

Investment Opportunities in the Energy Sector of Eritrea.

1. Background to the Sector

Like in most developing countries, biomass carriers of energy are still the major sources of energy in Eritrea. In 1998, the total **primary energy** supply was 685,710 ton of oil equivalent (TOE), of which 441,640 TOE, or 66.3%, was derived from local biomass fuels, and the remaining 244,060 TOE, or 33.7%, from imported oil products. 45,820 TOE from the oil products was used for the thermal generation of 213 GWh of electric ity.

The final energy consumption per capita was 194 kilogram of oil equivalent (kgoe) with modern energy (electricity and oil products) accounting for 65.3 kgoe. The per capita share of modern fuel for Eritrea is very low even by some African standards, and compares poorly with that of Republic of South Africa (2,350), Egypt (1630 kgoe), Algeria (890 kgoe), Zambia (130 kgoe), Kenya (110 kgoe), Ghana (110 kgoe), Sudan (70 kgoe) but higher than few countries like Mozambique (44 kgoe), Tanzania (30 kgoe), Ethiopia (20 kgoe) (Source: Energy Statistics of non-OECD countries, International Energy Agency Publication, 1999). However, in most rural areas of Eritrea, up to 95% of the total energy consumed is derived from biomass sources. Only 2% of the rural population (74% of the total) is estimated to have access to electricity whereas in the urban areas the access is over 82% on the average. This shows that there is a formidable task required to electrify the rural areas.

Per capita electricity generation was 61 kWh while consumption was 48 kWh in 1998. In comparison, per capita electricity generation was (all in kWh) 4301 in South Africa, 744 for Egypt, Zimbabwe 694, Kenya 129, Tanzania 54, Sudan 47, Uganda 37, Ethiopia 21, Chad 12 (IEA, 1999). Final consumption of oil products is also very low standing at 62 kgoe per capita in 1998. There is about 500 kW solar PV system installed in the country for community based applications like water pumping, powering health centres, schools etc. This is still negligible in the national energy balance and amounts to just about 0.6% of the firm capacity of the electricity generation system. The firm capacity of the existing national utility, The Eritrea Electric Authority is around 70 MW which is all through thermal means. It is estimated that another 30 MW of generation capacity is owned by either public institutions (e. g., Assab Petroleum Refinery and Assab Port Administration), small municipalities in remoter towns, or private entrepreneurs with smaller gensets. Soon an 84 MW thermal generation plant and a 132 kV/66kV transmission lines is to connect Massawa, the site of the plant, with the major market centres Asmara, Keren, Dekemhare and Mendefera.

Policy objectives

The sufficient, reliable and sustainable production and supply of affordable energy throughout Eritrea is the main objective of the Government's policy in the energy sector. The general policy is to provide the energy services based on a diversified supply of energy sources. The specific objectives of this policy are twofold. Firstly, it is the intention to facilitate the economic growth through the provision of adequate, reliable and

sustainable refined energy at an economic price and at appropriate locations. Secondly, the policy is aimed at improving the living standards of the population through the provision of affordable energy. The implementation of the policy must be mindful of the desire to halt, and in some cases, reverse the recent trend in environmental degradation, and of the need to make the most effective use of limited resources, particularly in the initial stages of development.

To achieve the above mentioned objectives, the Ministry of Energy and Mines is entrusted with the task of designing and refining policies, strategies and regulatory issues in the energy sector, approving the corresponding plans and programmes formulated in the sector and supervising their implementation. As part of this task, the Ministry is drafting legislation on the commercial and safety aspects of the energy industry with the vision of making it efficient, safe, secured, competitive and fair trade balancing the interests of suppliers and consumers.

Policies and development strategies

Taking the above situation into account, the main energy sector development policies and strategies pursued by the Eritrean Government have been aiming at: -

- Promoting economically and environmentally sound energy sector development through the application of appropriate technology of energy production, conservation and usage optimisation;
- Implementing a policy of appropriate energy pricing structures that avoid all forms of subsidy;
- Diversifying sources of energy in order to minimise the strategic dependence on the dwindling biomass energy resources and imported oil by way of promoting private capital participation in hydrocarbon exploration and developing renewable energy resources potential;
- Modernising and expanding the country's power generation and distribution system and creating enabling situation for private participation in energy development and market;
- Developing capacity through training and establishment of the necessary institutional and legal framework in order to competently manage the sector.

2. Investment Opportunities in the Power Sector

To extend the supply of electricity to an increasing number of locations and customers, international, regional or national power companies, local or foreign Independent Power Producers (IPPs) and Independent Power Distributors (IPDs) are encouraged to invest in the required infrastructures. The Government will soon establish an Electricity Regulatory Board and a System Operator with whom the IPPs and the IPDs will interact. The IPPs have the option to generate power from sources like the renewables wind and solar, geothermal, or using state of the art conventional energy technologies. In principle importation or exportation of electricity and thus regional integration of power are permissible subject to the approval by the Government. In particular national companies

and electric membership co-operatives are highly encouraged to enter in the market of rural electrification either by extending the national grid or through a self contained system of generation and distribution.

