Energy Needs for Achieving MDGs in Eritrea

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The Eritrean economy, particularly the rural economy, still heavily depends on traditional fuels. Biomass fuels accounted for 64% of the total energy production in Eritrea in 2003, but rural households derived 94% of their energy from unprocessed traditional fuels, mainly fuel wood, charcoal, dung and agri-residues. Only 3% of the rural population have access to electricity in Eritrea. Without massive intervention, this heavy dependence on biomass sources is likely to continue for the foreseeable future. It is not so much the use of biomass fuels that raises concerns and apprehension; it is the unsustainable manner in which they are being managed and used which raises numerous environmental concerns. In Eritrea, forest off take is estimated at 2.4%-2.8% compared to the threshold for sustainability of 1.25%. The use of inefficient stoves and appliances by majority of rural households has led to sever depletion of wood fuel resources and high health hazards from pollutants emitted during the combustion of biomass fuels in poorly ventilated houses. The link between energy and gender is stark and clear as the burden of the collection of traditional fuels and domestic cooking falls on women and children. The opportunity cost of the time spent in collection of biomass fuels by rural women in terms of production loss is quite high.

According to the Living Standards Measurement Survey (LSMS) carried out by the National Statistics office in 2003, the poor constitute about 66 percent of the Eritrean population, of which about two-thirds live in rural areas and the remaining 33 percent in urban areas.

It is known that there was no particular explicit target related to modern energy provision to the poor or the energy requirements for the Millenium Development Goals (MDGs), yet affordable energy is an essential parameter for achieving all these goals. As indicated in the Interim National Poverty Reduction Strategy Paper (I-PRSP), the Government of Eritrea (GoE) emphasizes that access to sustainable source of energy by the poor is a necessary and critical input for poverty alleviation and sustainable human development by creating or expanding income generation and for providing a host of social services: educations, health care, clean water supply, communications and so on. The link between energy and these services is detailed out in the table below.

In its long-term program that ranges up to 2015, the Ministry of Energy and Mines has schemed energy development programs proper to poverty alleviation, education, water and environment sustainability, with particular attention to the development of alternative energy resources and proper utilization of the available energy resources. The goal is, "to reduce by half, between 2005 and 2015, the proportion of urban, semi urban and rural households without access to adequate lighting, and reliance on cooking methods that are not sustainable; and by 2015 to provide adequate clean and efficient energy services to all educational, health and clean water supply facilities". Rural electrification through extending the national grid, promotion of renewable energies such as solar, wind, geothermal, modern biomass/biogas, and improved stove program and improvement of the supply of oil products for productive

uses are among the options planned to achieve these goals.

Therefore, the Ministry of Energy and Mines is planning an aggressive programme of energy supply as an input to the achievement of the planned Millennium Development programs and goals. As the energy dimension of the poverty alleviation programs of the different sectors has not been clarified, it is quite difficult at this moment to prepare a detailed 10-year implementation plan, budget breakdown, yearly investment requirements, type of energy technology and geographic area of beneficiaries, human and institutional capacity requirements etc., to meet the energy requirements for achieving the MDGs especially those related to improving agricultural productivity. For the parallel energy targets stated above, which the Ministry of Energy and Mines has planned to undertake, a brief description and indicative projected investment requirement is provided below.

Rural Electrification through national grid extension: This has been among the major activity of the Ministry of energy and Mines and its development partners especially Sida on the one hand and the benefiting communities on the other. Around 60,000 households have benefited from the recently completed Phases I and II rural electrification programmes that started in 1999 involving almost 70 villages and four semi urban areas including and surrounding areas of Dibaruwa, Aditekelezan, Hagaz, Elabered, Tesenei Mendefera, Himbirti and Mekerka areas. Another 80 villages and 10 semi-urban areas involving 30,000 households and 1500 commercials are planned to be electrified through the Government of Eritrea and World Bank funded 'Asmara power Distribution and Rural Electrification Project' during 2005-2008. Moreover a Rural Electrification Fund will soon be established as per the Electricity Proclamation Number 141/2004. The financial source for this Fund is from the GoE, donors, 1% levy on electricity sales and community contribution; the World Bank has already committed 1.4 Million $ seed funding. The Rural Electrification programme is being conducted following the Directives No. EI.001/2001 of the Ministry of Energy and Mines. The Government covers the cost of medium voltage extension from nearest source and the benefiting villages/semi-urban areas cover the low voltage distribution costs. The village communities are allowed to pay in two/three instalments to make benefit of equivalent number of harvests. This arrangement is very much welcomed by the villagers and request for electrification is overwhelmingly very high. As the grid penetrates the rural areas agricultural or non-agricultural income generating activities are expected to benefit from it by shifting away from diesel based gensets and pumpsets to the more dependable grid electricity.

