

Growth and Performance of Electricity Sector in Rwanda - A Descriptive Analysis

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Abstract

The sustainable electricity supply is an important factor to accelerate the economy and it is not only on the industrial side, the access to the electricity improves also the social and economic indicators of households. Rwanda's electricity sector is viewed as one of the most effective sectors in East Africa. However, Rwanda is still one of the lowest electricity consumption per capita compared to other countries in the region. The Government of Rwanda has developed a National Energy Policy and a National Energy Strategy which envisages that the Energy sub - sector is to ensure security of supplies by increasing domestic energy production. The growth of various electricity supply sources exhibits a high volatility. There are currently visible disparities between rural and urban areas in terms of access to electricity and income level. The growth of customer base is continuously increasing, which means the demand for electricity consumption is increasing not only from the capital city Kigali, but also from the growth towns and from the rural Rwanda. The national production of electricity takes place mainly from conventional sources: hydro and thermal and in recent past non-convention source also contributing to the total supply of electricity. There is a considerable improvement in the investments in the energy sector in recent years in terms of number of energy projects and the estimated value of investment in the sector. Nevertheless, the importation of electricity constitutes still around one-fifth of total supply. To achieve greater access energy for masses in the years to come, on supply side, Government of Rwanda needs to relook in its policy environments and on the demand side, subsidization and waiver of tariff and other related fees.

A descriptive analytical approach is used for this paper as it presents in general growth and performance for the period of 2000 -2014. It is mainly based on the secondary data collected from various sources of electricity sector in Rwanda.

Keywords: Energy, Electricity, Growth, Performance, Consumption, Demand, Power Generation, Public - Private Participation.

Introduction

Energy is the backbone for various sectors' development, which in turn contributes to overall growth of an economy. An unutilized and underutilized resource of power production not only hampers the growth of a particular sector, but also acts as a preventive factor for the sustainable development of an economy. It has been argued that electricity crisis of an economy creates wedge in the national wheel of effective management of industrial and socio-economic development program (A.Sesan Ayodele, 2001). Galip Altinay and Erdal Kargot (2005) illustrated with Turkish economy in which the supply of electricity is vitally important to meetv the growth targets hence electricity consumption sustain the economic growth. According to Nazima Ellahi (2011) sustainable electricity supply is an important factor to accelerate the economy and empirically demonstrated that poor electricity supply contributes to the dismal performance of Pakistan's industrial sector. Prasad and Dieden (2007) reported that there is a correlation between electrification and uptake of SMMEs in south Africa.

Not only on the industrial side, the access to the electricity improves also the social and economic indicators of households (Gunther Bensch et l., 2005). Alice Shiu, Pun-Lee Lam (2002) examined the causal relationship between electricity consumption and real GDP for China for the period between 1971-2000. The results indicate that the real GDP and electricity consumption for China are co-integrated and there was unidirectional Granger causality¹ running from electricity consumption to

real GDP but not vice versa. Seung - Hoon Yoo (2004) investigated that the short and long-run causality issues between electricity consumption and economic growth in Korea by using the co-integrated and error - correction models. The results show that there exists a strong relationship between electricity consumption and economic growth, thus it does not necessarily imply a 'causal ' relationship. The relationship may very well run from electricity consumption to economic growth, and /or from economic growth to electricity consumption.

1. Granger causality refers that if the two series X and Y (say) are individually I (1) (i.e. integrated or order one) and co-integrated then there would be a causal relationship at least in one direction. The presence of co-integrated among the variables rules out the possibility of "spurious" correlation.

S-H. Yoo (2005) examined that the casual relationship between electricity consumption and economic growth among four members of the association of South East Asian Nation (ASEAN) namely Indonesia, Malaysia , Singapore and Thailand, using time-series techniques for the period 1971-2002. The results indicate that there exists a strong relationship between electricity consumption and economic growth.

The electricity infrastructure is becoming an increasingly important component of the economies with no exception to a developing country like Rwanda. Rwanda is one of the fastest growing African state and expected to emerge as a middle income economy by 2020. The economy has been moving from agrarian economy to service

oriented economy. Though nearly 47-50% of GDP contribution is from services sector, over 87% of the population depends on subsistence agriculture for their livelihood and more than 94% use firewood as their primary source of energy by industrial and households (EDPRS September 2013). Rwanda's electricity sector is viewed as one of the most effective sectors in East Africa. However, Rwanda is still one of the lowest electricity consumption per capita compared to other countries in the region. Among other factors, higher per capita GDP at \$644 (NISR:2014), lower electricity prices due to high productivity and increase in population result in large demand for electricity consumption. Rwanda's per capita electricity consumption (42 KWh / year / capita) is the lowest one compared with 478 kwh in sub-Saharan Africa and 1,200 KWh for developing countries as a whole. (Ministry of Infrastructure - Energy Sector Strategic Plan -2013).

In 2008, less than five percent of the population had access to electric power, with less than one percent in rural areas. There are visible disparities between rural and urban areas in terms of access to electricity and income level. Rural access to electricity stands at 4.7 percent compared to 46 percent for urban areas. (Ministry of Infrastructure - Energy Sector Strategic Plan -2013).

It is quite obvious to notice that the supply of electricity is very low hence lowest per capita consumption. Rwanda attempts to bridge the electricity supply and demand gaps through importation of electricity. Rwanda's Economic Development and Poverty Reduction Strategy (EDPRS and EDPRS: 2) papers and Millennium Development Goals

(MDGs) in Rwanda have set meaningful targets through various ministries and development partners. Government of Rwanda has been continuously monitoring the achievements against the set targets, of which electricity related targets are given top priority.

The target for the expansion of electricity supply was set by Vision 2020 and the Economic Development and Poverty Reduction Strategy (EDPRS 1 of 2009 -2012). It was primarily aimed at increasing electricity access from 4% in 2008 to 40% in 2025 and later this target was pushed up further to 70% to be achieved by 2017. The total capacity of energy in Rwanda was 51 Mw in 2008 and the set target is to increase it to 563 MW by 2018 and further it is fused to increase 1,000 MW by 2020. EDPRS clearly spells out that by 2012 a wholesome of 350,000 connections, have to be created thus providing electricity access to the households and industrial sector. Especially number of households to be accessed with the electricity aimed to be increased from 70,000 (i.e. base line 2006) to 270,000 by 2012. The installed capacity of electricity generation (off /on grid MW) was targeted to be increased from 45MW (i.e. base line 2006) to 120Mw by 2012. However, the assessment shows that as on 2012 only 110 MW of installed electricity generation capacity was achieved, while 308,326 households connections were created and connected to the grid which accounts for 16 percent of Rwanda's population (EDPRS 2 September 2013).

