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A review of energy in Rwanda

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ABSTRACT

During the last two decades, Rwanda has experienced an energy crisis mostly due to lack of investment in the energy sector. With the growing of the population and increasing industrialization in urban areas, energy provided by existing hydro and thermal power plants has been increasingly scarce with high energy costs, and energy instability. Furthermore, as wood fuel is the most important source of energy in Rwanda, the enduring dependence on it and fossil fuel consumption as well, will continue to impact on the process of environmental degradation. Rwanda is rich with abundant renewable energy resources such as methane gas in Lake Kivu, solar, biomass, geothermal; and wind energy resource is currently being explored. Recently, the Government has given priority to the extension of its national electrical grid through development of hydro power generation projects, and to rural energy through development of alternative energy projects for rural areas where access to national grid is still difficult. This paper presents a review of existing energy resources and energy applications in Rwanda. Recent developments on renewable energy are also presented.

Contents

1. Introduction

Rwanda is a small mountainous, landlocked country in the Great Lakes region of Africa. Bordered by the Democratic Republic of the Congo (DRC), Burundi, Tanzania and Uganda, it is located at 2°:00 Latitude South and 30°:00 Longitude East. Total land area is about 24,950 km^2, and inland lakes cover about 1390 km^2.

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Nomenclature

SNEL	Société Nationale d'Electricité/R.D. Congo
SINELAC	Société Internationale d'Electricité des Pays des Grands Lacs
CEPGL	Communauté Economique des Pays des Grands Lacs
UEB	Uganda Electricity Board
VAT	value added tax

Rwanda's population of more than 9.1 million (17% urban) is growing at an annual rate of 2.6% and expected to grow to 10 million in 2010, and to 13 million in 2020 with respectively a mean annual growth rate of 2.4 between 2007 and 2010, and 2.0 between 2010 and 2020. The GDP per capita is 365 US$ with an average real GDP growth rate of 10.3% in 2006–2007. The shares of the total GDP sector by sector are 36.4% for agriculture, 14.2% for industry and 43.8% for services and 5.6% for adjustments [1,2]. The electric power generation capacity is very low as compared to its potential and access to energy is very limited. Created in 1976, ELECTROGAZ is a 100% publicly owned company, the unique power grid electricity supplier in the country. At present only 4.3% of the population has access to electricity with 23.4% of the population in urban area and less than 1% in rural areas. The electricity consumption per capita is among the lowest in the world, 30 kWh/year/inhabitant. Per capita power consumption for those connected to the grid is approximately 720 kWh/person/year. Rwanda's grid infrastructure is small and old, and pressured by hasty growth in demand, supply disturbances, and inefficiencies. In Rwanda there are no known crude oil resources and this restricts the country to be completely dependent on imported petroleum products. The transport sector is the main user of petroleum products with 69% of the market, followed by households 16.5% and manufacturing using 14.5% [3].

Rwanda's land area covered by forest is 20% of the total and wood fuel constitutes 80.4% of the total energy consumption. Wood energy is used by 17.7% of the population for light and 98.7% of the population uses wood and charcoal energy for cooking [3,4]. The demand for wood resources is exceeding an exhausted supply and the situation will continue to deteriorate unless policy measures are taken to accelerate the substitution of wood fuel by other forms of alternative energy resources, national forest resources will be depleted. During the last two decades, with the growing of the population and increasing industrialization in urban areas, Rwanda has incessantly experienced energy deficit and this has increased drastically in 2004. The consequence was the rapid growing of the cost of energy per kWh, 17 RWF in 1995, 42 RWF in 1997, 82 RWF in 2005, 112 RWF in 2006 (VAT not included).[1] The Government of Rwanda has taken urgent option of renting thermal power plants, but this was not bringing a sustainable solution.