Wind Energy Applications: A pilot project funded jointly by the GoE and GEF has just began to install a small wind farm to strengthen the Assab grid and about 6 decentralised wind-diesel engine hybrid to electrify semi-urban communities mostly along the southern coast and two wind mechanical pumping systems for irrigation. The plan is to replicate these wind energy applications elsewhere in wind-rich regions of Eritrea or for feeding the national grid. Wind water pumping for human and livestock consumption and agricultural production through irrigation could be installed anywhere in the country as per the wind resource assessment done by the Ministry of Energy and Mines. Ice making for fishermen and sea water pumping to salt fields along the coasts are among the productive functions of wind energy that we would like to promote. Arrangement is planned with Tesinma in Dekemhare to manufacture the wind water pumping structures for which donors support is required.

Solar PV applications: Over 600 kW aggregate capacity involving over 2000 solar PV systems are in service in the country for applications like powering: health centres/stations, village water pumps, remote primary and junior schools, remote offices, light houses,

telecommunications centres, solar home systems and even water pumping for drip irrigation. One private company has installed 100 solar home systems on monthly fee for hire basis, with two lights and battery charger for radio/radio cassette operation, in two small villages called Sebaa and Akrur in Zoba Debub. More GoE-private partnership and donor support is required to expand the application of solar PV systems especially in areas far away from the grid, island and pastoral communities etc.

Dissemination of Improved Stoves: It is known that the improved stove dissemination programme of the Ministry of Energy and Mines is gaining national and international reputation. This is manifested by the distinguished Ashden Award it received from the London based organisation in 2003 (see www.ashdenaward.org). Over 22,000 systems have been installed in rural households so far and demand for it is overwhelming. As most of the stove components are producible in the villages themselves, chain reaction is being promoted by training artisanal women to transfer skills from one village to the neighbouring villages. The Department of Energy has started to benefit from carbon trading for the saved CO_2 emissions of 0.6 tonnes/stove/year at the rate of 6 USD/ton of CO_2.

Modern biomass energy: There are enough indications that there is already good potential for modern biomass energy usage in certain locations in Eritrea: -

- The Alighider Farm Estate has the potential to supply raw materials (cotton and sorghum stalks, elephant grass, banana leaves etc.) for briquette production for at least 15 plants each of capacity 4000 tons per year. Briquettes, a chopped and compressed agricultural waste, are excellent replacement for fuelwood and charcoal. Alternatively, the Agricultural waste could be used to generate electricity thermally.
- Biogas plants could be installed in agro-industrial establishments and other smaller dairy farms
- Biogas could be generated from cactus trees
- Energy recovery from municipal solid and liquid wastes
- Energy crops for the production of modern biofuels could be considered where feasible
- Biogas generation from sugar plantations

Geothermal Energy: Part of Eritrea is situated in a volcanic area predominantly in the East African Rift Valley. Measurements at the volcanic mountain Alid indicate an underlying hydrothermal reservoir with a temperature in the range of 250 - 350^{o}C. Studies sponsored by USAID have concluded that the water to rock ratio in the reservoir is high enough for a developable hydro-thermal electricity generation system. It appears as possible to install one or several power stations in this area. The distance to the existing transmission line between Massawa and Asmara is not more than about 100 km, which makes the site even more interesting for development. More detailed studies are however necessary for an assessment of the financial and environmental feasibility of exploiting this geothermal resource.

Investment in innovative new energy systems like hydrogen based fuel cells when found economically feasible will be considered for licensing.

Funding Requirements:

To generate Table 1 below, the following crude assumptions have been employed. Note that an average of 12.6 Million USD is required per year between 2005 and 2015 while the total investment needs until 2015 is over 130 Million USD.

