewable Energy Association and All Uganda Renewable Energy Association

Uganda Renewable Energy Association existed since 1997 while All Uganda Renewable Energy Association was established in 2009. Private activities by businessmen and establishments promoting renewable energy in Uganda do not effectively function at present.

(b) East African Energy Technology Development Network (EAETDN)

The EAETDN is an NGO established in 1998 to promote renewable energy, including small hydropower for improving living standards of low-income households. It has thirty five experts in various fields such as renewable energy and policy-making. Both genders join and work together in EAETDN.

3.2.5 Business Financing of Private Entities and Users' Funding Source

Because there are no private enterprises that manufacture and sell equipment for hydropower, wind power and bio-energy, funding source of private enterprises that deal with PV equipment is described below.

As for supply sides of PV, there are importers, wholesale dealers, shops and installation and repair contractors. Meanwhile, users of PV are the public facilities, private houses and lodges/hotels, telecommunication companies utilizing PV and wind power at relay stations, and battery charging business shops.

There are no special financing systems for private entities on renewable energy. Any private citizen who desire to install PV can obtain subsidy from GoU or obtain loan from banks. GoU established a subsidy system for PV installation by private citizens and finances 28% of the expenses of PV facilities within the limit of US$ 250 from July 2009. The private citizen share 20% of the expenses through their own funds and 52% loan from PostBank, FINCA Uganda or two microfinance organizations. With this system, private enterprises can safely do PV business with private citizens under the guarantee of GoU.

3.2.6 Existing Business Samples of Renewable Energy

(a) PV Equipment Sales Business (Photo U-23 in Appendix 1)

AB Matra Uganda Limited imports PV modules, batteries, inverters, charging controllers, solar pump and other accessories from Germany and India. It directly orders goods and receives them at its stores after agencies obtain clearance from custom at Mombasa port and Entebbe airport. It sells PV equipment to shops, NGOs, contractors at a wholesale price and also install and maintain/repair PV equipment directly by its permanent and temporary staff.

(b) Battery Charging Business with PV

(b-1) Charging Business for Mobile Telephones (Photo U-21 in Appendix 1)

Battery charging business for mobile telephones is being done with PV in off-grid areas. Battery charging fee is generally Ush 300 to 500 per time in Uganda. In case charging frequency is ten times per day, monthly income reaches Ush 90,000 (US$ 40), corresponding to 63% of average household income of Ush 142,778[29] in rural areas in Uganda. This charging business needs initial investment of around Ush 950,000 to cover Ush 700,000 for a PV module of 50 Wp, and Ush 250,000 for cable and installation fees. As this initial investment can be recovered within a year, the battery business can be economically feasible.

Another example of charging business is by utilizing the capacity of vehicle battery 75 to 100 Ah. One owner travels to the town on the grid 30 km far from his place, and engage in charging mobile telephones through the vehicle battery at his off grid location. He needs one day for charging his battery to store power for charging mobile phones for two or three days. Said owner spends Ush 4,000 and Ush 3,000 as transportation and charging cost, respectively. He earns Ush 22,500 for charging 45 units at Ush 500/unit, using the charged vehicle battery. Consequently, his net income is Ush 15,500 per charged vehicle battery. In case vehicle battery is charged seven times per month, the monthly income reaches Ush 108,500. Said business needs initial an investment of Ush 300,000 for a vehicle battery and return of investment is expected within three months.

These two business models are illustrated in **Figure 3.2.6-1**.

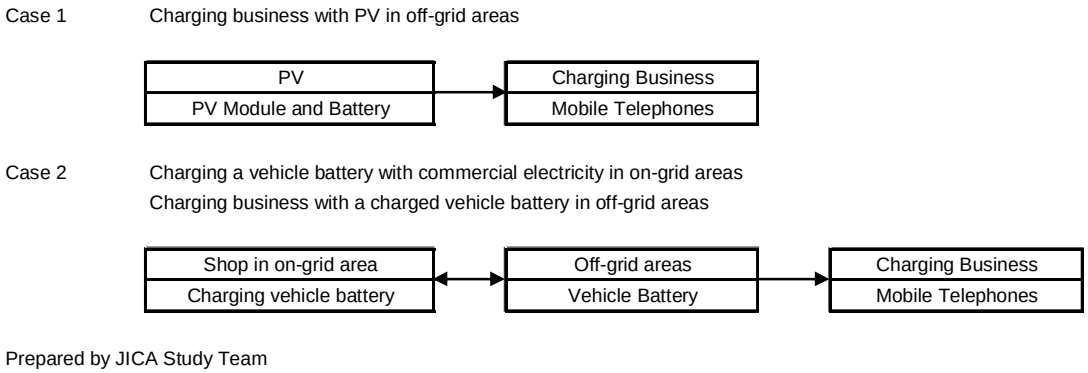


Figure 3.2.6-1 Battery Charging Business

[29] Uganda National Household Survey 2005/06

(b-2) Charging Business for Rechargeable Lanterns (Photo U-22 in Appendix 1)

The charging business for rechargeable lanterns is done with PV at two locations.

1) Nkoola Institutional Development Associates Ltd. (NIDA)

NIDA, managed by Ugandans, is engaged in rechargeable business using PV for Cold Cathode Fluorescent Lamp (CCFL) lanterns at Ssazi at the opposite bank of Entebbe International Airport. According to the JICA Study Team of the "Preparatory Survey for Renewable Energy Promotion Program in Africa - Public Facility Electrification -", the outline of NIDA business is as follows:

NIDA lends lanterns to 100 customers for a deposit fee of Ush 20,000 and charge Ush 1,000 per time for charging said lanterns. It needs to charge lantern after 10 hours use or after five days have passed. The lanterns cannot be used after a certain amount of electricity is discharged to avoid over-discharging. Computer system with SD cards is used to record charging hours of lanterns before and after charging the battery. The lanterns have external output device (cigarette lighter socket) which users can utilize to charge mobile telephones or for supplying power to a portable TV.

It takes one to two hours to charge a lantern. The charging system consists of two sets of PV module of 120 Wp and a charge controller. Eight lanterns can be charged at once, and 30 to 40 lanterns can be charged every day. The cost of a lantern is Ush 200,000. Parts of lanterns are imported and are assembled in Uganda. The total cost of the system, excluding that of lanterns, is US$ 4,000. NIDA is operating this business at three locations, including Ssazi. It receives application from 1,808 customers in 11 villages, requesting for immediate operation as soon as funds are available.

2) Dembe Trading Enterprises Ltd. (DTE)

DTE was established through a joint investment with Ugandan enterprise and Siemens AG in Germany. It is engaged in charging business of lanterns using PV and its market is Mukono, 40 km away from Kampala. It operates an energy hub project to lend rechargeable LED and Compact Fluorescent Light (CFL) lanterns to 500 customers for a deposit fee of US$ 10. Its fee for charging lanterns is US$ 1 per time. Each firm invested EUR 225,000 each to establish three hubs in an area and expand their business to other areas. The business does not progress smoothly due to the global economic crisis. It operates a hub to serve 250 customers as a trial case at present.

This hub has 45 and 6 PV modules of 120 Wp and 75 Wp, respectively. It can charge lanterns, mobile telephones and batteries for TV. Batteries for LED and CFL lanterns can be used for 200 and 11 hours of operation, respectively, after being charged.

This lantern charging business model is illustrated in **Figure 3.2.6-2**.

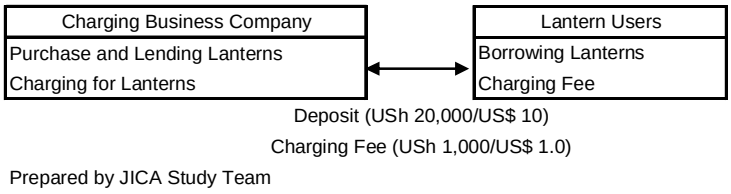


Figure 3.2.6-2 Rechargeable Lantern Charging Business

(c) Small Hydropower (IPP) Business (Photo U-7 and U-8 in Appendix 1)

There are private enterprises engaged in hydropower business by selling power to the UETLC. These include Kilembe Mines Ltd. and Kasese Cobalt Co. Ltd. which sell power of 5 MW and 11 MW, respectively, to the UETLC. Hydromax Ltd. (9 MW), WENRECO (3.4 MW), Tronder Power Ltd. (13 MW) and South Asia Energy Management System (18 MW) are constructing hydropower stations. These IPP business model is illustrated in **Figure 3.2.6-3**.

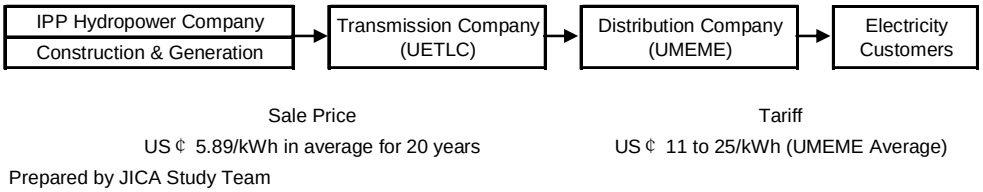


Figure 3.2.6-3 Small Hydropower Station Operation (IPP) Business

The REF subsidized WENRECO with US$ 8.2 million for the construction of the hydropower station. Its completion however is delayed. GoU enacted feed-in-tariffs system to financially encourage private enterprises to join in the hydropower business. The feed-in-tariffs determined by the ERA are shown in **Table 3.2.6-1**.

Table 3.2.6-1 Feed-in-Tariff System for Hydropower (20 MW in maximum)

(Unit: US Cents/KWh)

Time of Use		Year 1 to 6	Year 7 to 20	Simple Weighted Average
Peak	(1800-2400 hrs)	12.00	9.00	9.00
Shoulder	(0600-1800 hrs)	6.40	5.40	5.70
Off-Peak	(0000-0600 hrs)	4.00	1.50	2.25
AverageTariffs		7.20	5.33	5.89

Source: ERA

The system allows higher tariffs for the first six years to financially support IPP of hydropower, of which the initial investment is much higher than thermal power projects.

(d) Cogeneration (IPP) Business (Photo U-25 in Appendix 1)

Cogeneration is a system in which steam produced by boiler with bagasse is utilized to manufacture sugar and generate electric power in the sugar factory. Kakira Sugar Works Ltd. is selling to UETCL 12 MW power out of 23.5 MW produced in the factory. The outline of this IPP business is illustrated in **Figure 3.2.6-4**.

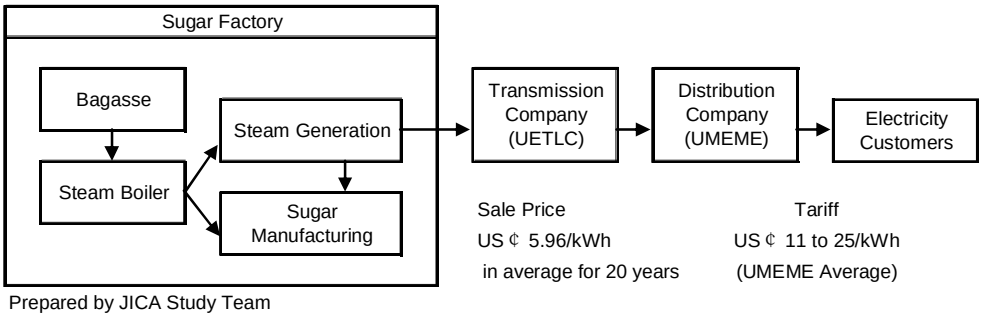


Figure 3.2.6-4 Cogeneration (IPP) Business

The Kakira Sugar Works Ltd. received a subsidy of US$ 3.3 million from the REF for the first construction of cogeneration facility of 6 MW. However it did not obtain another subsidy for the expansion of facilities to 12 MW. GoU is supporting the IPP projects by Feed-in-Tariff system instead of direct subsidy to construction fund since 2007. The tariff determined for cogeneration by the ERA is shown in **Table 3.2.6-2**. As well as those for hydropower tariffs for the first six years for cogeneration are higher than after 7 years.

Table 3.2.6-2 Feed-in-Tariff System for Cogeneration (20 MW in maximum)

(Unit: US Cents/KWh)

Time of Use		Year 1 to 6	Year 7 to 20	Simple Weighted Average
Peak	(1800-2400 hrs)	12.00	8.00	9.60
Shoulder	(0600-1800 hrs)	6.00	4.50	5.10
Off-Peak	(0000-0600 hrs)	4.10	4.00	4.04
AverageTariffs		7.03	5.25	5.96

Source: ERA

(e) Biomass Gasification Power Generation (IPP) Business (Photo U-3 in Appendix 1)

Renewable energy business through power generation using biomass saves electricity purchase cost and promotes increase in profits. The Muzizi tea factory of James Finlays Ltd. is operating a gasification plant of 205 kW in maximum capacity since 2006. The outline of this cost saving business with biogas power generation is illustrated in **Figure 3.2.6-5**.