The Government of Rwanda has developed a National Energy Policy and a National Energy Strategy (Republic of

Rwanda, 2009) and Energy Sector Strategic Plan 2013- 2018 (Ministry of Infrastructure June 2013). The national policy envisages that the Energy sub - sector is to ensure security of supplies by increasing domestic energy production from several sources including: hydro-electricity, methane gas, solar power, peat-based power, diesel thermal plants, biomass and petroleum.

However, the electricity generation capacity of Rwanda has not increased as expected and remains low compared to the need of the country's growing economy. It is an interesting area to analyze these performance gaps. With this context, this paper attempts to answer the following research questions:

1. Is there a steady increase in the domestic electricity production and reduction in the importation of electricity?
2. What is mix and status of electricity generation?
3. Is there a consistency in reaching the goal of access to electricity by household and industrial sector?
4. What is the state of other electricity indicators such as (i) electricity generation capacity in terms of Kwh, Mwh, MW . (ii) Annual growth rates and trend percentages for electricity production and importation and exportation. (iii) The customer growth and revenue trends. (iv) The percentage share of electricity consumption by industry and household services and their trends. (v) The operational performance in terms of trends for sales revenue , cost of sales, operating expenses, gross profit and net profit.

A descriptive analytical approach is used for this paper as it presents in general growth and performance for the period of 2000 -2014. It is mainly based on the secondary data collected from various sources including the annual reports of Energy and Water and Sanitation Authority (currently known as Rwanda Energy Group) and annual reports of MINIINFRA Government of Rwanda.

Evolution and Growth of Electricity Sector in Rwanda

A bold program of socio-political reforms, aimed at improving justice, governance, human resources development and democratization has been implemented in Rwanda since 1995 in parallel with ongoing economic reforms. Important changes that have been made include privatization of state-owned enterprises, financial and banking sector reforms, improved public financial management and civil service reforms (MINICOM 2008).

The Electricity sector has gone through some significant changes during the last 12 years. The ELECTROGAZ, which had a monopoly for the production and distribution of electricity and water until 1990s, formally lost its monopoly power by a law that was enacted in 1999. After extensive deliberations, ELECTROGAZ was placed under a management contract with Lahmayer International in August 2003 to manage and restructure ELECTROGAZ in collaboration with Hamburg Water Works for five years. However, the contract was terminated in March 2006 and it reverted to the Government of Rwanda to run by a Board of Directors. ELECTROGAZ was split into

RECO (Rwanda Electricity Corporation) and RWASCO (Rwanda Water and Sanitation Corporation) during 2008. In 2010 those two corporations were merged (under the Law N° 43/2000 of 09/07/2010) and given the name EWSA Ltd (Energy and Water and Sanitation Corporation).

EWSA was responsible for generation, bulk transmission and distribution and retailing functions on commercial basis, while some of the new large generation projects were planned for development by the private sector with an agreement to sell to the utility under power purchase agreements (Energy Sector Strategic Plan 2013 - 2018 (Ministry of Infrastructure June 2013)).

In 2014, EWSA was replaced by Rwanda Energy Group (REG Ltd) with effect from 10 / 07 / 2014, which owns Energy Development Company Ltd and Energy Utility Company Ltd that are created to manage energy production and energy

maintenance respectively, as well as the Water and Sanitation Corporation Ltd created independently to manage water resources. These Companies work with the spirit of private sector to improve service delivery to the stakeholders. It was estimated that these Companies need investment worth of \$3 billion (around Rwf 2 trillion) to increase access to water from the current 74 percent to 100 percent and access to electricity from 17 percent to 70 percent by 2018 (New Times 31st July 2014). These organizational reforms have been contributing to the performance improvement, though initially needs more investments.

Production of Electricity

The production of hydro electricity power (Table -1) in Rwanda witnesses a high volatility during the period between 2000 and 2014. Highest annual growth rate in hydro power production was witnessed during 2007 and 2008 with 123.9%.

Table -1: Annual Growth Rate of National Electricity Production and Importation in Rwanda during 2000 to 2014 (in Mwh)

Year	Hydro Power Production (in Mwh)	Hydro Power Production Annual Growth Rate	Thermal Production (in Mwh)	Thermal Power Production Annual Growth Rate	Solar (PV) Production (in Mwh)	Solar (PV) Power Production Annual Growth Rate	Methane Gas Production (in Mwh)	Methane Gas Production Annual Growth Rate	Net Imports (in Mwh)	Importation Power Annual Growth Rate	Total Production (in MWh)	Total Electricity Power Annual Growth Rate
2000	110,842								93,014		203,856	
2001	89,273	-19.46%							120,073	29.09%	209,346	2.69%
2002	98,214	10.02%							127,526	6.21%	225,740	7.83%
2003	117,641	19.78%							117,473	-7.88%	235,114	4.15%
2004	84,279	-28.36%	6,257						113,491	-3.39%	204,027	-13.22%
2005	65,734	-22.00%	50,123	701.07%					89,098	-21.49%	204,955	0.45%
2006	37,321	-43.22%	130,272	159.90%					62,064	-30.34%	229,657	12.05%
2007	32,203	-13.71%	133,237	2.28%	124				85,409	37.61%	250,973	9.28%
2008	72,104	123.90%	122,059	-8.39%	309	149.19%			84,688	-0.84%	279,160	11.23%
2009	98,898	37.16%	145,745	19.41%	363	17.48%	3,312		62,426	-26.29%	310,744	11.31%
2010	112,010	13.26%	159,863	9.69%	324	-10.74%	8,973	170.92%	79,754	27.76%	360,924	16.15%
2011	149,327	33.32%	189,759	18.70%	299	-7.72%	6,110	-31.91%	77,649	-2.64%	423,144	17.24%
2012	181,451	21.51%	202,401	6.66%	306	2.34%	8,826	44.45%	90,845	16.99%	483,829	14.34%
2013	148,114	-18.37%	254,946	25.96%	142	-53.59%	9,938	12.60%	94,408	3.92%	507,548	4.90%
2014	165,098	11.47%	245,497	-3.71%	297	109.15%	15,618	57.15%	89,454	-5.25%	515,964	1.66%

Source : National Institute of Statistics of Rwanda (NISR - 2014 pp:105-106) and REG.