Meanwhile, the country possesses a very rich hydro power potential, a big amount of methane gas reserve in Lake Kivu estimated at 55 billion m^3 of which 39 billion are economically exploited, a daily global solar radiation of about 5.2 kWh/m^2, peat reserves estimated at 155 millions ton, 1/3 of which is exploitable dry peat, a good potential for geothermal energy estimated at between 170 and 320 MW and wind power potential, but detailed studies need to be conducted for harnessing those resources [4]. Recently with the support of donors, in order to improve the power distribution capacity of the existing network and to support rural electrification, new projects on renewable energy application have been developed. This will help to surmount the situation of energy shortage and environmental degradation the country is being faced to.

[1] Rwandan francs per US$: 262.20 (1995), 585 (2007), 393.44 (2000), 574.62 (2004), 610 (2005), 560 (2006), 553 (2007). [URL: http://www.exchange-rates.org/currentRates/F/RWF].

2. Energy sources and consumption by sector

Biomass (wood, agriculture residues, charcoal, peat and organic gas) constitutes the major source of energy accounting for 80.40% of the total energy. Fuel and electricity constitute respectively 6% and 0.90% of the total energy. The sources of energy and energy consumption sector by sector in Rwanda are presented in Fig. 1. Of the total energy consumed, households account for 91%, transport sector, industry sector and public services account respectively for 4.5%, 2.7%, and 1.8%. Energy consumed in the rural areas, where the majority of the population lives, is 85% of the total energy. Wood-fuel constitutes 90% of rural energy consumption. The balance 10% is met by other options such as agricultural residues, fuel, charcoal, grid and non-grid electricity, peat, gas, solar and other renewable energies. Wood and charcoal energy is used by 98.7% of the population for cooking and by 17.7% of the population for light.

3. Power energy status

3.1. Power energy generation capacity

In Rwanda, installed electric power generation capacity is very low at 41.25 MW from both Hydro and thermal generation infrastructures. Hydro power accounts for 26.74 MW, while Thermal power generation is now at 14.5 MW. Created in 1976, ELECTROGAZ is a 100% publicly owned company, the unique power grid electricity supplier in the country. Power generation sources in Rwanda are presented in Table 1. ELECTROGAZ power generation comes from Mukungwa, Ntaruka, Gihira and Gisenyi power plants located in the North-Western region. Mukungwa and Ntaruka are the most important on-grid power plants in Rwanda. The Mukungwa station draws water from a Lake Ruhondo that is in

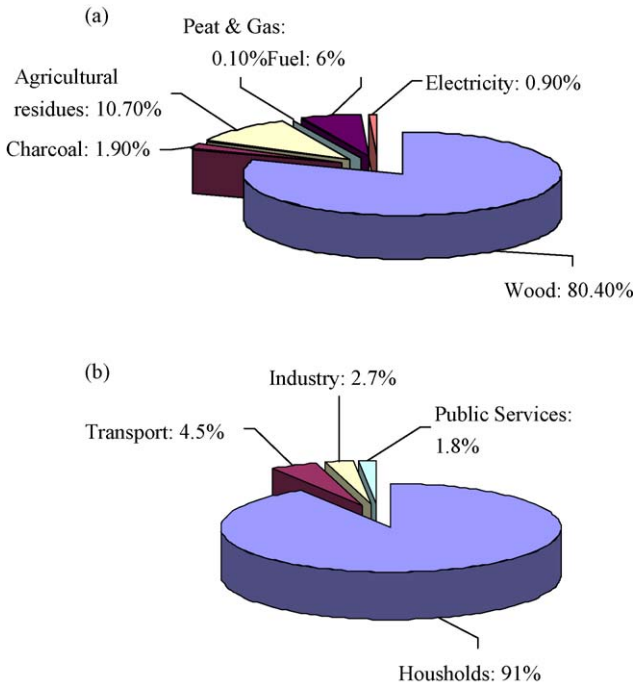

Fig. 1. Sources of energy (a) and energy consumption by sector in Rwanda (b).