Renewable Energy Resources, Policy and Investments with Emphasis on Geothermal Energy.

Ministry of Energy & Mineral Development

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Renewable energy resources

Renewable sources of energy are those that are replenished continuously by a natural process

- These include; biomass, Solar, wind, hydro geothermal and others
- However biomass ceases to be a renewable energy if not used sustainable
- They can be can be transformed into modern energy services to provide clean, sustainable, and affordable energy
- Their potential for power generation is given in Tables 1 and 2

Renewable Energy Potential

- Rural electrification stands at 4%
- Abundant renewable energy resources like hydro, plentiful biomass, Solar, geothermal and others.
- Renewable Energy Technologies can give the least cost and affordable options for supporting rural electrification to support:
  - agricultural production,
  - food processing, and small scale industries.
  - Increased access of electricity to key social services like Schools, hospitals, community centres
  - and water and sanitation services.

Table:1 Resources potential for power generation in Uganda

Energy Source	Estimated Electrical Potential (MW)
Hydro	2,000
Mini-hydro	200
Solar	200
Biomass	1650
Geothermal	450
Peat	800

Renewable Energy Policy

- Government has adopted a Renewable Energy policy whose goal is to increase the use of modern renewable energy from the current 4 to 61% of the total energy consumed by 2017
- This goal is to be achieved through implementation of several programmes, namely;

RE programmes

- Power generation using renewable energy generation plants
- Rural and peri-urban electrification through subsidized community based projects

  Modern energy services; stoves, Solar PV, fuel wood substitution by LPG
- Energy Efficience in all sectors of the economy
- Biofuels programme

Barriers to Geothermal energy development.

- Lack of adequate technical data and general information to stimulate investment.
- Inadequate Technical and Institutional Capacity to implement and manage the investments
- Lack or inadequate financing mechanisms to facilitate the development and promotion of geothermal energy
- Lack of or inadequate Research and Development geared to strengthening local manufacturing capacity in geothermal energy technology;

Barriers to geothermal energy development Cont'd

- High upfront financial resources for the drilling of exploratory wells.
- There are many influencing factors affect efficiency that are site specific (type, temperature and depth of well, chemical properties,
- There problems associated with the type of technology used, distance to electricity network, etc.)

Policy Principles

Renewable Energy Power Investment < 20MW

- Feed in tariffs and standardized power purchase agreement

- Business environment is made more predictable
- Reduced transaction costs
- Cogeneration plants are already being implemented.
  Kakira Sugar Factory(18 MW) and Kinyara Sugar Works (5 MW)

This will increase the accessibility of electrical power for productive use, and to middle income households and spur economic development

Table 3: Comparison of Geothermal with other energy supply options

Source	Electricity	Heat	Fuel	**Chemical products**
Fossil oil	High	High	High	High
Natural gas	High	High	High	High
Nuclear power	High	Low	Low	-
Solar PV	Low	Low	Low	-
Geothermal	High	High	Low	-
Hydro-power	High	Low	Low	-
Wind	Medium	Low	Low	-
Biomass	High	High	High	High

Policy actions

RE policy sets out specific targets for implementation of:

- Power generation using renewable energy generation plants
- Rural and peri-urban electrification
- Modern energy services delivery; stoves, Solar PV, fuel wood substitution by LPG
- Energy Efficiency in all sectors of the economy and Biofuels programme as shown in the following slides

Table 4: Renewable Energy Programmes

PROGRAMMES	**BASELINE**	**CUMULATIVE TARGETS**	
1. Power Generation	**2007**	**2012**	**2017**
Mini and micro hydro (MW installed)	17	50	85
Cogeneration (MW installed)	15	35	60
Geothermal (MW installed)	0	25	45
Municipal Waste (MW installed)	0	15	30
2. *Rural Electrification and Urban Access*	**2007**	**2012**	**2017**
3. *Biofuels* (Ethanol, Biodiesel) (m^3/a)	0	720,000	2,160,000
4) Energy Efficiency	**2007**	**2012**	**2017**
Solar water heaters (m^2 installed)	2,000	6,000	30,000
Energy savers (No)	1,000,000	2,000,000	4,000,000
Industrial energy audits implemented (No)	20	70	300