3. Investment In the Oil Sector

3.1 Upstream: - Petroleum exploration and development is one of the sectors, which the Government has given priority. To this effect it has enacted two relevant laws in July 1993, namely, i) a Proclamation to Govern Petroleum Operations (Proclamation No. 40/1993) and ii) A proclamation pertaining to the Payment of Income Tax (Proclamation No. 41/1993). These two proclamations were revised recently to give additional incentives to investors and are replaced, respectively, by Proclamation No. 108/2000 and No. 109/2000. For example, the income tax has been reduced from 50% to 35%.

The Ministry of Energy and Mines has compiled all technical information of the prospective areas in the Eritrea Red Sea in two volumes in collaboration with Robertson Red Sea International Ltd. So as to help potential investors get the background information on the hydrocarbon potentiality. The Eritrean Red Sea basin, covering about 125,000 km², is underdeveloped and offers attractive exploration opportunities in the pre-rift (Mesozoic), syn-rift (Miocene) and post-rift (Late Miocene to early Quaternary) sedimentary units.

3.2 Downstream: - Rehabilitation of the existing refinery in Assab or construction of a new refinery, oil and gas distribution licenses, depot construction, jetty expansion, retail stations in urban/semi-urban areas and through agents in rural areas, and LPG retail stations in urban/semi-urban areas are among the investment opportunities in this sub-sector.

4. Investment in Renewable Energy Technologies: -

The potentials for increased utilisation of renewable energy sources in Eritrea has been assessed in recent comprehensive energy studies by the Ministry of Energy and Mines in collaboration with international consultants. A summary of the conclusions is given below.

Biomass Resources

It has been indicated that biomass energy source cannot be sustainably harvested at the present rate of take-off relative to the stock. As it will continue to be the major source of energy for rural areas, proper management practices have to be introduced. Development of biomass resources either on a large-scale levels (reforestation, afforestation), community level (community woodlots) or individual level (agroforestry/farm tree planting) when assisted by the removal of barriers to proper tree management like water and soil conservation, tree species selection, land ownership, ownership of planted trees,

alternative uses of land etc, could lead to a success story in regenerating the dwindling resource.

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 Elaborated Agro-industry and other smaller dairy farms
- Biogas could be generated from cactus trees
- Energy recovery from municipal solid and liquid wastes
- Energy crops, like Salicornia that can grow with seawater (being developed by Sea Water Farm), could generate electricity for local uses or for feeding the central grid.
- Dissemination of improved wood stoves throughout rural or urban Eritrea is highly desirable and attractive for artisans or entrepreneurs.

Solar radiation

Preparation of solar radiation maps for Eritrea is in progress. This work is carried out by the Energy Research and Training Centre of the Ministry of Energy and Mines and is based on satellite data and ground station data measured at 10 automatic recording meteorological stations. The average annual global radiation is found to be in the range of 5-6 kWh/m²d.

There is no doubt that Eritrea has a very high potential for utilisation of solar energy. Possible uses are solar photovoltaic systems, solar water heaters and sterilizers, solar crop dryers and tobacco curing, solar desalination plants, solar cooling and refrigeration, solar thermal electricity generation and are among the investment opportunities. A local partial manufacture of solar photovoltaic panels and associated batteries is highly beneficial and attractive to reduce costs.

Wind energy

The historical and recent data that exists suggest that the southern coastal region has very good wind conditions for electricity generation. In fact the measurements as reflected in

the wind-class classification in the table below shows Assab and Gahro, close to the border with Djibouti to the south, have among the best potentials in Africa. Windy passes that are suited for electricity generation also exist in the northern mountains as represented by the Dekemhare and Gizgiza stations. The critical average wind speed for wind pumping of about 2.5 m/s is available throughout Eritrea.

The recently completed GEF sponsored feasibility study for wind energy applications in the southern coastal areas has shown that a 2.4 MW wind park in Assab and many off grid wind stand alone, wind-diesel or wind-solar hybrid systems are very much feasible and quite economically attractive for investors. Wind pumps for irrigation or watering villages and their livestock have very good potential practically in all locations in Eritrea.

Table 1: Wind speed, power density, and power class of the 25 Eritrean wind stations

Mean annual wind speed, at 10 m ht.	Wind power density at 10 m ht in W/m ²	Wind power class	Stations in each class
0 - 4.4 m/s	0 - 100	1	Massawa, Bada Debresina, Hadish Adi, Engel, Adobha, Embatkala, Asmara, Alighieri, Agordat, and Dahlak
4.4 - 5.1 m/s	100 - 150	2	Idi, Hashimet, Tio Nakfa, and Keren
5.1 - 5.6 m/s	150 - 200	3	Kerkebet, Areza Kohaito, Maileham
5.6- -6.0 m/s	200 - 250	4	Dekemhare
6.0 - 6.4 m/s	250 - 300	5	Gizgiza
6.4 - 7.0 m/s	300 - 400	6	Assab
7.0 - 9.4 m/s	400 - 1000	7	Gahro

Hydropower

There are many potential sites for micro and small hydropower and to some extent large-scale hydropower projects in the river basins of Eritrea but all require detailed feasibility studies.

Geothermal steam

Part of Eritrea is situated in a volcanic area. Measurements at the volcanic mountain Alid indicate an underlying hydrothermal reservoir with a temperature in the range of 250 - 350°C. Studies sponsored by USAID have concluded that the water to rock ratio in the reservoir is high enough for a developable hydro-thermal 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 energy when found economically feasible will be considered for licensing.

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