Further, the table - 1 shows hydro power production negative growth rates between 2000-2001 with -19.46%, 2005-2006 with - 43.22% , 2006-2007 with -13.71% where as during 2012-2013 with -18.27 % . but between 2013-2014 growth is slightly increased to 11.47%. The electricity production was slowed down due to decline in the water levels of lakes and power plants equipments breakdown to run the existing hydro power plants to their full capacity. The production shortage of hydro electricity can be attributed to the cost of operation, low level of new investments and high cost of diesel and other input costs during 2004 and 2007.

The electricity supply from thermal power sources has shown a strong growth with the year 2004-2005, which went up to the highest of 701.05% but during 2012-2013 declined to 25.96%. Nevertheless, the supply from thermal sources also recorded a negative growth of -8.39% during 2007-2008 and -3.71% between 2013-2014. The commissioning of Jabana - II thermal power plant in may 2009 resulted in an additional increment to the domestic electricity supply. The negative growth of thermal power can be attributed to the breakdowns of power plants and repairs which resulted in a high cost of operation, low level of new investments during 2007 and 2008.

Though the growth of power production from the two main sources (hydro and thermal) of power production was associated with high fluctuations. They have sources which contributed to the economy of Rwanda in terms of reduction in its dependency on imports from its neighboring suppliers. The dependency on imports was high to the tune of 127,526 (MWh) in 2002 and low with

62,426 (MWh) in 2009, but in 2013, it went up to 94,408 (MWh). It is noticed that the annual growth rate of electricity importation has witnessed a maximum of 29.09% in 2000-2001 and recorded as the lowest with -26.29% in 2009.

The government of Rwanda under public and private participation model has started initiations to produce energy viz., solar energy and methane gas as shown in table -1. The growth rate was as high as 149.1% with solar energy during 2007-2008, but reached negative rate with -53.59% during 2012-13. On the other hand, methane gas recorded unprecedented growth rate with 170.4% during 2009-2010. Nevertheless, the supply from methane gas sources also recorded a negative growth of -31.91% between 2010-2011 whereas methane gas has increased to 57.15% between 2013-2014.

Further ,Table - 2 (and Figure -1) shows a high volatility in power production trends from the base year 2000 through 2014. The hydro power production trend percentage has steadily decreased between 2000- 2009 i.e. from 100% the base year i.e. 81% (2001), 89% (2002), 76%,(2004) , 59%(2005), 34%(2006), 29%(2007), 65% (2008), 89%(2009). Whereas from 2010 to 2012 it was increased steadily from 101% (2010) to 164% (2012) but again it showed a declining trend between 2012 - 2014 i.e. from 164% to 134% (2013), 149% (2014). Further, the table witnesses that the thermal power production trend has been steadily increasing from the base year 2004 to 2014 i.e. from 100% to 4075% but with minor exception of declining trends during 2007 - 2008 i.e. 2129% to 1951% and between 2013 -2014 i.e. from 4075% to 3924%.

The trend in energy Solar has been in hype as it increased from 100 % (base year 2007) to 293% (2009), but the trend percentage is steadily decreasing i.e. from 293% (2009) to 115% (2013) and 240% (2014). On the

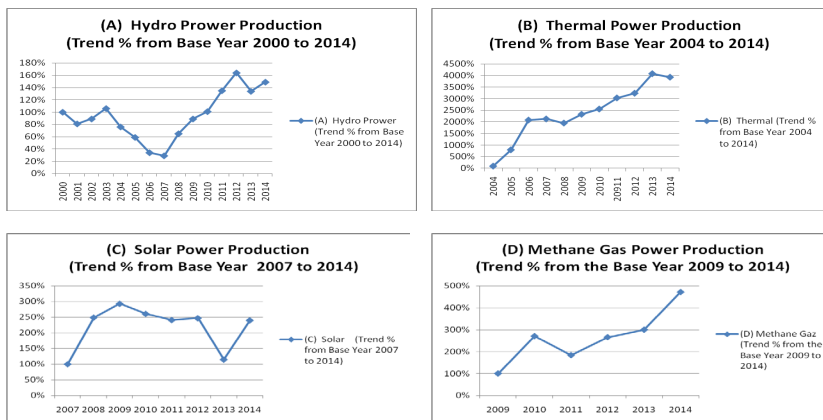
other hand, methane gas trend percentage has been steadily increasing from the base year 100% (2009) to 472% (2014) with an exception of down trend 184% during 2011.

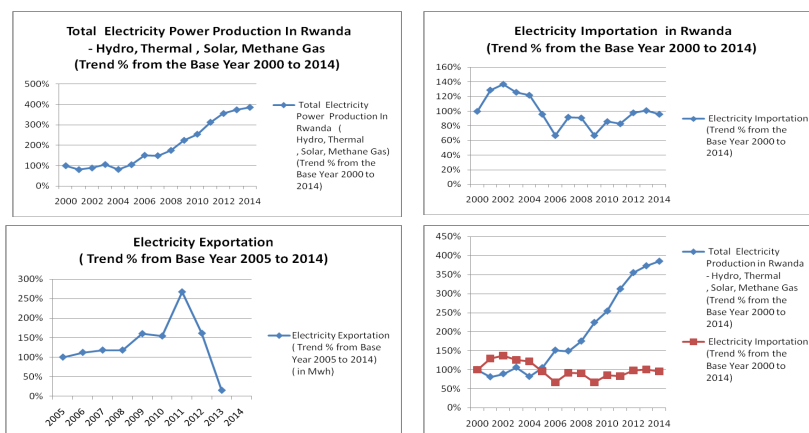
Table - 2 Trend Percentages of Total Electricity Production - (Hydro, Thermal, Solar, Methane Gas) and Importation in Rwanda during 2000-2014 (in Mwh)