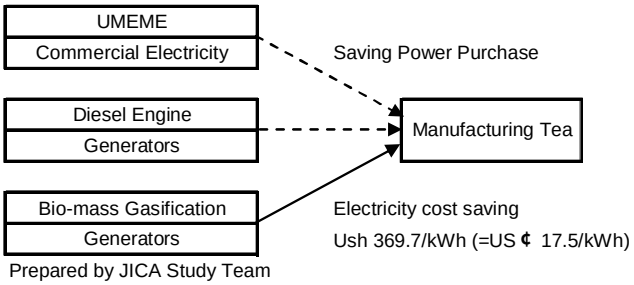


Figure 3.2.6-5 Cost Saving Business with Biogas Power Generation

3.3 Present Situation of Financial Market related to Renewable Energy

3.3.1 Overview of Present Development of Financial Market

Long-term finance for social and economic development is available only through the World Bank/IDA, AfDB, EADB and other donors. In Uganda, AfDB, EADB and Uganda

Development Bank (UDB) offers loans for private investment. However, the appraisal process is not business- like, i.e. response is very slow. Hence, business opportunities will be lost due to time constraints. Furthermore, commercial banks do not allow long-term financing of more than four years, due to government's control concerning risk management. It is noted that commercial banks fund source are from the savings deposits of households and private companies. If commercial banks go bankrupt due to long term loan risk, account holders will attempt to recover their savings from said bank. The government is concerned with such social unrest. However, Barkleys Bank, which is typical commercial bank, was allowed to finance ERT scheme for the implementation of the West Nile project. This is because said bank is an international mega bank. This is the only case of financing made by a commercial bank to ERT project schemes.

3.3.2 Present Financial Scheme and Past Performance

(1) EADB

EADB is a financial institution especially established for development financing, and as a sub organization of EAC, the federation of Uganda, Kenya and Tanzania. As above-mentioned, commercial banks in Uganda are not allowed to provide longer-term financing, which is only available from development banks. EADB, one of the potential development banks, financed Kakira sugar factory for its renewable energy project within the ERT scheme. In general, commercial banks do not finance renewable energy projects and do not offer the long-term financing. Therefore, the financial scheme operated under ERT is a significant incentive to investors as it provided special consideration for longer repayment terms and low rate as follows:

- Kakira sugar factory project
  - ✓ System: Co-generation system fueled by bagasse
  - ✓ Capacity: 4MW to connected to grid
  - ✓ Loan: US$ 8.6 million
  - ✓ Terms of repayment: 7 years (from 2005)
  - ✓ Interest rate: 13% p.a.
  - ✓ Completion: June 2008
  - ✓ PPA: Contract with UETCL (to sell power UETCL)
  - ✓ Scheme: Sale of power with feed in tariff

Other than the Kakira sugar factory project, the Sugar Corporation in Uganda located in Kinyara, is financed by EADB under the following terms:

- Sugar Corporation in Uganda
  - ✓ System: Co-generation system fueled by bagasse
  - ✓ Capacity: 4 MW to connected to grid
  - ✓ Loan: US$ 3 million
  - ✓ Terms of repayment: 5 years (2008 to 2013)
  - ✓ Interest rate: 8% p.a.

EADB has source funds from its shareholders, i.e. GoU, GoK, and Government of Tanzania as well as the following institutions and resources:

- AfDB
- European Investment Banking
- JBIC
- EXIN Bank of India
- China Development Bank
- Issue of bonds

The terms of repayment of EADB is between two and eight years to borrowers such as private industries, public corporations for telecommunication and transportation, hotels, tourism organization and public facilities like schools and clinics. EADB provided financing to FINCA Uganda, one of the private MFIs. The details of the loan are as follows:

- Loan: US$ 1 million
- Interest rate: 9% p.a.
- Terms of repayment: 5 years (2000 to 2005)

(2) MFSC

Focusing on the important function of microfinance in the rural areas, the Ministry of Finance in Uganda established MFSC to promote and assist financial activities of SACCOs and MFIs. MSFC is a potential development finance institution since 2001, as it is 100% subsidiary of the Ministry of Finance.

The main roles of MFSC are as follows;

- To pursue the activities according to Rural Financial Services Strategy (enacted in 2006)
- To finance the establishment of value chain for the agriculture industry products to enhance yield

MFSC promotes the following businesses:

- Services for business development
- Assist, protect and provide capacity building for SACCOs (733 organizations) and MFIs (450 organizations) as the affiliates
- Assist business funds of SACCOs and MFIs as the affiliates
- Capacity building for employees of MFSC, SACCOS and MFIs

MFSC was set up to facilitate effective government assistance for financial services, because the government program for the grants did not contribute to alleviate poverty in the rural communities. After the completion of the independent business activities of SACCOs and MFIs, MFSC will minimize its functions until it is phased out.

MFSC has the following lineup of financial products:

- Agriculture Development Fund

- ✓ To promote rural energy access
  - Tourist home, kiosk, telecommunication center, trading center
  - Power supply in the evening time provides lighting to expand the business hours to enhance productivities and sales.
  - Processing of agriculture products
  - Establishment of agriculture infrastructure
- ✓ Financial scheme
  - Terms of repayment: 2 to 4 years with grace period of 6 to 12 months
  - Interest rate: 9% p.a.

■ Business development fund for SACCOs
- ✓ Subsidy for the audit fee (50%)
- ✓ Subsidy for management information services
- ✓ Finance for the business fund
  - Loan: max. Ush 10 million
  - Terms of repayment: 24 months with grace period of 6 months
  - Interest rate: free
- ✓ Finance for the improvement of business infrastructure
  - Purpose: Audit fee and business fund
  - Interest rate: Ush 10 million
  - Terms of repayment: 24 months with grace period of 6 months
  - Interest rate: 9% p.a.

■ Micro-Enterprise Fund for MFIs (business development fund)
- ✓ Terms of repayment: 24 months with grace period of 6 months
- ✓ Interest rate: 13% p.a.

■ SME (Small and Medium Enterprise) Development Fund
- ✓ Terms of repayment: 4 years with grace period of 6 to 12 months
- ✓ Interest rate: 17% p.a.

MFSC promotes the financial service of guarantee fund, which ensures the repayment for the loan of the agriculture industry firms such as sugar factories. MFSC guarantees to repay the commercial banks financing for sugar factory firms, who cannot afford repayment of the loans. Commercial banks will promote loans to sugar factories, because of the guarantee by MSFC to repay on behalf of said factories. The details of the loan are discussed between MFSC and commercial banks. The actual financial services were identified as 853 loans including SACCOs' 733 and Ush 35.9 billion lent during 2004 and April 2009.

3.3.3 Status of Lending and Issues Related to Renewable Energy

(1) Status of Lending

In Uganda, hydropower generation is a major area where renewable energy development has advanced. World Bank and other development financial institutions have granted loans to Bujagali hydro power project, which recently commenced development. Existing notable hydro power plants such as, Mobuku 1 and 3 are owned and operated by mining companies. The former is owned by Kilembe Mines, a copper mining company under the government. The latter meanwhile is owned by Kasese Cobalt Company.

World Bank provided Uganda with assistance to ERT 1 between 2002 and 2008, in which the following fast track projects reached financial closing,

- Kakira Sugar Works: 12 MW cogeneration, loan amount: US$ 7.73 million, Term to maturity: 10 years including 3 year grace period, Interest rate: 7.58% p.a. (floating; charged by BoU) + 3% spread
- Kisiizi hydropower owned by a Christian church: 300 kW (expansion), GTZ provided grant for 70% of the development cost, with no World Bank funding.

Renewable energy lending is limited to cogeneration project of Sugar Corp. of Uganda by EADB and PV panels. Hence, lending activities for PV panels are discussed below.

(a) PostBank's Activities

Under ERT 1, there was a scheme whereby BoU lent to financial institutions that subsidized purchases of SHS. BoU lent US$ 425 thousand to PostBank which arranged loans to SACCOs for SHS purchases. PostBank's activities in relation to SHS are as follows:

- PostBank formed a partnership with the following members to expand utilization of PV panels. Its role in the partnership is to arrange loans for SACCOs and to administer subsidies.
  - ✓ BoU: providing financial support to financial institutions
  - ✓ REA: administration of subsidies and to publicize subsidy program
  - ✓ SACCOs: to make loans to SHS purchasers
  - ✓ PV merchandiser: installation of SHS, with a prior agreement with PostBank
  - ✓ PSFU: audit of solar systems, certification after installation
- It took one and a half years to establish this partnership, but 56 transactions were engaged after it started operation in December 2008. Since the role of post-installation certification was shifted from PSFU to REA about seven months ago (March 2009), some 200 transactions are still pending.
- There are 27 PV merchandisers in Uganda, nine of which have entered into the partnership agreement with PostBank. Actual installations in rural areas are handled by their local agents or subcontractors.
- PostBank is estimated to be involved in 5% of the total PV transactions, and it aims to expand to 1 million transactions in two years.
- PostBank has relations with 860 SACCOs, but it is only with 3 of them that PV panel transactions were concluded.

The performance of PostBank may not be satisfactory so far because it took so long to form the partnership arrangement with various parties concerned. Furthermore, there are about 200 pending transactions due to the transfer of responsibility of post-installation certification. Nevertheless, they have already established the partnership framework, and they gave the impression that they would pursue the new and promising opportunity vigorously.

(b) Equity Bank Uganda's Activities

- They have been involved in solar-related lending over the past 11 years, with assistance from BoU in the recent three years. They have granted 200 loans in the area.
- They deal with five suppliers, including Ultra Tech, Sun Top and Conserve. They provide warranty for a period of one-half year.
- It has five transactions with schools, all of which are privately-owned.
- The cost of solar products for household use is Ush 190 thousand (less than US$ 100). However, they agree to lend up to Ush 500 thousand (US$ 250) to good customers without collateral, if the loan is related to solar products.
- Interest rate is 24% p.a. and two years is the term to maturity.

(c) Other Banks' Activities

- FINCA Uganda provides financing in rural areas for acquisition of solar products.
- Community Micro Finance Ltd., acquired by Global Trust Bank, provides short-term working capital for businesses.

(2) Issues

According to a World Bank official in-charge of financial industry:

- One of the issues in the financial industry of Uganda is the inability to procure long-term funding in the market
- Interest (coupon) rate of national bond is high at 10%, as well as the preferred rate that commercial banks charge, which is 18 to 19%.

According to REA:

- Cost is an issue in financing. Normal interest rate is 23 to 24% p.a., and even larger projects have to pay 18% interest p.a. Term to maturity is also as short as 2 to 3 years.
- PostBank is controlled by the limitations in its computer system, making it difficult to lend to hydro power projects as the system does not allow a one year grace period and bi-monthly repayment schedule.

As to the PostBank computer system constraints, a PostBank official explained the issue related to the cost for upgrading the system. According to said official, the current system was installed more than ten years ago by an Indian company. Its consultant came and reviewed upgrade options for about three months, and came up with a costly scheme, which could not be easily justified.

As discussed above, the issues in Uganda, i.e., short term lending period and high interest rates, are similar to that in Kenya. If yen loans or grant for revolving facilities are provided, it would facilitate PV panel purchases (although yen loans leave the currency exchange risk with the borrower).

3.3.4 Possibility of Micro-credit in Rural Area

Meetings were held with PostBank and Equity Bank Uganda to understand the situation of micro credits in Uganda. Both are commercial banks, but have strong links with agricultural areas from their origin.

PostBank's explanation:

- Uniform evaluation of family members is not possible as individual members in the same family are different.
- It is not possible to cross-check customers' credit situation as there is not much information about customers available and there is no registration system for the properties. Therefore, it is necessary to spend a lot of efforts in relationship banking.
- There are no significant irrigation facilities and harvesting is not possible after drought or fire. Maize has shorter cropping cycle reducing the credit risk of maize farmers. However, in the case of sugar farmers, harvest can only be done 1.5 years later, which increases risks.

Comments from Equity Bank Uganda are as follows

- Many people do not have stable monthly income, and hence, only four out of ten applicants can be granted with loans.
- Only about 20% of the population own land
- Even if it is a group lending, all group members are not willing to pay debts if their harvest is damaged by drought or flood. It would be appreciated if such risk can be shared.
- So far, all the 200 loan transactions related to solar products does not have any problem with repayment terms.

In Uganda, micro credits are doing business in a difficult environment with some interventions. Nevertheless, the role of such institutions needs to be expanded to promote rural development. Moreover, it should be worthwhile to consider setting up risk sharing framework by partial guarantees and to realize lending scheme to satisfy borrowing demand by rural residents.