Potential demand for Energy services

There exist high demand for energy services in the areas of social services provision such as:

-Health

- Education sectors

-Water supply &

-Productive uses

Potential demand for energy services Cont'd

- In determining the potential demand for social and productive use of energy services, the following has been used:
- Typical health clinic
- A typical rural school
- A rural household and a
- Typical trading centre

Assumptions in deriving energy services demand

Rural electrification gap

- The population of Uganda is taken at 30 million
- average household size taken at 6 people per household
- 5 million households
- 80% of the population live in the rural areas
- 4 million rural households
- A rural electrification rate of 4 % is used
- 160,000 are electrified using one method or another
- Un-electrified rural population 3.840 million households

Table 6: Power requirements for a clinic based on solar PV

Area	Power requirements (W)
Outpatient ward	200
Martenity	200
Administration office with a computer	500
4 Staff quarters	200
Laboratory	40
Vaccine refrigeration	250
Water pumping	400
Total	1790

Table 7: Power requirements for a rural school (400 students)

Area	Power requirements (W)
4 classrooms (lighting)	90
Staffroom (lighting)	40
Admin. Office lighting and computer	540
Security lights	40
Boarding section	120
Water pumping	1200
5 units, staff quarters	250
Total	2280

Energy Requirements for trading Centre

Population of 3,000 people

- 30 shops, clinics and a few schools
- 2 mechanical workshops
- 1 motor garage
- Maize mills and carpentry workshops
- A filling station
- Generally using 50 KVA transformer

Table 8: Energy services demand

Location	Energy service	Units	Access	Gap	Unit Demand	Total Demand
H'holds	Lighting, radio, TV and telephone	4.0 million	160,000	3.80 million	50W	190 MW
Clinics	Lighting, water pumping, laboratory, computer	4006	2003	2003	1790W	2.0 MW
Schools	Lighting, water pumping, laboratory, computer	22,000	1,000	21.900	22800W	50MW
Trading centres	Productive use	5,500	550	4,950	50KW	249MW
Total						490MW
H'holds	Cooking	5.0 million	500,000	4.5 million	1	4.5 million
Clinics	Cooking	4006	100	3,906	3 stoves	11,718
Schools	Cooking	22,000	1,000	21,000	3 stoves	63,000
Institutional demand						74,720

Geothermal in Rural Energy

Geothermal provides a potential for

- Mini grids of 5-10 MW to meet the electrification gaps

Source of heat for industrial application

- Water supply in rural areas

Table 9: RETs Investment Costs

Technology	Capacity	Investment cost	Functions
Institutional wood cookstoves	150-300Ltrs	US$7.5/ltr	Cooking
Solar PV		US$ 12-15/W	Lighting, telecommunication, water pumping etc
Solar Water Heating		US$ 0.8-1.5/W	Institutional, industrial and domestic water heating
Biogas	$8m^3$	US$ 1,350	Cooking, lighting and power generation
Gasification	250KW	US$ 400,000	Power and heat
Cogeneration	1 MW	US$ 1.2 million	Power and heat
Wind Turbine	10-100KW	US$ 800-1300/KW	Power and heat
Small hydro	US$	US$3000/KW	Power and heat
Geothermal	1 MW	US$ 2	Power and heat

Geothermal Investment Costs

According to Kenya Generation Company (Kengen) the cost of development a one MW geothermal power unit are:

- Drilling Campaign US$ 3.5 million
- Casting US$1.0 million
- Ground infrastructure and turbines/MW US$ 2.0 million
- Total investment cost US$6.5 million

Development of Uganda's 450MW potential require an investment of over US$ 900 million for the ground infrastructure and turbines.

Conclusion

- Geothermal can provide an affordable energy for national development especially for the rural areas

  However we should realize that meaningful geothermal development rotates around the issues of

- Institutional capacity building and frameworks

- Fiscal and financial incentives for investment