Electricity (In Mwh)	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
(A) Hydro	110,842	89,273	98,214	117,641	84,279	65,734	37,321	32,203	72,104	98,898	112,010	149,327	181,451	148,114	165,098
(B) Thermal					6,257	50,123	130,272	133,237	122,059	145,745	159,863	189,759	202,401	254,946	245,497
(C) Solar								124	309	363	324	299	306	142	297
(D) Methane Gas										3,312	8,973	6,110	8,826	9,938	15,618
Total National Electricity Production (A+B+C+D)	110,842	89,273	98,214	117,641	90,536	115,857	167,593	165,564	194,472	248,318	281,170	345,495	392,984	413,140	426,510
Electricity Importation	93,014	120,073	127,526	117,473	113,491	89,098	62,064	85,409	84,688	62,426	79,754	77,649	90,845	94,408	89,454
Total Electricity (National Production + Importation) Available in Rwanda	203,856	209,346	225,740	235,114	204,027	204,955	229,657	250,973	279,160	310,744	360,924	423,144	483,829	507,548	515,964
Electricity Exportation (in Mwh)						1,823	2,033	2,146	2,155	2,915	2,806	4,860	2,939	265	
(A) Hydro (Trend % from Base Year 2000 to 2014)	100%	81%	89%	106%	76%	59%	34%	29%	65%	89%	101%	135%	164%	134%	149%
(B) Thermal (Trend % from Base Year 2004 to 2014)				100%	801%	2082%	2129%	1951%	2329%	2555%	3033%	3235%	4075%	3924%	
(C) Solar (Trend % from Base Year 2007 to 2014)								100%	249%	293%	261%	241%	247%	115%	240%
(D) Methane Gaz (Trend % from the base Year 2009 to 2014)										100%	271%	184%	266%	300%	472%
Total Electricity Production (Trend % from the Base Year 2000 to 2014)	100%	81%	89%	106%	82%	105%	151%	149%	175%	224%	254%	312%	355%	373%	385%
Electricity Importation (Trend % from the Base Year 2000 to 2014)	100%	129%	137%	126%	122%	96%	67%	92%	91%	67%	86%	83%	98%	101%	96%
Electricity Exportation (Trend % from the Base Yr 2005 to 2014)						100%	112%	118%	118%	160%	154%	267%	161%	15%	
Total Electricity Available in Rwanda (Trend % from Base Year 2000)	100%	103%	111%	115%	100%	101%	113%	123%	137%	152%	177%	208%	237%	249%	253%

Source : National Institute of Statistics of Rwanda (NISR - 2014 pp:105-106) and REG.

Figure - 1 Electricity Production Trends by source during 2000 to 2014 (in MWh).





The **Table -3** presents that the percentage contribution of different sources to Rwanda electricity supply during 2005 to 2014. It indicates that the hydro power supply rose from 12.83% in 2007 to 37.50% in 2012 but it is showing the reduction percentage share of total power from hydro sources during 2012 to 2013 i.e. 37.50% to 29.18%. However, percentage share of hydro power production has been increased from 29.18% to 32% between 2013-2014.

Table 3; Percentage Share Electricity Production and Importation (Source-wise) in Rwanda during 2005-2014 (in Kwh)

Sources of Electricity Power	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
(A) TOTAL HYDRO POWER PRODUCTION (KWh)	65,734,130	37,321,610	32,203,721	72,104,917	98,898,331	112,010,702	149,327,350	181,451,198	148,114,937	165,097,896
% Share**	32.07	16.11	12.83	25.83	31.83	31.03	35.29	37.50	29.18	32.00
(B) TOTAL THERMAL POWER PRODUCTION (KWh)	50,122,802	130,272,373	133,237,060	122,059,012	145,745,645	159,863,694	189,759,741	202,401,683	254,946,468	245,496,842
% Share**	24.46	56.23	53.09	43.72	46.90	44.29	44.85	41.83	50.23	47.58
(C) Energie Jali - Solar (KWh)	0	0	124,283	309,092	362,917	323,865	298,791	305,864	142,381	297,211
% Share**	0.00	0.00	0.05	0.11	0.12	0.09	0.07	0.06	0.03	0.06
(D) Methane Gaz (KWh)	0	0	0	0	3,311,590	8,972,564	6,110,211	8,826,162	9,937,590	15,618,028
% Share**	0.00	0.00	0.00	0.00	1.07	2.49	1.44	1.82	1.96	3.03
(E) Total National Production (KWh) (A+B+C+D+E)	115,856,932	167,593,983	165,565,064	194,473,021	248,318,483	281,170,825	345,496,093	392,984,907	413,141,376	426,509,977
% Share**	56.53	72.34	65.97	69.66	79.91	77.90	81.65	81.22	81.40	82.66
(F) Total Importation (KWh)	89,098,300	64,097,400	85,409,140	84,688,127	62,426,306	79,754,589	77,649,668	90,845,533	94,408,691	89,453,986
% Share**	43.47	27.66	34.03	30.34	20.09	22.10	18.35	18.78	18.60	17.34
Grand Total of Electricity Power (KWh)	204,955,232	231,691,383	250,974,204	279,161,148	310,744,789	360,925,414	423,145,761	483,830,440	507,550,067	515,963,963
** % Share of Source wise - Hydro, thermal, Solar, Methane Gas and importation from Total Electricity Power (Source : National Institute of Statistics of Rwanda / NISR - 2014 pp:105 /106)										

Source : National Institute of Statistics of Rwanda (NISR - 2014 pp:105-106) and REG.

The contribution of thermal sources was high with a percentage share of 56.23% in 2006, which declined to 43.72% in 2008 and 41.83% in 2012 further slid to though rose marginally to 50.23% in 2013

and again declined to 47.58% in 2014. Thus the thermal power supply is highly volatile.

Among the new energy sources solar energy has contributed less than 0.12% to

the total electricity supply and methane gas has contributed less than 2.49% in 2010 and again it increased to 3.03% during 2014. With various reforms and policy initiatives of Government of Rwanda, dependency on import of electricity has been progressively declining.

It is noticed that the import of electricity was 43.47% in 2005 which was decreased to 17.34% in 2014 with an exception in the year 2010 with 22.10% share. With the advent of the availability of new energy sources such as solar and methane gas the domestic electricity supply increased from 56.53% in 2005 to 82.66% in 2014 with an exceptional year of 2011 which witnessed a growth to 81.65%.

Higher fuel costs and operational costs of thermal power plants, the transmission losses, outdated power generation stations are the possible reasons that account for the high level of dependency on importation

to the amount of one-fifth electricity demand of Rwanda. The exploration of new energy sources like bio-gas plants, peat-power etc., shall contribute to increase the total national production.