Micro-credit is disseminated to both urban and rural communities, for poor as well as ordinary residents. Especially in rural communities, available financial opportunities are less since the limited numbers of commercial banks branches do not lend money to the poorer population. This is because cash demands of rural households are usually too small to earn business profits as required by bank loan schemes. Therefore, the microfinance services delivered by MFIs and SACCOs are indispensable in the rural communities. The numbers of the members in SACCOs vary from ten to a thousand. MFIs and SACCOs will finance any amount of cash requirement applied by members who have valid reasons for availing microfinance such as for purchase of seeds, fertilizer, farming implements and livestock. There is a requirement of fund for capital investment of the new business and the working capital for the existing business. The typical loan conditions are as follows:

- Interest rate: 30% p.a., 2.5% per month
- Terms of repayment: 24 months

3.3.5 Incentive and Penalty of Financial Scheme for Renewable Energy Promotion

No regulatory framework is identified for the financial scheme which promotes the introduction of the renewable energy projects. As referred in 3.1.3., preferential taxation system is identified as the incentives to promote solar PV systems installation with zero rated VAT and customs tax.

The operational aspect for preferential taxation of VAT was supposed to be discussed for further improvement of the promotion of PV systems. Main players such as importers of solar systems benefit fully from the zero rated VAT, because they import all the equipment components as one unit. Domestic local dealers in meanwhile Uganda have to pay VAT since related equipment are separately purchased from the domestic market and not as one unit. Dealers add the tax amount on the price of SHS, which end users have to pay. End users are unable to benefit from the preferential taxation system since the tax authority does not allow dealers to benefit from the same, as they worry that separate components will be used for purposes other than the solar PV systems. Finally, the merit of zero rated VAT is not applied fully to the implementation of solar PV projects. The operational procedure for preferential taxation of VAT is initiated by the government to execute the energy policy for the promotion of the solar PV projects.

Regarding the zero rated customs tax, the formality of the tax procedure delays the final decision, and hence, many suppliers fail to avail of such benefits. As the preferential taxation system has not been disseminated well to related sectors, applied cases of the zero rated taxation are less.

3.3.6 Usable Policy Finance Institutions for Renewable Energy

Under the World Bank's ERT 1 scheme, BoU administered funds from donors such as World Bank. UECCC has been established since then, and it will play such role from now on. It is expected that the actual roles and overall framework of UECCC will be determined by summer 2009. However, some of the roles are being reconsidered to include providing partial risk guarantees and refinancing upon maturity of the loan to the end-borrowers. It is also expected that these two provisions will be respectively applied to medium scale generation projects such as mini hydro (minimum 100kW even if it is off grid) and solar PVs.

World Bank plans to include only the financial institutions regulated by BoU in the ERT 2 scheme, thus SACCOs will not be included. According to Financial Markets Dept. of BoU, they are considering the introduction of a law regulating SACCOs, and such a law may cover non-bank financial industries including insurance and pension funds. According to BoU, there are some examples of SACCOs being fabricated with other members' money being stolen. It is also noted that SACCOs' lending is limited to income generating activities.

The Development Bank of Uganda, which is 100% owned by the government, still exists. However, it is still not in operational while as the government is considering a revitalization plan, including privatization as alternative.

3.4 Existing and Potential Business Opportunities in the Renewable Energy Field

3.4.1 Needs of Renewable Energy

Taking into consideration the present situation of private enterprises engaged in renewable energy business, related needs in each field is described below.

(1) Business Sales of PV Facilities

In order to achieve the target of 10% rural electrification based on the RESP, the IREMP proposed to electrify about 400,000 households in on-grid and off-grid areas as shown in **Table 3.4.1-1**. This plan aims to increase electrified households by connecting to distribution lines. The IREMP also plans to electrify only public facilities in off-grid areas.

Table 3.4.1-1 Targets and Projected Connections in Indicative Rural Electrification Master Plan

(Unit: Nos. of Connection)

Period	Yr 1-2	Yr 3-5	Yr 6-10	Yr 11+	Total
On-grid	156,000	156,000	167,000	35,000	514,000
Off-grid		12,000			
Total	156,000	168,000	167,000	35,000	526,000

Source: Indicative Rural Electrification Master Plan Report, MEMD, January 2009

The IREMP's plans for electrification in off-grid areas will be through PV system and diesel engine generators. Demand of PV in off-grid is estimated as 2.7 million household customers with about 48 MWp total capacity and US$ 713 million in cost as shown in **Table 3.4.1-2**.

Table 3.4.1-2 PV Market estimate by IREMP

Consumer	Market			Capacity		Costs	
	Without access after IREMP	Maximum uptake expected	PV customers (nos.)	Average per site (Wp)	Total (MWp)	Price (US$/site)	Total (million US$)
Households	3,783,000	71%	2,685,930	14	37.6	193	518
Health centres	3,400	100%	3,400	840	2.9	15,120	51
Education facilities	9,500	100%	9,500	840	8.0	15,120	144
Total	3,795,900		2,698,830		48.4		713

Source: Indicative Rural Electrification Master Plan Report, MEMD, January 2009

On the other hand, ERT 2 plans electrification of households as shown in **Table 3.4.1-3**.

Table 3.4.1-3 House Holds Electrification Plan by ERT 2

	On-grid (1st subsidy)	On-grid (2nd subsidy)	PV	Total
2009	1,000	3,000	1,000	5,000
2010	7,000	25,000	4,000	36,000
2011	8,000	25,000	6,000	39,000
2012	8,000	25,000	7,000	40,000
2013	2,000	5,000	2,000	9,000
Total	26,000	83,000	20,000	129,000

Source: Energy for Rural Transformation II, WB Project Appraisal Document No. 47183-UG

About 2.7 million households will be supplied with electricity for the next 10 years according to IREMP. About 20,000 households will be subsidized for the next five years in ERT 2. The demand of PV will be a minimum of 20,000 sets for the next five years.

It is expected that business related to PV will be expanded judging from the fact that three companies interviewed by the JICA Study Team sold 6,300 sets of PV in 2008 and that rural

electrification rate is still so low at 10% after ten years.

(2) Hydropower

GoU is encouraging private enterprises to engage in small hydropower business by setting high electricity purchase price in feed-in-tariffs. There are many business opportunities foreseen such as business sales of power connected to national grid, independent grid and mini-grid in off grid areas.

There are lots of potential sites for hydropower development in Uganda. At present, 50 sites have been identified and it is expected that more small-scale hydropower sites will be identified if a hydro potential study is conducted. As unit development cost of small hydropower is generally US$ 3,000 per kW, the project cost of US$ 3 million to 30 million may be necessary for the development of such hydropower with 1 to 10 MW in installed capacity. If this investment fund is available, small development would be a promising business as generation cost of hydropower will not be affected by fuel price.

UNEP and GEF commenced the “Small Hydro for Greening Tea Industry in East Africa Project” to assist tea factories in developing hydropower with 0.2 to 5 MW in installed capacity in the east African countries in 2007, for four years. It is expected that said tea factories will be encouraged to construct hydropower stations under this project.

(3) Wind Power

There is a possibility that wind power generation for pumps for irrigation and human consumption water supply will be popular in Uganda as well as in Kenya. It is necessary to promote the use of wind power by educating users and to develop its market.

(4) Bio-energy

The promising bio-energy business is cogeneration in sugar factories and electricity generation with gasificated biomass as described below.

a) Cogeneration in sugar factories

Kakira Sugar Works Ltd. is generating electricity of 23.5 MW by cogeneration. It is selling electricity of 12 MW, and is planning to expand its generation capacity by 8 MW. Kinyara Sugar Works Ltd. and Sugar Corporation of Uganda Limited are generating electricity of 7.5 MW and 9.5 MW, respectively. However, both do not sell their electricity.

As mentioned in the Renewable Energy Policy, potential of cogeneration possible to be developed soon is 67 MW. As developed power is 48.5 MW in total, there is remaing potential of 18 MW. Bagasse will be produced at 590,000 ton every year. Presently, it is also possible to produce 670 MW by cogeneration.

GoU is encouraging private enterprises to engage in cogeneration business by setting high electricity purchase price in feed-in-tariffs. It is expected that cogeneration business is a promising business to expand in the future.

UNEP and GEF commenced "Cogeneration for Africa" to assist sugar factories in developing cogeneration in east African countries in 2007, for six years. It will facilitate funding to the construction of cogeneration with financial assistance from said project. Because hydropower is the main power source in Uganda, it is necessary to study whether cogeneration can be approved as a CDM project.

b) Biomass gasification generation in tea factories and food process plants

There is a possibility that processing plants of agricultural products will construct biomass gasification plants to generate power in order to save purchase cost of commercial electricity, as done by the Muzizi tea factory of James Finlays Ltd. The power generation with biomass gasification plant will become profitable business once gasification technology is established.

(5) Battery Charging Business with PV for Mobile Telephones and Rechargeable LED Lanterns

The battery charging business in rural non-electrified areas is promising as mentioned in Section 3.2.6. It is reported that 80% of adults in Uganda, as well as in Kenya, use mobile telephones. In the non-electrified areas, demand of charging mobile telephones is significant and small charging business is popular at present. People in the areas go to towns where electricity from the national grid is available, to charge their telephones. They pay transportation cost and spend time to avail of such services. As described in Section 3.2.6, the charging business with PV needs only a small initial investment and is easily profitable.

The World Bank and IFC are promoting the use of rechargeable LED lanterns through the "Lighting Africa" project. Private enterprises have been doing charging business for lanterns in Uganda. The JICA Study Team expects that the use of rechargeable LED lanterns will widely spread soon in Uganda. Consequently, it is anticipated that charging business for lanterns and mobile telephones will become popular shortly.

The battery charging business is promising with power sources connected to the national grid in electrified areas and PV in non-electrified areas. In case of PV business with only PV modules and connection cables, business time is limited during the day only. It could become a full-time business by adding batteries and charge controller.

3.4.2 Sector-wise Business Opportunity in Renewable Energy Field

Possibility of business related to renewable energy is described below for each field of private power producers, power distributors, manufacturers, equipment dealers, battery charging business enterprises, engineering service providers and consultants.

(1) Power Producers

As mentioned in Section 3.2.1, in case construction of Karuma hydropower station is delayed and power demand increases at a rate of 7% p.a., power will inevitably be insufficient. It is necessary to develop power plants other than said hydropower station, and aggressively develop small scale power projects utilizing renewable energy.

GoU enacted feed-in-tariffs system to encourage private enterprises to engage in the business

related to hydropower and biomass power generation shown in **Table 3.2.6-1** and **Table 3.2.6-2**. This feed-in-tariffs system may make private business of operation of hydropower, and biomass power generation profitable.

(2) Power Distributors

It is considered that the power distribution business is expanding with the increase of rural electrification and power demand. There is a possibility of establishing power distributor in independent grid, utilizing PV and hydropower as power source in off-grid areas. However, the business seems difficult to succeed because of existing issues to be solved such as finding power sources and tariff collection from electricity customers.

(3) Manufacturers

Possibility of business related to renewable energy is described below.

- PV: It is difficult to manufacture PV modules in Uganda because high quality electricity and high technical capabilities are essential. Business to manufacture PV batteries may be promising as they are manufactured in Uganda already. It also may be possible for manufacturing enterprises to produce related equipment to PV such as invertors and controllers in licensed factory or with technical guidance.
- Hydropower: Turbines such as 100 kW class can be locally manufactured as done in Kenya. There is a possibility that turbine manufacturing business will succeed if small hydropower is developed continuously every year.
- Wind power: As there are a few sites suitable for wind power in Uganda, business for its related facilities seems difficult to succeed.
- Bio-energy: It is possible for private enterprises to develop business related to biogas production by learning the related knowledge in design, construction and operation from the projects under construction in Kenya. The business will be supported from view points of environment protection.

(4) Equipment Dealers

The equipment dealers of renewable energy, especially PV, are considered to be expanding in non-electrified areas. From view point of prevention of global warming in the world and demand of electrification of households in Uganda, importers, wholesalers, sale shops, contractors, repair shops and other enterprise for PV presently have chances in expand their business.

(5) Battery Charging Business

Because the electrification target rate in the rural area in 2019 is still as low as 10%, battery charging business may expand by utilizing power from UMEME, small hydropower stations and PV for charging mobile telephones in non-electrified areas. In addition, charging business for rechargeable lanterns will become more popular depending on the type of lanterns used widely. Private and small and medium-scale enterprises may then be motivated to engage in the rechargeable business.

(6) Engineering Service Providers

There is a high possibility that engineering service providers will provide overall services from planning to maintenance of PV system at tourist lodges, similar to Kenya. In addition, equipment dealers may expand service business from planning to maintenance of PV owned by general users.

(7) Consultants

It is expected that consultants will expand their business related to renewable energy because consultant services for planning, design construction and maintenance of renewable energy facilities will be required more than before. As construction of large and small hydropower projects are underway and will commenced in various palces, there is a good chance for consultants, specializing in hydropower development in the fields of civil, electrical and hydromechanical engineering, to expand their business.