The vision of the Government of Eritrea is to electrify every home, businesses and social

amenities in the long-term. More specifically, the following targets have been identified as part of the poverty reduction strategy:

- Reduce by half, between 2005 and 2015, the proportion of urban, semi urban and rural households without access to adequate lighting; at the moment 78% of the urban and only 3% of the rural people are electrified. Assume that there are 700,000 households in 2004 of which 75% are rural and 25% urban. All urban and 80% of rural lighting is to be provided through electricity of which 70% shall be grid connected, whereas the rest will have decentralised wind and solar systems. Note that kerosene wick lamp is not acceptable. The international average for electricity connection (through grid extension, solar or wind) is 400 USD per household.

- Reduce by half, between 2005 and 2015, the proportion of urban, semi urban and rural households reliant on cooking methods that are not sustainable. Acceptable sustainable cooking method is using the improved *mogogo* stoves for injera making, using biogas, LPG or electricity. Only 22,000 of about 700,000 households have improved stoves. Assume that cooking/heating in urban areas will be met through the commercial fuels LPG (50%), electricity (20%) and/or kerosene (30%), whereas 75% of the rural areas shall have improved stove through fuelwood and the rest shall use LPG (10%), biogas (5%) or kerosene (10%). Cost for LPG accessories is 100 USD, improved stove is 10 USD and kerosene stove is 5 USD. Biogas systems are recommended for dairy farms and generally require accessories similar to LPG for cooking.

- By 2015 provide adequate, clean and efficient energy services to all educational, health and clean water supply facilities. Assume that 70% of all schools, 50% of all health facilities and 20% of all village/township water sources do not have modern energy facilities. By 2015, the number of rural schools and health facilities could reach 1500, respectively and the number of villages requiring energised water pumping facilities may be around 2000. A typical cost for school power systems is USD 5,000, for a health facility 30,000 USD and motorised pumping is estimated at 15,000 USD.

Table 1: Summary of investment requirements for improving energy access to the poor (in Million USD)

		2005	2010	2015	Total 2005-15	Average 2005-15
Rural grid based electrification	Capital costs	3	4	5	43	3.9
	Operating cost	1	1.2	1.2	12.4	1.13
	Total	**4**	**5.2**	**6.7**	**55.4**	**5.04**
Electrification through wind of villages/semi-urban areas	Capital costs	1.2	2	3	22.6	2.05
	Operating cost	0.8	1	1	10.4	0.95
	Total	**2**	**3**	**4**	**23**	**3**
Wind Water Pumping Units	Capital costs	1	1	1	11	1
	Operating cost	0.4	0.4	0.4	4.4	0.4
	Total	**1.4**	**1.4**	**1.4**	**15.4**	**1.4**
Solar PV for schools, health facilities, water	Capital costs	1.64	1.64	1.64	18	1.64
	Operating cost	0.22	0.22	0.22	2.4	0.22

pumping, solar home systems, MSMEs	**Total**	**1.86**	**1.86**	**1.86**	**20.4**	**1.86**
Improved stoves 400,000 households	Capital costs	0.5	0.8	1.0	8.2	0.75
	Operating cost	0.1	0.2	0.3	2.1	0.2
	Total	**0.6**	**1.0**	**1.3**	**10.3**	**0.77**
Biogas units of different sizes	Capital costs	0.4	0.4	0.4	4.4	0.4
	Operating cost	0.12	0.12	0.12	1.32	0.12
	Total	**0.52**	**0.52**	**0.52**	**5.72**	**0.52**
	Grand Total	**10.38**	**12.98**	**15.78**	**130.22**	**12.59**

As modern energy and in particular electricity is one of the requirements to stimulate rural development and eradicate poverty, a significant government and donor support is required and the Government is committed to make strong efforts in the transformation of the energy sector. The Government of Eritrea and the World Bank have been collaborating and dialoguing on the power sector for some time which has provided a strong foundation for our partnership. The European Union Energy Initiative for Africa, GEF and the Clean Development Mechanisms are expected to play a critical role in implementing Government objectives in the energy sector in order to reduce the poverty level of the rural, semi urban and urban population and meet the Millennium Development Goals.