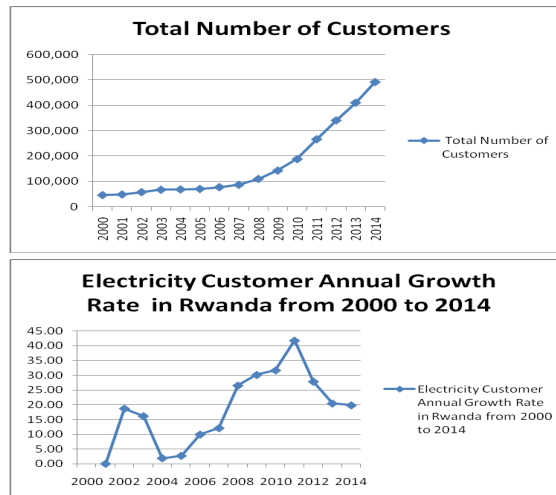
The customer growth as shown in table - 4 (and Figure - 2) illustrates that the number of customers who accessed electricity in Rwanda was 48,581 in 2001 and has increased to 490,860 customers in 2014 with an assured growth rate of 19.84%, but recorded highest level of annual growth of 41.74% during 2010 to 2011. Thus the customer growth recorded around 10 times increase between 2001 and 2014. It is also noted that the percentage of customer growth that access the electricity was less than 6% in 2001 which increased to around 20% in 2014. Further, the trend percentage customer growth has been steadily increasing from 100% to 1067.55% from the base year 2000 to 2014.

Table - 4; Electricity Customer Growth Rate and Trend Percentages in Rwanda during 2000 - 2014

Year	Total Number of Customers	Electricity Customer Annual Growth Rate in Rwanda from 2000 to 2014	Trend Percentage of Customers' Growth from the Base Year 2000 to 2014
2000	45,980		100.00
2001	48,581	0.06	105.66
2002	57,679	18.73	125.44
2003	67,008	16.17	145.73
2004	68,314	1.95	148.57
2005	70,187	2.74	152.65
2006	77,181	9.96	167.86
2007	86,537	12.12	188.21
2008	109,502	26.54	238.15
2009	142,497	30.13	309.91
2010	187,624	31.67	408.06
2011	265,947	41.74	578.40
2012	340,000	27.85	739.45
2013	409,610	20.47	890.84
2014	490,860	19.84	1,067.55

Source : National Institute of Statistics of Rwanda (NISR - 2014 pp:105-107) and REG.

Figure - 2 Total Number of Customers and Annual Growth Rate during 2000 - 2014.



On the other hand table - 5 shows that the revenue per customer has been decreased from Rwf 312 to Rwf 138 during 2006 - 2014.

Table 5; Electricity Customer Revenue (Pre Paid and Post Paid) and Revenue per Customer in Rwanda during 2006 -2014 (in Rwf)

Year	Electricity Customer Total Revenue (in RWF '000)	Revenue Per Customer (in Rwf)	Electricity Customer Prepayment Revenue (in RWF '000)	Electricity Customer Prepayment Revenue (in RWF '000)	Annual Growth Rate	Electricity Customer Postpayment Revenue (in RWF '000)	Annual Growth Rate
2006	24,110,514	312	7,691,537	7,691,537		16,418,977	
2007	26,482,472	306	10,233,454	10,233,454	33.05	16,249,018	-1.04
2008	29,637,939	271	12,608,902	12,608,902	23.21	17,029,037	4.80
2009	32,266,564	226	15,351,419	15,351,419	21.75	16,915,145	-0.67
2010	37,362,627	199	18,963,904	18,963,904	23.53	18,398,723	8.77
2011	43,035,002	162	23,290,628	23,290,628	22.82	19,744,373	7.31
2012	55,542,893	163	29,748,543	29,748,543	27.73	25,794,350	30.64
2013	62,093,178	152	33,552,676	33,552,676	12.79	28,540,503	10.65
2014	67,569,678	138	35,895,946	35,895,946	6.98	31,673,732	10.98

Source : National Institute of Statistics of Rwanda (NISR - 2014 pp:105-107) and REG.

The total electricity consumption levels as shown in table - 6 illustrate that the percentage share of electricity consumption by industries is very low comparatively to the percentage share of electricity consumption by house hold services during 2008 to 2013. It was mainly due to thin base of industrial sector in Rwanda.

The percentage share of household service electricity consumption has been steadily increasing out of total electricity consumption from 74.26 % to 79.71% i.e. between 2008 - 2013 but percentage share of industries electricity consumption is showing as marginal decrease from 25.74% to 20 .29% between 2008 - 2013 and this scenario can be noticed through Exhibit: 3.

Table 6; Percentage Share of Electricity Consumption by Industries and House Hold Services in Rwanda during 2008-2013 (in Kwh)

Year	(A) Industries Electricity Consumption (Kwh)	% share of Industry Electricity Consumption	Trend %	(B) Household Service Electricity Consumption (Kwh)	% share of Household service Electricity Consumption	Trend %	Total (A + B) Total Electricity Consumption (Kwh)	Total Electricity Consumption (%)	Trend %
2008	58,002,979	25.74	100	167,360,693	74.26	100	225,363,672	100	100
2009	55,506,267	22.60	96	190,105,864	77.40	114	245,612,131	100	109
2010	63,057,665	22.00	109	223,528,205	78.00	134	286,585,870	100	127
2011	67,733,083	20.75	117	258,674,075	79.25	155	326,407,158	100	145
2012	77,384,985	20.39	133	302,086,071	79.61	181	379,471,056	100	168
2013	78,734,160	20.29	136	309,324,238	79.71	185	388,058,398	100	172

Source : NISR - 2014 (pp:105-107) and REG .