3.5 Human Resources for Renewable Energy Promotion

3.5.1 Human Resources of Renewable Energy in Business Sector

(1) PV Equipment Sale Business

Wholesalers and sales shops carry out design, sales, installation, repair and so on for PV system. They design PV system and select PV modules, charge controllers, batteries, invertors and other components to meet the purpose and requirements of users. They install PV equipment including wiring and provide guidance on how to operate and maintain the equipment, if necessary.

According to the JICA Study Team for the “Preparatory Survey for Renewable Energy Promotion Program in Africa - Public Facility Electrification”, surveyed actual use of PV reveals that sales shops and electrical technicians in Uganda do not sufficiently understand electrical aspects of PV and proper use of battery, similar to Kenya’s situation.

Incafex Solar System Ltd. reported that three Ugandan PV technicians are trained for three weeks in KYOCERA Corporation in Japan every year. Other shops do not train their staff in the shops but receive training from equipment manufacturers. Considering the numbers of PV already installed in Uganda, numbers of shops and technicians who have overall knowledge in such system, from design to maintenance, are limited.

(2) Small Hydropower

Database of renewable energy including small hydropower has been constructed with GIS in the ERT through the support of GTZ. The renewable energy section in the MEMD is updating the database adding newly identified sites for small hydropower using map study, field reconnaissance and collected new information on existing power stations. The GIS provides information on rivers, roads and hydropower sites on 1 to 50,000 scale maps. However, the database is not sufficiently updated. It indicates that information on projects under construction are not provided due to the delay in receipt of new information from the REA and the MEMD, to be submitted to the renewable energy section.

Since it was the foreign engineers who have been engaged in implementing hydropower projects in Uganda, local human resource in private enterprises remain insufficient in carrying out such projects.

(3) Wind Power and Bio-energy

As there are few businesses in wind power and bio-energy, human resource with specialized techniques on such fields are very limited.

3.5.2 Human Resources of Renewable Energy in Financial Sector

Cogeneration projects utilizing biomass and large scale hydropower projects are financed by regional and international development financial institutions, while small scale hydropower projects are funded through grants at the moment. Since only foreign owned banks from U.K. and South Africa that could participate in financing in relatively large projects, currently promoted SHS is being discussed in this section.

Introduction of renewable energy has not advanced significantly in Uganda as well. However, institutional and organizational frameworks have already been developed, and existing human capital played its role reasonably well given the limitation of the market and requirements. According to PSFU, they are satisfied with financial institutions taking a day to make a decision of lending if an amount is small and about 2 weeks if the amount is larger like US$500,000.

Thus, if SHS and LED lanterns are to be introduced as large scale in unelectrified villages in the future, it will be necessary to promote loans through SACCOs and MFIs. PostBank is trying to expand partnership with SACCOs. However, only three out of the 860 SACCOs which has SHS transactions with PostBank. This example implies that potential requirement for assistance in human capacity development is essential.

SACCOs is not subject to any regulation and central bank inspection, and reportedly, there are occasions where members' money is stolen through fabricated SACCOs. To resolve such issue, legislation is being considered to regulate SACCOs. GoU established MFSC to build capacities of, and provide credit to, SACCOs and MFIs. These financial institutions lend to borrowers who may not be credit worthy as individuals. However, they are minimizing the risk by creating such mechanisms as joint and several guarantees, and initiating regular monitoring. In order to expand the utilization of renewable energy, it is considered necessary to provide assistance to these institutions in areas such as improvement in internal business processing, credit decision capabilities on borrowers, and coaching capacities for borrowers. Small scale SACCOs have two persons in an office, a manager and loan officer, and their number of loan transactions are about 200, according to REA. It is easily understood that capacity building is required not only for the improvement and promotion of knowledge but also for enhancing organizational framework for offices including those small ones.

3.5.3 Human Resources of Renewable Energy in Public and Academic Sectors

(1) Academic Sector

Makerere University conducts lectures on renewable energy for university students and

post-university students. Research works have been conducted related to PV, wind power, geothermal, hydropower, biomass and biomass gasification for 15 years. It provided technical support to CDM project of cogeneration at Kakira sugar works.

The websites of Nyabyeya Forestry College and Kyambogo University state that they are also doing research on biogas.

(2) Research Fields

CREEC in Makerere University researches PV, biogas, biomass gasification and mini-hydropower systems. CREEC accepts researchers from universities in Eastern African region and implements education and research. CREEC undertakes a joint study with University of Dar Es Salaam. It also undertakes contract research from international aid agencies.

3.5.4 Present Situation of Capacity Building and Educational Campaign

Educational campaign of renewable energy has hardly been done in Uganda at present. Limited example includes wholesalers or suppliers of PV system conducting workshops to train technicians individually, and the technical training on PV system installation carried out in Nakawa Vocational Training Institute.

Policy and institution are well promoted for utilization and promotion of renewable energy. However, significant capacity building and educational campaign activities are not observed.

A plan to install 500 solar water heaters and reduce 1 MW of electricity consumption is going to be implemented through the support of Renewable Energy & Energy Efficiency Partnership (REEEP). Utilization of engine powered by biomass ferment gasification, biomass burning gasification and Straight Vegetable Oil (SVO) are implemented by donors and NGOs. Such activity to introduce new renewable energy technology for Uganda is presently implemented. However, there is currently no educational campaign and capacity building activity to disseminate such new technology.

3.6 Other Donors Activities and Funds for Renewable Energy in Business Sector

3.6.1 Other Donors' Policies, Activities, and Performance

In this section, international organizations' activities are discussed mainly.

(1) World Bank, ERT 1

- There was a program in ERT 1 to provide funds to financial institutions for purchases of PV panels. However, ERT 1 ended in February 2008.
- The program was a refinance facility, called reimbursement scheme, in which BoU provided funding to a financial institution after the latter has made a loan. Although the process was complicated, this facility mitigated the issue of long term funding by financial institutions.

(2) World Bank, ERT 2

- ERT 2 was approved by World Bank board meeting in April 2009. It is expected to commence operation in autumn of 2009 after detailed mechanisms are finalized.
- ERT 2 includes a program to assist expansion of PV panel installations. At the moment, funds for PV panel purchases by customers will be provided through a credit enhancement scheme whereby credit risk is shared between the lending institution and BoU or UECCC, according to current discussions among parties concerned. Private financial institutions will submit the applications after they have passed their own internal credit review.
- ERT 2 also aims to provide assistance towards the development of hydro power projects of 1 - 5- 20 MW to be connected to the grid. However, its allocated budget is only US$ 2 million. World Bank expects that this will be a good encouragement to other donors to contribute additional funding.
- A scheme is included in ERT 2 to provide assistance for preliminary studies such as feasibility studies. PSFU will handle this scheme that shares the expenses with private businesses. This scheme is proposed because private sector players do not usually have experience, studies are costly and it is sometimes difficult to recover the initial out of pocket expenses at a later stage. (World Bank budget: US$ 650 thousand)

(3) EIB (European Investment Bank)

- Although renewable energy is not included, it may be worth noting the EIB's EUR 110 million assistance between 1997 and 2007. This was called EIB Uganda Apex Private Enterprise Loan Scheme that covered nine areas, including manufacturing, agriculture and fisheries. The term to maturity of the loans to final borrowers ranged between 5 and 12 years, and said loans can be either in foreign currencies or Ugandan Shillings. The loans can cover up to 50% of the total cost of the projects.

(4) GTZ, KfW (Kreditanstalt fur Wiederaufbau) and SIDA

- Assistance was provided for capital market development, and for establishment of Credit Reference Bureau whereby information of borrowers can be shared among financial institutions.

(5) Danida

- Micro, small, medium enterprises (MSME) and agriculture are the target areas of DANIDA, and assistance is being provided to facilitate flow of funds to high risk areas by providing guarantees to individual financial institutions

3.6.2 Existing Funds and Performance

Existing funds and performance are identified as the projects to promote the installation of SHS are organized and financed by UNDP and SHELL Foundation. UNDP had a grants program to develop the revolving fund as the financial mechanism for establishing the market of SHS. As UNDP installed 700 SHSs only during 1998 and 2003, the market size was limited within minor regions.

On the other hand, noticeable ERT scheme is operational through the World Bank. The World Bank commenced ERT, targeting the whole regions of Uganda in 2002. One of the ERT schemes is to promote the sales of SHS through loan and subsidy. As commercial banks, Equity Bank and Global Trust Bank finance suppliers and dealers for the importing cost of solar PV systems as working capital. At the same time, BoU appointed MFSC as the service provider of the low cost fund with SACCOs and MFIs so that end users in rural communities may be financed to purchase SHS through reasonable financial cost. Regarding subsidy, PSFU delivers both to the suppliers and dealers, and the end users.

Figure 3.6.2-1 shows the fund flows. Blue arrow indicates the loan while the yellow one indicates subsidy. Green indicates the physical flow of SHS and red is the cash flow. The financial flows are indicated as follows:

- Loan fund flow from commercial banks to suppliers and dealers (Blue in **Figure 3.6.2-1**)
  IDA - BoU (Loan to commercial bank: rate 14% p.a., repayment 4 years) - Commercial Bank (Loan to suppliers: rate 18-24% p.a., repayment 24 months) - Suppliers and dealers
- Loan fund flow from MFSC to end users (Blue in **Figure 3.6.2-1**)
  IDA - BoU - MFSC (Loan to SACCOs/MFIs: rate 9% p.a., repayment 4 years) - SACCOs/MFIs (Loan to end users: rate 18-24% p.a., repayment 24 months) - End users
  MFSC finances loans to end users through SACCOs and MFIs.
- Subsidy flow from GEF (Deep blue in **Figure 3.6.2-1**)
  - ✓ Subsidy for end users: GEF - REA - PSFU - End users (Subsidy 30% of SHS, Own fund 50% of SHS)
  - ✓ Subsidy for suppliers and dealers: GEF - REA - PSFU - Suppliers (Subsidy for business plan and sales promotion) (Sales promotion rate: US$ 2.5/W)

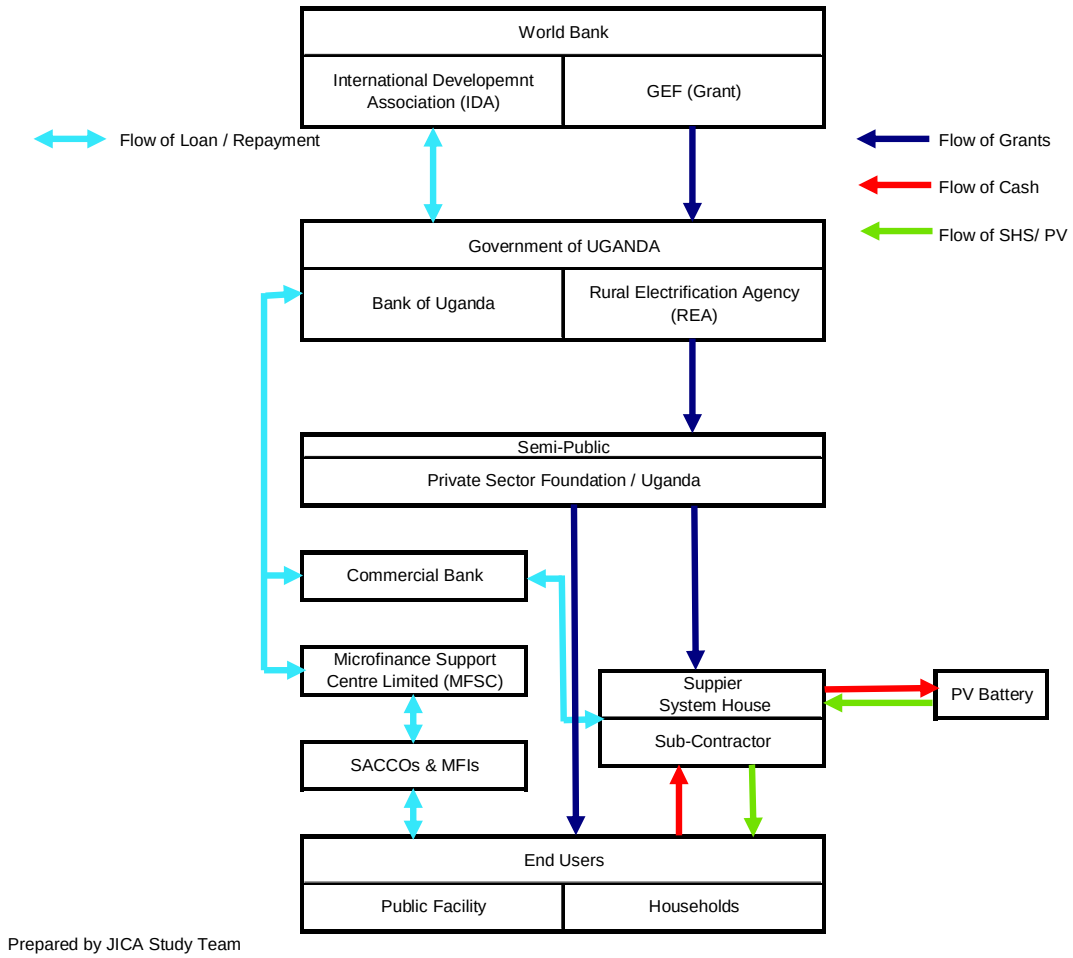


Figure 3.6.2-1 Promotion Scheme of SHS by ERT

The ERT, operated by the World Bank, completed Phase-1 (ERT 1: 2002 to February 2009) followed by Phase-2 (ERT 2: July 2009)

Chapter 4 ISSUES AND COUNTERMEASURES

4.1 Kenya: Issues and Countermeasures

4.1.1 Issues for Promotion of Renewable Energy in the Private Sector

Issues for promotion of renewable energy to the private sector is sorted out like (1) policy and institution, (2) private sector's participation environment, (3) financing environment, (4) capacity development and (5) technology introduction.

(1) Policy and Institution

Provision of policy and institution about installation of renewable energy appears late, although Photovoltaic (PV) is becoming popular in the private sector. There are schemes on preferential taxation and feed-in-tariff. However, there is no clear keynote or policy documented. Therefore, what should be done at first is to prepare a renewable energy policy and publish it as national basic keynote similar to Uganda.

Information such as contents, benefits and economic effects has not been disseminated to the general public, politicians, government officials and business entrepreneurs. One of the issues is the political activation of educational campaigns.

With the trend on formulating countermeasures against global warming, developing countries will be strongly advised to reduce CO_2 emission. Regarding this, policy and institution related to said countermeasures will surely be required including establishment of institution to ensure quantification of emission.

(2) Environment for Private Sector's Participation

Environment for private sector's participation is defined as the circumstance of risk and burden in the private businesses' participation in the renewable energy business. Currently, any private business cannot easily participate in the renewable energy business because of risk and burden barriers. The risk signifies that business could possibly fail and be discontinued. Usually, detailed survey and plan preparation are done before starting the business to reduce the risk. Since the process is not profitable, the incurred cost becomes a big burden to the business. Private sector's participation can therefore be promoted by mitigating the risk and burden.

(3) Financing Environment

The biggest issue in promoting renewable energy is the improvement of the financing environment. Whenever an occasion to exchange views with IFC in Sub-Saharan Africa[30] is possible, the important topic is the necessity of support to financial institutions. It is difficult to finance the construction for any renewable energy sector like PV, hydro, geothermal, biogas and wind. Demand of PV system is recently increasing. However, its dissemination is limited because the price of SHS is high relative to people's income. Although there are large development projects on hydropower and geothermal by Kenya Electricity Generating Company Ltd. (KenGen), these are all regarded as national projects.

[30] Africa north of the Sahara is called "White Africa" and the south is called "Black Africa" or "Sub-Saharan Africa".

Installation of mini-hydro, biogas and wind power stations has begun. Although there are already many proposed construction plans, most of them are unrealizable. The main reason for this is the difficulty in financing.

(4) Capacity Development

The issue in capacity development is the strategic planning and implementation towards promoting renewable energy. Private business engaged in renewable energy has recently existed. Therefore, human resources related to renewable energy is limited. Since there is not much demand on such human resources at present, it can be considered that this is not bottle neck for dissemination and expansion. If businesses related to said sector is promoted and required employment is expanded, effect of capacity building will be assured considering that the demand to human resources and needs of capacity building are expected to increase. At present, strategic planning and implementation of capacity development is important to achieve the target of effective dissemination and expansion of renewable energy.

(5) Technology Introduction

The issue on technology introduction is that the selection of technology to be supported by the country, among to be introduced and to be disseminated by the private sector, has not been done. Effect of support will be better if a suitable technology is selected. Most technology on renewable energy is new, and is either not yet introduced or is still in its earlier stage. It is also noted that some existing technologies are not extensively introduced. The merit of introduction should be confirmed based on a long-term perspective, with the selection of technology to be supported.

It is important to consider in the selection process that new technology becomes closer to maintenance-free and has lesser impacts to environment. Therefore, the new technology has more merit to be introduced to the nation. Usually, it is necessary to perform such selection considering price fluctuation in the future because of the fact that technology in early stage of development is expensive and could become less costly as it becomes popular.

4.1.2 Countermeasures for Policy and Institutional Design

At first, a national basic keynote and policy should be clearly documented and published.

As a countermeasure, monitoring of the feed-in tariff introduced in 2008 is important. This scheme involves buying of renewable electricity generated from sources such as wind, biomass and mini-hydro, at a relatively costly price. It can be confirmed whether the number of power producers is effectively increased or not in the current price level by monitoring this scheme. Consideration including revised price level is necessary based on the result of monitoring.

Although there is preferential taxation for PV system, this should be arranged for the other facilities of renewable energy as well. Effective reform measure is to increase subsidy and preferential treatment for loans related to installation of renewable energy facilities, although there is a problem on fiscal resources.

Regarding the issue on unfamiliarity and lack of knowledge of renewable energy, the Study

Team proposes that educational campaign activity thorough media should be done after publishing the basic keynote.

The movement of enhanced countermeasures to global warming means increase of opportunity in receiving investment and support to introduce renewable energy and energy conservation technology for developing countries. For effective utilization of investment and support, it is important to institutionalize a system to estimate reduction effect of CO_2 emission.

4.1.3 Countermeasures for Environment for Private Sector's Participation

For clearer understanding, the market related to renewable energy in Kenya should be classified into three groups as follows:

(i) IPP; business which generates and sell power to the grid
(ii) Self-energy supply business to existing own business: captive power development
(iii) Off-grid energy supply business

The Study Team proposes that the government conduct a study on related matters before conducting business in the three market of private sector above. The details are explained as follows.

(IPP Business)

KenGen is the main player in IPP business. It generates power by hydro, wind and geothermal systems and has plans to further utilize bio fuel. Support to this group of players is most effective if quantitative expansion of renewable energy is expected. If the government can show the scale and feasibility of the project to be developed by IPP at reliable level through master plan study and feasibility study (F/S), it would facilitate participation of IPP operators.

REA reported that there are 150 mini-hydro potential sites and surveys to other potential sites on hydropower development are still proceeding. The F/S of the projects of which developers plan to apply feed-in-tariff is now conducted by developers under the permission of a feed-in-tariff commission composed of MoE, Kenya Power and Lighting Co. Ltd. (KPLC) and Energy Regulatory Commission (ERC). Conducting the F/S is an economic burden to the developer. Therefore, it is proposed that the government execute basic survey and publish obtained results to offer developers of potential sites in public.

(Self-energy Supply Business)

In case of self-energy supply operator, various configurations of development are expected such as 100% of supply for self-consumption, for self-consumption and sale to the grid, and cooperative development with the IPP operator. The developer may refuse the disclosure of information to be obtained by the study and fairness to apply public fund may not be completely ascertained because resources to be developed is almost owned by the developer. However, there are some possibilities for this kind of business to be also the target of the study mentioned above.

(Off-grid Energy Supply Business)

Technical study support to off-grid energy supply business for each site is not realistic since the scale per site is considerably small such as that of Solar Home System (SHS). Business operator will easily prepare plan for renewable energy business if the government conducts nationwide study and show appropriate combination of potential of energy demand and renewable energy. Additionally, participation risk for private operator will be reduced if the pilot project is conducted to show the business model based on the most appropriate combination and profitability as business. The Energy Kiosk project by UNIDO can be regarded as a pilot project. However, if the potential study of energy demand and renewable energy was done before implementing Energy Kiosk project, the project would show the further attractive effects.

4.1.4 Countermeasures for Improvement of Financial Environment

Three issues namely, 1) Short repayment period, 2) High interest rate, and 3) Requirement of collateral, are pointed out in Section 2.3.3.

Resolving the above issues leads to the improvement of financial environment. The issue on collateral is now being improved by the policy and efforts of local banks. Grant aid fund and soft loan is effective in solving the issues on repayment period and interest rate.

For example, establishing of trust fund for development and expansion of utilities for renewable energy like medium/mini hydro and PV system through international organizations (such as the World Bank and UNIDO) is considerable based on grant aid fund. In case of UNIDO, comprehensive cooperation, not only for electrification, is also possible since UNIDO supports development[31] at the community level.

It is considerable to delegate fund management to governmental financial institutions like Agriculture Fund Corporation (AFC)[32], which specializes in village development. Moreover, such institution provides financial services to individuals and small enterprises in the village through low interest rate and long repayment period loans. Repayment is expected as the source of revolving fund[33] and to promote long-term finance to private sector.

Introduction of long repayment period and low interest rate through two-step loans is also considerable. Two-step loan is expected to make long-term finance easier in the private sector while banks capitalized by the government are expected to be the bridge bank in Kenya.

There are no financing provided to private sector related to renewable energy without the support of donors since there are no such institutions providing long term finance except development banks, regardless of the financial demands. The reason for not realizing the financing to private sector is the financial institutions' reluctance in providing long-term loans due to risks to the cash supply side of the project (e.g. for every several hundred million yens of small-hydro and cogeneration of bagasse). In such case, grant aid or soft loan is indispensable.

[31] Construction of Energy Kiosk and LED lantern assembly in Kenya
[32] See Section 2.3.2.
[33] See Section 2.3.2. The team received a comment that "Japanese non-project grant aid is utilized as revolving fund" from AFC.

In case the system involves costly energy such as SHS, commercial banks do not accept applications since the main customers are the poor villagers. Furthermore, banks refuse to prepare small-scale loans to accommodate such applications. The reason for this is the bad cost performance as the loaned amount is too small leading to dead loans, which are beyond the business of commercial banks.

Although there are many financial commodities, none of these is related to renewable energy. Private enterprises can participate in renewable energy business only after preparation of specific and practical rules. In such situation only, demand for fund is determined and necessity for financing is realized. Lack of policy and law scheme cause delay of dissemination of renewable energy and disturbs the participation of financial institution. Establishment of renewable energy law and arrangement of institution is also important from the aspects of improvement of financial environment.

4.1.5 Countermeasures for Capacity Building

As mentioned in Section 4.1.1, the key factor of capacity building is to design the capacity building as strategic tool for promotion and dissemination of renewable energy. After the dissemination of renewable energy being on the track of stable increasing, effect of capacity building will be ensured by conducting vocational training according to the demand of the human resources in the market of renewable energy.

Design of capacity-building programs is important until the time when renewable energy dissemination gets on track to increase on its own and by that the demand of human resource in this sector increases.

The Study Team proposes the following regarding capacity building:

- Development of human resources for persons who can start up renewable energy business (See: **Appendix 2**)
- Development of human resources for the business professional
- Preparation of framework for development of human resources to start up renewable energy business

At first, starting up the business related to renewable energy is necessary. It is effective to develop eligible human resources who can start the business. In this case choosing candidates with entrepreneur spirit and ability is important.

Since the demand related to renewable energy is still small, it is important to develop human resources in specific occupations in which the trained persons can be business professional with the knowledge or technology of renewable energy. For example, teaching staff in universities could qualify for the educational and research posts. He/she can contribute to the promotion of renewable energy through education and research fields, and can earn a living if he/she can be trained as specialist of renewable energy.

Dissemination and promotion of strategy of renewable energy is effective if framework of capacity building to promote starting up renewable energy business is established. Framework

of capacity building in universities involving the private business sector and entrepreneurs will be effective on the dissemination and promote of renewable energy business.

After the demand of human resource related to renewable energy is increased, the training for technician in each related field, especially for maintenance and operation, becomes effective.