Figure - 3 Percentage Share of Electricity Consumption of House Hold Service and Industries

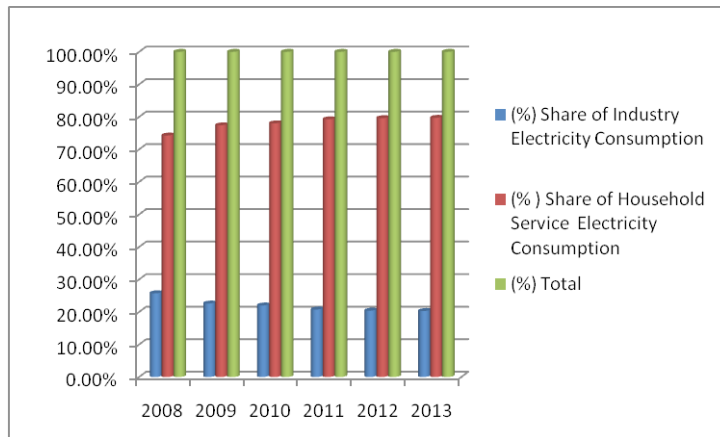
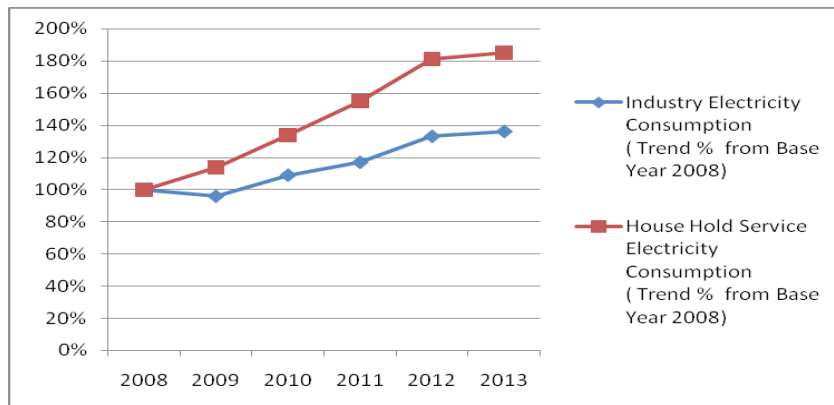


Figure - 4 Trend Percentage of Electricity Consumption of House Hold Service and Industry from the base year 2008 to 2013



Further, it can be seen from table: 6 and Figure - 3 and 4 the trends in electricity consumption by industrial sector and household service in Rwanda during 2008 to 2013. Trend percentage of industry electricity consumption increased from 100% to 136% i.e. from the base year 2008 to 2013 where the trend percentage of electricity consumption by household service steadily increasing from 100% to 185 % between 2008 to 2013. As shown in exhibit : 4. the trend growth rate in household electricity consumption is much higher than the industrial electricity consumption.

However, the demand for electricity has been increasing at slow pace due to sluggish industrialization growth. Hence there is a moderate need to generate electricity for

industries in near future compared to a higher demand from household sector.

Currently power supply in Rwanda during 2013-2014 is available from four main sources which include thermal power plant with 47.6% share followed by hydro power plant contributing 32% of total supply. The rest of the power needs are met through importation of power to the extent of 17.33%. However, methane gas 3.03% and solar energy 0.06% are contributing less than four percent of total supply.

The trends in the installation of power generation capacity in Rwanda since 1957 to 2014 are presented in table:7. Rwanda began its decent with a modest 1.2 MW capacity installation in 1957 and grown to the current level of 144.28 MW.

Table - 7 : Electricity Generation Projects' Installed Capacity from 1957 to 2014 (in MW)

Installed Capacity in MW																
Year of Operation	1957	1959	1982	1984	1989	2004	2006	2007	2008	2009	2010	2011	2012	2013	2014	Total Capacity (in MW) by December 2014
1 Hydro Power	1.20	11.25	12.00	1.80							9.10	5.38	0.50	3.30	34.20	78.73
2 Thermal Power						7.20			3.60	21.00					10.00	41.80
3 Jali Solar Power PV								0.25							8.00	8.25
4 Methane Gas																
5 Importation (Hydro Power)	3.50				12.00											15.50
Total	4.70	11.25	12.00	1.80	12.00	7.20	0.00	0.25	3.60	21.00	9.10	5.38	0.50	3.30	52.20	144.28

Source : Energy utility Division - Rwanda Energy Group

The first national power source is Hydro - Power which is having four main hydro - electric plants in Rwanda are Mukungwa, Nitaruka, Gisenyi and Ghira. Nyabarongo and Rukara are the other projects to be connected to the grid. In addition , Rwanda has 333 potential sites for micro, medium and regional shared plants. The second national power source is Thermal - Power which is having four main thermal - power plants at Jabana -1 Jabana -2 , Aggreko -1 (Gikondo) and Aggreko -2 (Mukungwa).

Keeping in view the increasing demand for electricity, Government of Rwanda has also embarked on the initiative of privatizing state - owned EWSA as Rwanda Energy Group during 2014 and targeted to expand the existing electricity generation capacity from 144.28 MW in 2014 to 595 MW by 2017 and the future development plan is to connect 1.7 million customers to the power grid and to increase additional power production to the tune of 1000 MW by 2017. The medium- to long term plans during 2018 - 2025 envisaged

to generate power to the tune 310 MW of hydropower, 460MW of geothermal power, 350 MW of methane -based power, 300 MW of peat based power, 20 MW of HFO with an estimated investment of \$2.796 billion (Africa Development Bank Group - Rwanda Energy Sector Review and Action Plan 2013). EDPRS - 2 (2013-2018) proposed two measures i.e. the development of a clear roadmap for investment in electricity generation and leveraging private sector investment in the sector to increase energy

generation capacity to meet future demand which can be pushed further to 1450 MW by 2020.

The local and foreign direct investment in energy sector is taken as a proxy for the investment in the electricity sector. As shown in table - 8 there is a considerable improvement in the investments in the energy sector in the recent years in terms of number of energy projects and the estimated value of investment in the energy sector.

Table : 8 Local and FDI Investments in Rwandan Electricity Sector during 2007 to 2014 (in Rwandan Francs, U.S. Dollars and Euros)

Year	Year Wise No. of Energy (Electricity) Projects	Year (Date) of Electricity Project Establishment	Year Wise Electricity Capacity Installed (Mw)	Investment in Local Currency (Rwf)	Investment or Estimated Value in FDI (\$ U.S Dollars)	Investment or Estimated Value in FDI (Euros)
2007	Hydro Project	September 2007	0.20		\$664,231	
	Solar Project	July 2007	0.25			
	Total Capacity		0.45		\$664,231	
2010	Hydro Project	March 2010	0.10	246,774,273		
	Thermal Project	December 2010	9.00		\$16,180,500	
	Total Capacity		9.10	246,774,273	\$16,180,500	
2011	Hydro Project	March 2011	2.24		\$2,722,310	
	Hydro Project	June 2011	3.18		\$8,418,300	
	Hydro Project	November 2011	0.10			
	Total Capacity		3.28	0	11,140,610	
2012	Hydro Project	March 2012	0.50	1,381,912,800		
	Hydro Project	September 2012	0.40		\$1,253,289	
	Thermal Project	October 2012	10.00			
	Total Capacity		10.40	1,381,912,800	\$1,253,289	
2013	Hydro Project	January 2013	0.50		\$1,482,639	
	Hydro Project	February 2013	0.45	2,167,310,219		
	Hydro Project	March 2013	2.40		\$4,340,419	
	Total Capacity		2.85	2,167,310,219	\$5,823,058	
2014	Hydro Project	April 2014	2.20			€ 10,612,914
	Hydro Project	June 2014	4.00		\$8,000,000	
	Hydro Project	November 2014	28.00		\$121,100,000	
	Thermal Project	November 2014	10.00			
	Solar Project	August 2014	8.50		\$8,000,000	
	Total Capacity		52.70		\$137,100,000	