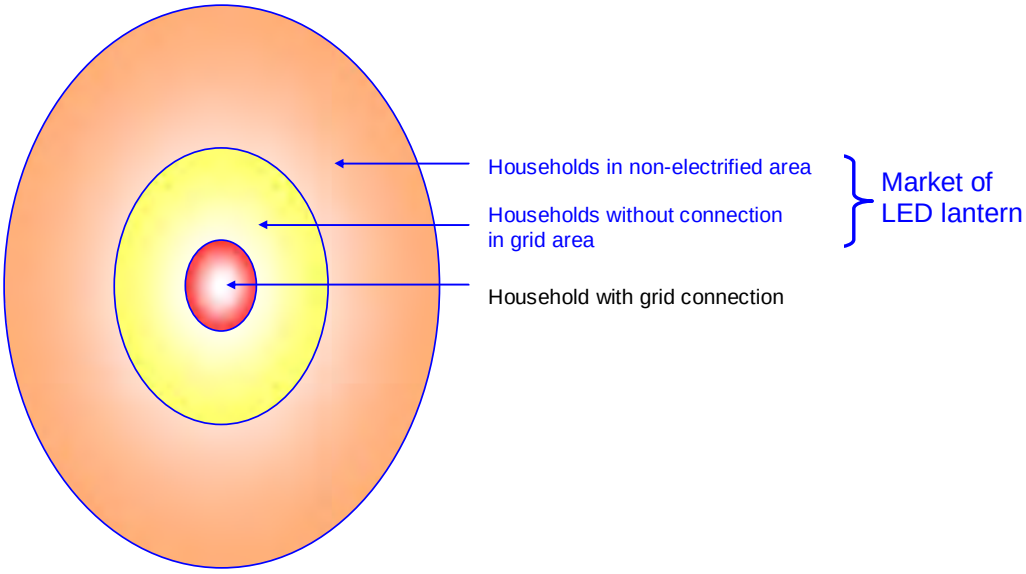
4.1.6 Countermeasures for Technology Introduction

As mentioned in Section 4.1.1, there is no renewable energy technology that has been identified to be provided with support for dissemination.

The Study Team proposes the following three technologies which are not yet pervasive in Kenya, expected to be disseminated in the private sector, and of which dissemination seems to be beneficial for the nation.

- Rechargeable Light Emitting Diode (LED) Lantern
- Straight Vegetable Oil (SVO)
- Solar water heater

LED is a new technology. However, it will be disseminated even in developed countries from now. Although it is not a renewable energy, it is regarded as a sidebar technology if the power source is renewable energy like PV. The World Bank and IFC is promoting LED lantern in its “Lighting Africa” project, while UNIDO is also supporting the assembly of LED lantern and promoting those as a rechargeable device in the Energy Kiosk. The dissemination of LED lantern in the private sector has been initiated and there is high possibility of rapid-growth dissemination. High needs, reasonable price and ease of maintenance are conditions to be promoted to the private sector. LED lantern purely meets the lighting needs and its price is now reasonable for the public. It is also easy to maintain compared to SHS. These fulfill the conditions for dissemination. Market of LED lanterns includes not only non-electrified villages but also households without grid connection in the area covered by grid as shown in **Figure 4.1.6-1**. Therefore, potential demand is huge. The technology can greatly contribute to the improvement of electrification ratio in Kenya.



Prepared by JICA Study Team

Figure 4.1.6-1 Market of LED Lantern

There are many technologies related to bio energy. However, SVO is a simple technology utilizing oil-plant seed like sunflower. SVO was used as fuel of diesel engine back in those days when diesel engine was developed. The SVO can be an alternate to diesel oil. Therefore, the technology should be supported to by the government as it has big market and can reduce quantity of fossil fuel imports. Although UNIDO introduced a diesel generator as power source to Energy Kiosk, SVO production is not progressive because cultivation of sunflower as material was not going well.

Solar water heater is an existing technology and has already been popular in many countries, but not in Kenya. Energy conservation effects can be expected if electric water heater can be replaced with solar water heater, and it can contribute to the energy conservation of the country.

4.2 Uganda: Issues and Countermeasures

4.2.1 Issues for Promotion of Renewable Energy in the Private Sector

Issues for promotion of renewable energy in Uganda are almost similar to those of Kenya as presented in Section 4.1.1. The differences are in policy and institution, and financing environment, which are described as follows.

(1) Policy and Institution

Unlike Kenya, the clear keynotes and policies are documented in Uganda and the framework of institution for promoting renewable energy is ready. The matter to be addressed as a next step is to monitor the effectiveness of the existing institutions and enhance them if necessary.

The other two issues, political activation of educational campaign and countermeasure to global warming, are similar to that of Kenya.

(2) Financing Environment

Similar to Kenya, the biggest issue in promoting renewable energy is the difficulty in financing. Its difference with the case in Kenya is that there is already an existing framework of financing in Uganda: the Energy for Rural Transformation (ERT). It is effective to utilize such framework to solve issues in Uganda.

4.2.2 Countermeasures for Policy and Institutional Design

The clear policy and framework of institution to promote renewable energy is ready. Method to improve is to enrich each institution within the framework.

For example, feed-in-tariff introduced in 2007 is presently working. However effects appear much limited than what was expected. This can be improved if the tariff is revised.

Individual institutions are bound to focus on PV system concerning preferential taxation. It is necessary to enrich institutions for other renewable energy sources as initial incentives. Solar water heater can significantly reduce electricity consumption while dissemination of biomass fermentation gasification system can be effective to curb deforestation. For these, specific institutional design focusing on several points is the next step to be taken in Uganda.

Regarding the issue on unfamiliarity and lack of knowledge on renewable energy, the Study Team proposes that educational campaign activity thorough media should be done.

The movement of enhanced countermeasures to global warming means increase of opportunity in receiving investment and support to introduce renewable energy and energy conservation technology for developing countries. For effective utilization of investment and support, it is important to institutionalize a system to estimate reduction effect of CO_2 emission.

4.2.3 Countermeasures for Environment for Private Sector's Participation

Similar to Kenya, it is easy to understand if the market related to renewable energy in Uganda is classified into three groups, as follows.

(i) IPP; business which generates and sell power to the grid
(ii) Self energy supply business to existing own business: captive power development
(iii) Off-grid energy supply business

The Study Team proposes that the government conduct a study on related matters before conducting business in the three market of private sector above. The details are explained as follows.

(IPP Business)

Support to IPP business is most effective if quantitative expansion of renewable energy is expected. If the government can show the scale and feasibility of project to be developed by IPP at reliable level through master plan study and F/S, it will facilitate participation of IPP operator. Such technical study to arrange the development of environment for potential project of IPP business is a suitable field to attain cooperation from Japan. Promising renewable energy to be

developed are hydro, geothermal, and bio-energy.

There are 50 mini-hydro potential sites and surveys of other potential sites for hydropower development are proceeding. In the current institution, F/S is now conducted by developers under the permission of REA. F/S is an economic burden to developer, therefore, it is proposed that the government conduct basic survey and publish its results to offer developers of potential sites in public.

(Self-energy Supply Business)

In case of self-energy supply operator, various configurations of development are expected such as 100% of supply for self-consumption, for self-consumption and sale to the grid, and cooperative development with the IPP operator. The developer may refuse the disclosure of information to be obtained by the study and fairness to apply public fund may not be completely ascertained because resources to be developed is almost owned by the developer. However, there are some possibilities for this kind of business to be also the target of the study mentioned above.

(Off-grid Energy Supply Business)

Technical study support to off-grid energy supply business for each site is not realistic since the scale per site is considerably small such as that of Solar Home System (SHS). Business operator will easily prepare plan for renewable energy business if the government conducts nationwide study and show appropriate combination of potential of energy demand and renewable energy. Additionally, participation risk for private operator will be reduced if the pilot project is conducted to show the business model based on the most appropriate combination and profitability as business.

4.2.4 Countermeasures for Improvement of Financial Environment

In Uganda, same as Kenya, it is difficult to obtain a long-term fund in the financial market and the interest rates are high. The countermeasures are basically same as that in Kenya. Practical solution is to utilize grant aid from donor or soft loan. ERT, which is already implemented, is improvement of the existing financial environment.

Aside from ERT, the Study Team proposes individual improvement strategies as follows:

- The government should understand that dissemination of renewable energy leads to carbon credit, and should realize that all relevant players like investors and developers/promoter of the project can benefit from said carbon credit. By doing so, economic efficiency is improved, willingness to invest is increased and financial institution can make decision to finance such projects more easily.
- It is reported that negotiation duration of Power Purchase Agreement (PPA) is considerable which affects the progress of IPP project. Mini-hydro and bagasse cogeneration system are possible projects to connect and sell extra electricity to the grid. Such scheme requires PPA negotiation and there is a possibility to promote such project if duration of PPA negotiation can be shortened. In such circumstance, some plans and improvement such as preparation

of PPA standard for each generation technology desired to be administered by Electricity Regulatory Authority (ERA). If this is realized, there is a possibility that financial procedure and decision can be made smoothly when project receives finance. As a result, circumstance of development financing is improved.

4.2.5 Countermeasures for Capacity Building

In Uganda, circumstance of human resources of renewable energy is same as in Kenya. Significant demand of human resource has not yet been called for. Therefore, the Study Team proposes the following regarding the issues on capacity building.

- Development of human resources for persons who can start up renewable energy business (See: **Appendix 2**)
- Development of human resources for the business professional
- Preparation of framework for development of human resources to start up renewable energy business

Description for each item above is as discussed in Section 4.1.5.

After the demand of human resource related to renewable energy is increased, the training for technician in each related field, especially for maintenance and operation, becomes effective.

4.2.6 Countermeasures for Technology Introduction

As mentioned in Section 4.1.1, there is no renewable energy technology that has been identified to be provided with support for dissemination.

The Study Team proposes the following three technologies which are not yet pervasive in Uganda, expected to be disseminated in the private sector, and of which dissemination seems to be beneficial for the nation.

- Rechargeable LED Lantern
- SVO (Straight Vegetable Oil)
- Solar water heater

LED is a new technology. However, it will be disseminated even in developed countries from now. Although it is not a renewable energy, it is regarded as a sidebar technology if the power source is renewable energy like PV. High needs, reasonable price and ease of maintenance are conditions to be promoted to the private sector. LED lantern purely meets the lighting needs and its price is now reasonable for the public. It is also easy to maintain compared to SHS. These fulfill the conditions for dissemination. Market of LED lanterns includes not only non-electrified villages but also households without grid connection in the area covered by grid as shown in **Figure 4.1.6-1**. Therefore, potential demand is huge. The technology can greatly contribute to the improvement of electrification ratio in Uganda.

There are many technologies related to bio energy. However, SVO is a simple technology utilizing oil-plant seed like sunflower. SVO was used as fuel of diesel engine back in those days

when diesel engine was developed. The SVO can be an alternate to diesel oil. Therefore, the technology should be supported to by the government as it has big market and can reduce quantity of fossil fuel imports.

Solar water heater is an existing technology and has already been popular in many countries, but not in Uganda. Energy conservation effects can be expected if electric water heater can be replaced with solar water heater and it can contribute to the energy conservation of the country.

Chapter 5 POTENTIAL AREA OF INTERVENTION FOR OFFICIAL ASSISTANCE FROM JAPAN

5.1 Kenya: Potential Area of Intervention for Promotion of Renewable Energy in Private Sector

It is thought that there is high possibility for Japan to contribute to promoting renewable energy in the field of private business in Kenya.

Based on the preceding discussions, the challenges, countermeasures, and cooperation of Japan related to renewable energy promotion are summarized in five aspects, as shown in **Table 5.1-1** below.

Table 5.1-1 Cooperation of Japan for Promoting Renewable Energy as Private Business

Aspect	Challenge	Countermeasures	Cooperation of Japan
(1) Policy and Institution	No progress and more efforts needed for enhancement.	- Stipulation of basic policy - Review and monitoring of existing bylaws - Improvement of individual bylaws - Dissemination and educational campaign - Addressing global warming	Technical Cooperation
(2) Environment for Private Participation	Not good environment; necessary lowering hurdle and risk for private entities to enter the renewable energy business.	- Conduct of feasibility study by the government prior to implementation	Technical Cooperation
(3) Funding Environment	Strong requirement for long-term and low-interest funds and necessity for money supply.	- Introduction of grant money or soft loan from donors	Grant and/or Soft loan
(4) Capacity Development	Small demand for employment of related business to renewable energy and need for strategic human resource development.	- Training for personnel who can establish business of renewable energy - Training for personnel working in the category of business in which the personnel earns living by training - Preparation of the training framework to promotes establishment of renewable energy business	Technical Cooperation
(5) Introduction of Technology	Low priority given to technology that should be supported by the government and need prioritizing.	(Priority Technologies recommended by the Study Team) - Rechargeable LED Capacitor Lantern - Straight Vegetable Oil (SVO) - Solar Water Heater	-Technical Cooperation -Grant and/or Soft loan

Prepared by JICA Study Team

(1) Cooperation for Policy and Institution

Japan can contribute to the five aspects shown in **Table 5.1-1** by technical cooperation. Particularly, the Government of Japan committed to the target of cutting CO_2 emission by 25% from the 1990 level by 2020 and to adopt four initiatives on CO_2 emission at the United Nations Summit on Climate Change in September 2009. Summary of the four points declared as initiatives are as follows.

(i) Developed countries contribute additional public and private financing
(ii) The rule/process to measure the effects of assistance is developed
(iii) Consideration of predictable and innovative schemes is required
(iv) Assistance and protection of intellectual property rights are concomitant

The three points from (ii) to (iv) above are directly related to the development of policy and institution and these should be pursued as Japanese technical cooperation proactively.

(2) Cooperation for Private Sector's Participation Environment

The study before project implementation as shown in **Table 5.1-1** can be conducted as contribution of Japanese technical cooperation. Technical cooperation of Japan can easily be provided for all of three business groups categorized in Section 4.1.3.

In the case of hydropower development projects, the following items are considered as specific assistances:

- Collection and arrangement of hydraulic data
  - ✓ Addition, improvement and installation of stream flow observation station
  - ✓ Consolidation of stream flow observation scheme
  - ✓ Arrangement and compiling as database of stream flow observation data
  - ✓ Capacity development and improvement of technicians
- Implementation of Pre-F/S and F/S for mini-hydro project
  - ✓ Listing up of mini-hydro potential sites in rivers in whole country
  - ✓ Implementation of Pre-F/S and prioritization
  - ✓ Implementation of F/S for potential candidate sites
  - ✓ Addition of new data to existing database of mini-hydro and GIS

It is possible to provide the same kind of assistance for the development of wind power, geothermal and bio fuel, although there would be less number of potential sites compared to hydropower development.

(3) Cooperation for Improvement of Funding Environment

By this study, the shortage of long-term and low-interest funds is recognized as the biggest issue in the promotion of renewable energy. A two-step loan is applicable out of the tools of Japanese official assistance to the private market. Expected finance scale is from several million to hundred millions of yen per project. The projects of IPPs and captive power developers are the target of this scale of finance. For instance, cogeneration in the sugar factory and small hydro development in the tea factory are enumerated.

There is anxiety regarding shortage of related human resources when it considers providing two-step loan. Foreign contractors are assumed to be the contractors of the projects of which scale is suitable for a two-step loan. Therefore, the shortage of human resources and the capability of domestic resources are not considered to be obstacle at implementation stage of the project. Moreover, human resources will be developed most effectively through practical business. Local human resources will be developed effectively under the foreign contractors on the job training basis. In the financial field, it is effective to carry out capacity building simultaneously with two-step loan through technical cooperation.

(4) Countermeasures for Capacity Building

Japan can contribute three items shown in **Table 5.1-1** by technical cooperation.

For the training for personnel who can establish business of renewable energy, it will be effective to select "the few and the proud" staff with the right entrepreneurial spirit and ability, and send them to Japan for training[34]. Education and research of renewable energy will be a full professional work which can earn a living. Therefore, the Study Team proposes a capacity development assistance in renewable energy at Jomo Kenyatta University of Agriculture and Technology (JKUAT). Establishing framework to promote human exchange is considered effective to develop new business of renewable energy. In the assistance to JKUAT, it is recommended that preparation of framework to promote collaboration with entrepreneurs and business people be included.

The proposal related to capacity building assistance is shown in **Appendix 3**.

In the financial field, there is also a big need for capacity development. Thus, for good performance of the two-step loan, the Study Team considers it more effective to have human resources development programs in parallel with execution of the two-step loan.

(5) Countermeasures for Technology Introduction

The three priority technologies mentioned in **Table 5.1-1** have already been discussed in Section 4.1.6. It is possible to apply Japanese technical cooperation to assisting in the introduction of these technologies, as follows:

(Rechargeable LED Lantern)

Main components of the rechargeable LED lantern are (1) LED lamp, (2) storage elements, (3) control circuit, and (4) case. The LED lamp and storage elements are fundamental technologies to control the quality of the product and these are the advantages in Japan. Usually, the lead acid battery and rechargeable dry cell battery are applied as the storage elements, however a fairly complete maintenance-free and long-life product is realized if large capacity capacitor is utilized. Unlike conventional batteries, the large capacity capacitor, which is the newest technology of Japan, does not need to be replaced. Additionally, the environmental impact of disposing large capacity capacitors is much smaller than for conventional batteries, hence it has big contribution to environment conservation. For this reason, a LED lantern that utilizes large capacity capacitor as its storage element is proposed as the technology to be introduced. Since the main material of the large capacity capacitor is carbon, a rapid decrease in price is expected

[34] One of important factors for success flotation is human network. Human network itself and the ability to create human network are essential abilities for entrepreneurs. The way to improve possibility for success flotation in developing countries is introducing a business model which is already successfully implemented in a developed country or a new technology existing in a developed country. Japan introduced many business models and new technology from U.S. and European countries after WWII. In order to see, learn and introduce a new technology and business model and create the human network to realize them, it is most effective to visit developed country directly.
European countries and U.S. are also considered as candidates as developed countries, hence it is beneficial for Japanese enterprises if the project is implemented by Japan's ODA.
OJT at enterprises in Japan is an effective way of training. Big companies are also fine, however there is a higher possibility to start up the business if the trainee can create a network with active enterprises of medium/small scale. If it is realized, the project can contribute for Japanese medium/small enterprises, which is deadbeat currently.

at volume production stage. However, the permeation of large capacity capacitor is difficult without assistance of policy since it is so expensive at present. Comparison of the characteristics of the large capacity capacitor and conventional lead acid battery is shown in **Appendix 4**.

General grant aid is proposed as the Japanese cooperation scheme for assistance measures in the technology introduction. Considering the rechargeable large capacity capacitor LED lantern as a rural electrification infrastructure like grid since it is a maintenance-free and long-life product, this may be available to be included as grant equipment. The ownership of the lantern will belong to the government and the lantern will be provided to users on rental basis. Employment is created if the operation of the rental business is delegated to a private operator and setting it up as PPP (Public Private Partnership) project. There is an initiative to install the charging function with an electrification public facility as a general grant aid scheme of Japan. In such case, it would be effective if the project for public facility electrification includes the lantern, and then be positioned as a rural electrification project in the area around the public facility.

(Straight Vegetable Oil: SVO)

The success or failure of SVO introduction is dependent on the acquisition of the oil crop materials. It depends on whether the necessary quantity of oil crops is available at a suitable price or not. In particular, oil crops can be grown such that it will be the fusion between energy and agriculture. It will be effective to implement the project to make JKUAT as implementation body, reserve the land to grow oil crop, grow the crop, press oil and utilize SVO as a Japanese technical cooperation project.

(Solar Water Heater)

Existing electric water heaters and those still to be installed in the future are targets for replacement with solar water heater. Thus, it will be effective to include assistance in introducing electric water heaters in a Japanese technical cooperation project as energy conservation measure in locations already electrified, especially in urban areas.

5.2 Uganda: Potential Area of Intervention for Promotion of Renewable Energy in Private Sector

It is thought that there is high possibility for Japan to contribute to promoting renewable energy in the field of private business in Uganda.

Based on the preceding discussions, the challenges, countermeasures, and cooperation of Japan related to renewable energy promotion are summarized in five aspects, as shown in **Table 5.2-1** below.

Table 5.2-1 Cooperation of Japan for Promoting Renewable Energy as Private Business

Aspect	Challenge	Countermeasure	Cooperation of Japan
(1) Policy and Institution	Well provision. Improvement of effectiveness and other policy action required.	- Monitoring/review of existing institutions - Dissemination and educational campaign - Addressing global warming	Technical Cooperation
(2) Environment for Private Participation	Not good environment; it is necessary to lower the hurdles and risks for private entities to enter into the renewable energy business.	- Conduct of feasibility study by the government prior to implementation	Technical Cooperation
(3) Funding Environment	Strong requirement for long-term and low-interest funds and necessity for money supply. Utilization of existing framework, ERT is effective.	- Introduction of grant money or soft loan from donors	Grant and/or Soft loan
(4) Capacity Development	Small demand for employment of related business to renewable energy and need for strategic human resource development.	- Training for personnel who can establish business of renewable energy - Training for personnel working in the category of business in which the personnel earns living by training - Preparation of the training framework to promotes establishment of renewable energy business	Technical Cooperation
(5) Introduction of Technology	Low priority given to technology that should be supported by the government and need prioritizing.	(Priority Technologies recommended by the Study Team) - Rechargeable LED Capacitor Lantern - Straight Vegetable Oil (SVO) - Solar Water Heater	-Technical Cooperation -Grant and/or Soft loan

Prepared by JICA Study Team

(1) Cooperation for Policy and Institution

Japan can contribute to the three aspects shown in **Table 5.2-1** by technical cooperation. Particularly, the Government of Japan committed to the target of cutting CO_2 emission by 25% from the 1990 level by 2020 and to adopt four initiatives on CO_2 emission at the United Nations Summit on Climate Change in September 2009. Summary of the four points declared as initiatives are as follows:

(i) Developed countries contribute additional public and private financing
(ii) The rule/process to measure the effects of assistance is developed.
(iii) Consideration of predictable and innovative schemes is required
(iv) Assistance and protection of intellectual property rights are concomitant

The three points from (ii) to (iv) above are directly related to the development of policy and institution and these should be pursued as Japanese technical cooperation proactively.

(2) Cooperation for Private Sector's Participation Environment

The study before project implementation as shown in **Table 5.2-1** can be conducted as contribution of Japanese technical cooperation. Technical cooperation of Japan can easily be provided for all of three business groups categorized in Section 4.2.3.

In the case of hydropower development projects, the following items are considered as specific assistance:

- Collection and arrangement of hydraulic data
  - ✓ Addition, improvement and installation of stream flow observation station
  - ✓ Consolidation of stream flow observation scheme
  - ✓ Arrangement and compiling as database of stream flow observation data
  - ✓ Capacity development and improvement of technicians
- Implementation of Pre-F/S and F/S for mini-hydro project
  - ✓ Listing up of mini-hydro potential sites in rivers in whole country
  - ✓ Implementation of Pre-F/S and prioritization
  - ✓ Implementation of F/S for potential candidate sites
  - ✓ Addition of new data to existing database of mini-hydro and GIS

It is possible to provide the same kind of assistance for the development of wind power, geothermal and bio fuel, although there would be less number of potential sites compared to hydropower development.

(3) Cooperation for Improvement of Funding Environment

By this study, shortage of long-term and low-interest fund is recognized as the biggest issue on promoting renewable energy and this situation is the same as in Kenya. A two-step loan is applicable out of the tools of Japanese official assistance to the private market. Expected finance scale is from several million to hundred millions of yen per project. The projects of IPPs and captive power developers are the target of this scale of finance. For instance, cogeneration in the sugar factory and small hydro development in the tea factory are enumerated.

Yen loan to Uganda is currently not possible, therefore it is difficult to achieve implementation of a loan project in Uganda at present. Since this restriction is laid by Japan and is expected that it will not last for a long time, the two-step loan is still possible as the proposed scheme by Japan.

In the case of Uganda, introduction of the two-step loan by utilizing the ERT 2, which exists as financial mechanism, is considered effective.

There is anxiety regarding shortage of related human resources when it considers providing two-step loan. Foreign contractors are assumed to be the contractors of the projects of which scale is suitable for a two-step loan. Therefore, the shortage of human resources and the capability of domestic resources are not considered to be obstacle at implementation stage of the project. Moreover, human resources will be developed most effectively through practical

business. Local human resources will be developed effectively under the foreign contractors on the job training basis. In the financial field, it is effective to carry out capacity building simultaneously with two-step loan through technical cooperation.

(4) Countermeasures for Capacity Building

Japan can contribute three items shown in **Table 5.2-1** by technical cooperation.

For the training for personnel who can establish business of renewable energy, it will be effective to select "the few and the proud" staff with the right entrepreneurial spirit and ability, and send them to Japan for training[34]. Education and research of renewable energy will be a full professional work which can earn a living. Therefore, the Study Team proposes a capacity development assistance to Center for Research in Energy and Energy Conservation (CREEC) in Makerere University. Establishing framework to promote human exchange is considered effective to develop new business of renewable energy. In the assistance to CREEC, it is recommended that preparation of framework to promote collaboration with entrepreneurs and business people be included.

The proposal related to capacity building assistance is shown in **Appendix 3**.

In the financial field, there is also a big need for capacity development. Thus, for good performance of the two-step loan, the Study Team considers it more effective to have human resources development programs in parallel with execution of the two-step loan.

(5) Countermeasures for Technology Introduction

The three priority technologies mentioned in **Table 5.2-1** have already been discussed in Section 4.2.6. It is possible to apply Japanese technical cooperation to assisting in the introduction of these technologies, as follows:

(Rechargeable LED Lantern)

Main components of the rechargeable LED lantern are (1) LED lamp, (2) storage elements, (3) control circuit, and (4) case. The LED lamp and storage elements are fundamental technologies to control the quality of the product and these are the advantages in Japan. Usually, the lead acid battery and rechargeable dry cell battery are applied as the storage elements, however a fairly complete maintenance-free and long-life product is realized if large capacity capacitor is utilized. Unlike conventional batteries, the large capacity capacitor, which is the newest technology of Japan, does not need to be replaced. Additionally, the environmental impact of disposing large capacity capacitors is much smaller than for conventional batteries, hence it has big contribution to environment conservation. For this reason, a LED lantern that utilizes large capacity capacitor as its storage element is proposed as the technology to be introduced. Since the main material of the large capacity capacitor is carbon, a rapid decrease in price is expected at volume production stage. However, the permeation of large capacity capacitor is difficult without assistance of policy since it is so expensive at present. Comparison of the characteristics of the large capacity capacitor and conventional lead acid battery is shown in **Appendix 4**.