Source : Energy utility Division - REG

Table : 9 contains a rough estimate of the power sector's investment requirements separated into the two intervals; 2013-2017 and 2018-2025. Under the government's accelerated plan (scenario:1) , the total investment needs of 2013-2017 are estimated at approximately \$4.2 billion, indicating as annual investment of \$ 845 million. This

annual requirement then drops to \$345 million in the 2018-2025, demonstrating the heavy concentration of investments in 2013-2017. There are a number of projects that are not considered technically ready and may be shifted from 2013-2017 to the subsequent years.

The investment requirements under the “delayed program” are estimated at \$2.5 billion for 2013-2017, indicating an annual investment need of \$510 million which would be then continue at a \$555 million / year in the subsequent years.

Table : 9 Investment Requirements of the Electricity (Power) Sector (in U.S Million Dollars)

Investment Component	Scenario :1 Accelerated Program		Scenario :2 Delayed Program	
	2013-2017	2018-2025	2013-2017	2018-2025
Generation	\$	\$	\$	\$
Domestic Hydro	475	145	312	308
Regional Hydro	300	55	102	253
Geothermal	935	440	482	893
Methane	900	160	300	760
Peat	615	320	353	582
Total	3225	1120	1549	2796
Transmission	150	250	150	250
Distribution				
Urban Distribution	150	350	150	350
Rural Distribution	700	1050	700	1050
Total	850	1400	850	1400
Grand Total	4225	2770	2549	4446
Average Annual Investment	\$845	\$345	\$510	\$555

Source : Electricity Master Plan : Seven -Year Strategy (2011) / African Development Bank Group.

The sources of financing would include: electricity tariffs; Rwanda Energy Group’s (formerly known EWSA) internal resources; government and development partners and private sector. In its Seven Year Electricity Development Strategy, the government has indicated its desire that the private sector undertake major generation projects while the public sector will implement transmission and distribution projects. (Africa Development Bank Group - Rwanda Energy Sector Review and Action Plan 2013).

Operating Performance

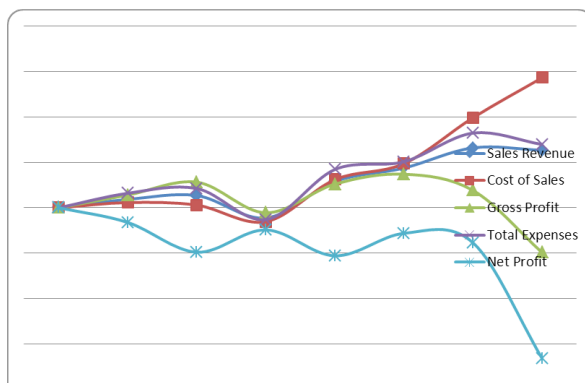
The operating performance of EWSA / REG is presented in Table - 10 (and Figure -5). They show the trends in cost of sales and operating expenses that have been steadily increasing among other elements such as sales revenue, gross profit , net profit from the base year i.e. 100% (cost of sales 2007) to 386 .80% (cost of sales 2014) whereas i.e. 100% (operating expenses 2007) to 239.62% (total operating expenses 2013) which are significantly high comparatively with sales trend percentage .

Table - 10 Operating Performance of Electricity Sector and Trend Percentages of - Sales, Cost of Sales, Gross Profit , Operating Expenses and Net Profit (EWSA/REG) during 2007-2014 (in Rwf)

Income Statement	31-12-2007	31-12-2008	31-12-2009	30-06-2010	30-06-2011	30-06-2012	30-06-2013	30-06-2014
Revenue	Amount (Rwf)	Amount (Rwf)	Amount (Rwf)	Amount (Rwf)	Amount (Rwf)	Amount (Rwf)	Amount (Rwf)	Amount (Rwf)
Revenue	31,212,288,325	36,974,611,069	39,588,706,810	24,203,725,621	49,348,177,918	58,593,606,151	72,437,435,013	70,811,807,513
Cost of Sales	18,267,199,282	20,380,328,180	19,333,663,993	12,685,407,539	29,624,227,620	36,062,208,206	54,548,442,252	70,657,869,623
Gross Profit	12,945,089,043	16,594,282,889	20,255,042,817	11,518,318,082	19,723,950,298	22,531,397,945	17,888,992,761	153,937,890
Total Expenses*	18,727,101,893	24,737,426,566	26,662,444,584	13,872,493,613	34,548,319,493	37,762,162,500	49,563,198,854	44,873,983,113
Net Profit After Tax	3,675,353,287	2,482,685,366	77,266,666	1,884,750,163	-217,351,571	1,606,871,234	834,628,461	-8,529,448,686
Trend Percentages	% (31-12-2007)	% (31-12-2008)	%(31-12-2009)	%(30-06-2010)	%(30-06-2011)	%(30-06-2012)	%(30-06-2013)	%(30-06-2014)
Sales Trend (%) from Base Year 2007	100	118.46	126.84	77.55	158.10	187.73	232.08	226.87
Cost of Sales Trend (%) From Base Year 2007	100	111.57	105.84	69.44	162.17	197.42	298.61	386.80
GrossProfit Trend (%) From Base Year 2007	100	128.19	156.47	88.98	152.37	174.05	138.19	1.19
Total ExpensesTrend (%) Base Year 2007	100	132.09	142.37	74.08	184.48	201.64	264.66	239.62
Net Profit Trend (%) Base Year 2007	100	67.55	2.10	51.28	-5.91	43.72	22.71	-232.07

Source: (1) RECO & RWASCO Annual Reports (Dec-2007 to Dec-2009) (2) EWSA / REG Reports (June 2010 to June-2014)

Figure - 5 Operating Performance and Trend percentages of Sales, Cost of Sales, Gross Profit and Net Profit (E W S A / REG) for the period of 2007 - 2014



There has been a steady increase in the sales revenue between 2007 and 2014 exhibiting 2.3 times growth with an exception of 2010 in which the revenue was reported to decline partially to a discrepancy due to the financial year change.