General grant aid is proposed as the Japanese cooperation scheme for assistance measures in the technology introduction. Considering the rechargeable large capacity capacitor LED lantern as a rural electrification infrastructure like grid since it is a maintenance-free and long-life product, this may be available to be included as grant equipment. The ownership of the lantern will belong to the government and the lantern will be provided to users on rental basis. Employment is created if the operation of the rental business is delegated to a private operator and setting it up as PPP (Public Private Partnership) project. There is an initiative to install charging function with an electrification public facility as general grant aid scheme of Japan. In such case, it is effective that the project for public facility electrification includes the lantern and be positioned as rural electrification project centering on public facility.

(Straight Vegetable Oil: SVO)

The success or failure of SVO introduction is dependent on the acquisition of the oil crop materials. It depends on whether necessary quantity of oil crops is available at a suitable price or not. In particular, oil crops can be grown such that it will be the fusion between energy and agriculture. It will be effective to implement the project to make the National Agricultural Research Organization (NARO) already supported by Japan for NERICA Rice Promotion Project, as implementation body, reserve the land to grow oil crop, grow the crop, press oil and utilize SVO as Japanese technical cooperation project.

(Solar Water Heater)

Existing electric water heaters and those still to be installed in the future are targets for replacement with solar water heater. Thus, it will be effective to include assistance in introducing electric water heaters in a Japanese technical cooperation project as energy conservation measure in locations already electrified, especially in urban areas.

Chapter 6 CONCLUSIONS AND RECOMMENDATIONS

(CONCLUSIONS)

1. **Present Situation:** Renewable energy has not prevailed much as a private business in both Kenya and Uganda except for PV system for rural electrification. Introduction of PV system is progressing more in Kenya than in Uganda. The number of rural households electrified by PV system in Kenya is about 56% of the total number of rural electrified households based on the data in 2007/08. Other cases of renewable energy introduction are cogeneration with bagasse in sugar mills and hydropower development in tea factory in both Kenya and Uganda.
2. **Policy and Institution:** Policies and institutions for promotion of renewable energy are still underdeveloped in Kenya. Although there are the tax incentives for renewable energy equipment and the feed-in tariff for electricity generated by renewable energy, the related policy documented has not been formulated. In Uganda, meanwhile, under a comprehensive policy document, various institutions are already prepared for renewable energy promotion. In addition, there are needs related to the development of institutions to address global warming in both Kenya and Uganda.
3. **Financial Situation:** The biggest bottleneck for promoting renewable energy is the lack of long-term and low-interest financing in both countries. The maximum loan term is five to seven years, and is usually four years even in the case of development finance. Furthermore, the interest rates are around 10% per year. Micro-credit in both countries is prevailed by SACCOs and others, with interest rate of around 30 percent per year and repayment period of around 24 months.
4. **Cooperation of Japan:** The following cooperation is considered effective in promoting renewable energy in Kenya and Uganda: (1) development of institutions to address global warming; (2) development of environments to facilitate private sector's participation in renewable energy projects; (3) providing two-step loans - the expected borrowers are IPPs, captive power developers like sugar factories and tea factories, and the organization handling micro-credit; (4) human resource development; (5) promotion of rechargeable LED capacitor lanterns as Public Private Partnership (PPP) utilizing grant aid scheme, promotion of SVO under the scheme of technical cooperation project, and promotion of solar water heaters under the technical cooperation for energy conservation.

(RECOMMENDATIONS)

5. **Cooperation Order:** It is important to set the order of cooperation properly. If it is a two-step loan, implementing a master plan study or F/S to facilitate participation of private entities like IPP is expected to develop renewable energy business. Subsequently, this order will bring about effective cooperation. In case of human training, conduct trainings or human resource development intended for the entrepreneur, education staff and researchers. It is then recommended to execute vocational trainings that specialize in renewable energy technology according to the increase of manpower needs in the field of renewable energy business.
6. **Packaging of Cooperation:** Packaging of two or more cooperation projects or with private business for formulating PPP is proposed. For instance, it is effective to execute a two-step loan and personnel training on financial field together as a package. In case of implementing electrification of public facilities

with the function of charging station under grant aid scheme, it is proposed to include rechargeable LED capacitor lantern as grant aid materials and initiate partnership with private business entity who lend the lanterns to residents around the public facility. This packaging of grant aid and private business will significantly contribute to the promotion of rural electrification.

7. **Creating New Demand:** The borrowers of the two-step loan are anticipated to be IPP entrepreneurs and captive power developers. The effects of such loan improve further if it creates new demand of renewable energy, hence, the loan borrowers. An example of potential demand with high possibility includes the tourism field such as eco-tourism lodges. It proposes the execution of the work to create such new demand in an organized manner.

Appendix1

Photos

1. Kenya

Photo K-1 Energy Kiosk with Small Hydro and PV at Kibae in the Foothills of Mt. Kenya (2009/4/17)

Kibae Energy Kiosk supported by UNIDO

PV Modules (500 Wp)

Intake and Pipelines (PVC 150 mm) of Small Hydro

Turbines/Generators mad in China (1 kW x 2 Nos.)

Electric Feed Processor and Incubator

Charging of Mobile Telephones (Ksh 5/time) and LED Lanterns(Ksh 10/time)

Service Business of Computer, Internet and Photo Copy

Business of Small Theater with TV and DVD

Photo K-2 Biogas Energy Kiosk at Kamahuha in the Foothills of Mt. Kenya (2009/4/17)

Kamahuha Market Services Center supported by UNIDO

Chopping of Banana Trunks (300 kg/day)

Hydrolysis Tank with Banana Trunks

Solar Water Heater for Temperature Control

Tank for Gas Produced ($4m^3$)

Methane Gas Generators (10 kW x 2 Sets)

Methane Gas Cooker

Battery Charging Business of LED Lanterns

Photo K-3 Home Electrification by Small Hydro at Mdea in the Foothills of Mt. Kenya (2009/4/17)

Intake Weir in a Stream of 2 m Wide

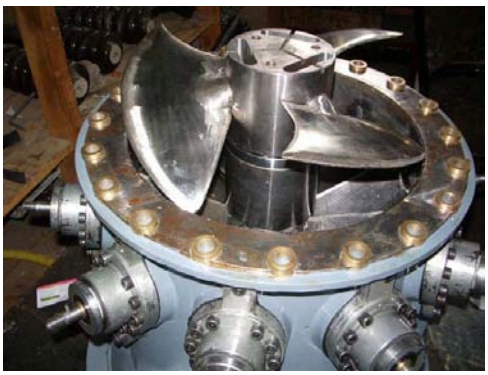
Power Station about 50m below the Intake

Turbine/Generator of 1.5 kW operated for 2 hours each Morning and Evening

Distribution of Power to 120 Households (Possible to use 8 W Electric Light and White&Black TV)

Photo K-4 Workshop of NGO Greenpower for Turbines and Generators in Nairobi (2009/4/20)

Turbine for Discharge of 1.2 m^3/s, Head of 11 to 22 m and 100 kW



Kaplan Turbine

Workshop manufacturing a Unit per 3.5 months

Generator made in France and Turbine in Nairobi

Photo K-5 Energy Kiosk by Small Hydro at Boito near Kericho (2009/4/24)

Intake and Waterway of PVC Pipes in Chemosit River

Waterfall and Hydropower Station

Turbines/Generators made in China (1 kW x 2 Sets)

Battery Charging Business of Mobile Telephones

Photo K-6 Eco Lodge with PV at Gilgil near Nakuru (Malewa Wildlife Lodge) (2009/4/24)

PV Module for Electric Fence (150 W)

PV Modules for Lighting in Lodge (1,280W)

Batteries (12 nos. x 350 Ah) and Standby Generator (12.5 kVA)

PV Module for Refrigerators and Freezers (800 W)

Photo K-7 Wind Power at Homabay by Lake Victoria (2009/4/25)

Wind Power Facility on a Hill supported by Nairobi University and UNIDO

Wind Power Turbine (2.5 kW, Tail is broken.)

Charging Facility of Kochia Development Group

Electric Light of 8 W in the House of the Chairlady

Photo K-8 Biogas Production Facility at Homabay by Lake Victoria (2009/4/25)

Biogas Facility under Construction supported by UNIDO & KIRDI

Wastes in the Slaughter House

Drying of Leavings of Fish (Nile Perch)

Use of Bio-gas for drying and Frying Fish Leavings

Photo K-9 Battery Charging Business at Homabay by Lake Victoria (2009/4/25)

Battery Charging Business Shop

Mobile Telephone Charging (Fee at Ksh 15/time)

TV Battery Charging (Fee at Ksh 10/time)

Monthly Electricity Fee at Ksh 500, Charging Business Income at Ksh 6,000

Photo K-10 Sondu/Miriu Hydropower Station at Nyando by Lake Victoria (2009/4/26)

Regulating Pond at Intake Weir in Sondu River

Intake Weir

Steel Pipe Lines and Powerhouse

Powerhouse (60 MW)

Photo K-11 Rice Mill at Ahero by Lake Victoria (2009/4/26)

Paddy Fields at Ahero

Rice Mill at Ahero

Inside of Rice Mill

Rice Hulls outside Rice Mill

Photo K-12 Battery Charging Shop with PV in Baringo, Northern Kenya (Photos by the Study Team for Public Facility Electrification)

PV Modules

Inverter

Batteries

Mobile Telephones under being Charged (Ksh 15/time)

Photo K-13 Kenya Industrial Research and Development Institute (KIRDI) (2009/4/29)

Entrance of KIRDI

Biomass Gasification Test Plant

Steel Processing Machines

Plastic Processing Machines

Cotton Gin

Ceramics Laboratory

Stainless Steel Workshop

Flour Mill and Potato Slicer by Bicycle Power

Photo K-14 Jomo Kenyatta University of Agriculture and Technology (2009/4/22)

Research, Production & Extension Division

Laboratory

Building in the University

Buildings in the University

Photo K-15 Wind Power Station at Ngong Hill (Photos by the Study Team for Public Facility Electrification)

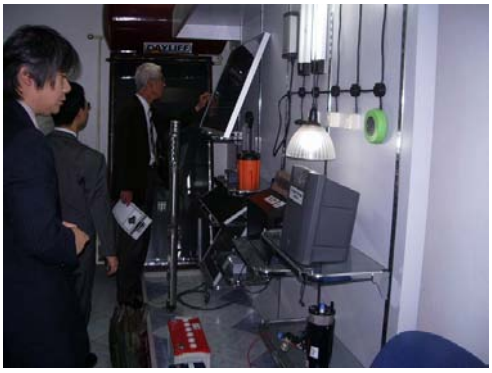
Wind Power Turbines (200 kW & 150 kW)

Wind Power Turbine

Scenery of Rift Valley from Ngong Hill

Plate of 250 VA Wind Power Turbine

Photo K-16 Shop to sell PV Facilities (2009/4/29)



Exhibits of Solar PV Facilities in Davis & Shirtriff

Exhibits of Solar PV Facilities in Davis & Shirtliff

Photo K-17 Water Sale Business with PV (Photos by the Study Team for Public Facility Electrification)

Water Well

Water Supply House, PV Modules and Water Tank

PV Modules and Water Tank

Water Supply House

Price Table (Ksh 3 per 20 lit.)

Prepaid System utilizing Wireless System for Mobile Telephones

Photo K-18 Rechargeable Lanterns (Photos by the Study Team for Public Facility Electrification)





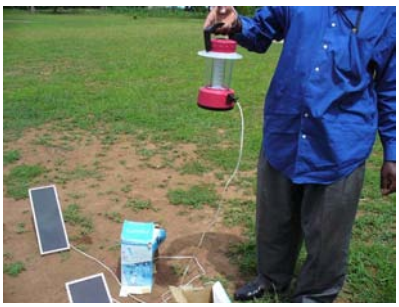





Photo K-19 Tea Factory and Small Hydropower Station (Photos by Nippon Koei in 2004)

Entrance of Mogogosiek Tea Factory at Kericho in Kenyan Tea Development Agency Ltd. (KTDA)

Mogogosiek Tea Factory in KTDA

Waterfall using for Hydropower for Mogogosiek Tea Factory

Waterway for Hydropower

Steel Pipe Lines and Powerhouse

Powerhouse (Left) and Pump house (Right)

Hydraulic Turbine and Generator

One of Many Waterfalls existing in Kericho