Gross Profit trend percentage has also been on hype from the base year 2007 with 100 % to 174.05% in 2012 with an exception of 88.98 in 2010 which can be admitted partially to the financial year change.

However, the gross profit was reduced from 174.05% in 2012 to 1.19% in 2014 even though the sales revenue was increasing during the same period. Further , Net Profit has shown a negative trend during 2007 and 2014.

It decreased from 100% in 2007 to -232.07% in 2014 even though the sales revenue has been increased during the same period. This analysis purports the idea that the electricity operations in Rwanda are

showing mixed trend. In the following paragraphs a SWOT - Analysis of EWSA (currently known as REG) is presented.

Findings And Recommendations

The research paper summarizes the findings based on the research questions mentioned in the beginning of the paper.

The electricity generation capacity has not increased as expected and remains low compared to the need of the country's growing economy. The target for the expansion of electricity supply was set by Vision 2020 and the Economic Development and Poverty Reduction Strategy (EDPRS) of 2009 -2012 that primarily aimed at increasing electricity access from 4% in 2008 to 40% in 2025 and later this target was pushed up further to reach 70% by 2017. The total capacity of energy in Rwanda was 51 Mw in 2008 and the set target is to increase it to 1,000 Mw by 2020. EDPRS clearly spells out that by 2012 a wholesome of 350,000 connections, have to be created thus providing electricity access to the households and industrial sector. Especially number of households should be increased from 70,000 (i.e. base line 2006) to 270,000 by 2012. The installed capacity of electricity generation (off /on grid MW) should be increased from 45Mw (i.e. base line 2006) to 120Mw by 2012. However, the assessment shows that as on 2012 only 110 MW of installed electricity generation capacity was achieved, while 308,326 households connections were created (EDPRS 2 September 2013).

The Mix and Status of Electricity Generation:

The mix of electricity generation includes the hydro power, thermal power, solar power and methane gas power in addition to importation and the status of electricity generation has been analyzed from the 2000 to 2014 and the major findings have been discussed in the following paragraphs.

Hydro Power Production

The production of hydro electricity power in Rwanda witnesses a high volatility during the period between 2000 and 2014 and highest annual growth rate was witnessed during 2007 and 2008 with 123.9 %. The production trend percentage has steadily decreased between 2000 - 2009. Whereas from 2010 to 2012 it was increased steadily from 101% (2010) to 164% (2012) but again it showed a declining trend between 2012 - 2014 i.e. from 164% to 134% (2013), 149% (2014).

Thermal Power Production:

Thermal power supply is highly volatile and it has shown a strong growth with the year 2004-2005, which went up to the highest of 701.05% but during 2012-2013 declined to 25.96%. Nevertheless, the supply from thermal sources also recorded a negative growth of -8.39% during 2007-2008 and -3.71% between 2013-2014. Production trend has been steadily increasing from the base year 2004 to 2014 i.e. from 100% to 4075% but with minor exception of declining trends during 2007 -2008 i.e. 2129% to 1951% and between 2013 -2014 i.e. from 4075% to 3924%.

Solar Power and Methane Gas Production

Solar energy and methane gas showed the growth rate was high 149.1% with solar energy during 2007-2008, but reached negative rate of -54.45% during 2012-13. On the other hand, methane gas recording unprecedented growth rate of 170.4% during 2009-2010. Nevertheless, the supply from methane gas sources also recorded a negative growth of -31.91% between 2010-2011.

The trend percentage has been increased from 100 % (base year 2007) to 293% (2009), but the trend percentage is steadily decreasing i.e. from 293% (2009) to 115% (2013) and 240% (2014). On the other hand, methane gas trend percentage has been steadily increasing from the base year 100% (2009) to 472% (2014) with an exception of down trend 184% during 2011.

Percentage Share of Hydro , Thermal , Solar and Methane Gas power production to total electricity generation during 2005 to 2014.

The percentage contribution of different sources to electricity supply during 2005 to 2014. It indicates that the hydro power supply rose from 12.83% in 2007 to 37.50% in 2012 but it is showing the reduction percentage share of total power from hydro sources during 2012 to 2013 i.e. 37.50% to 29.18%. However, percentage share of hydro power production has been increased from 29.18% to 32% between 2013-2014. Among the new energy sources solar energy has contributed less than 0.12% to the total electricity supply and methane gas has contributed less than 2.49% in 2010

and again it increased to 3.03% during 2014.

It is noticed that the percentage share of electricity importation was 43.47% in 2005 decreased to 17.34% in 2014 with an exception in the year 2010 with 22.10 % share. With the advent of the availability of new energy sources such as solar and methane gas the domestic electricity supply increased from 56.53% in 2005 to 82.66% in 2014 with an exceptional year 2011 (81.65%).

The hydro electricity production was slowed down due to decline in the water levels of lakes and power plants equipments breakdown to run the existing hydro power plants to their full capacity. The commissioning of Jabana - II thermal power plant in may 2009 resulted in an additional increment to the domestic electricity supply. Higher fuel costs and operational costs of thermal power plants, the transmission losses, outdated power generation stations are the possible reasons that account for the high level of dependency on importation to the amount of one-fifth electricity demand of Rwanda.

Customer Growth

The number of customers who accessed electricity in Rwanda was 48,581 in 2001 and has increased to 490,860 customers in 2014 with an assured growth rate 19.84% , but recording highest level of annual growth of 41.74% during 2010 to 2011. The customer growth recorded around 10 times increase between 2001 and 2014. It is also noted that the percentage of customer growth that access the electricity was less than 6% in 2001 and it has increased to around 20% in

2014. Further, the trend percentage customer growth has been steadily increasing from 100% to 1067.55% from the base year 2000 to 2014. The revenue per customer has been decreasing from Rwf 312 to Rwf 138 during 2006-2014.

Electricity Consumption by Household and Industrial sector

The trend percentage of industrial sector electricity consumption has been increased from 100% to 136% i.e. between 2008 and 2013, where as the trend percentage of electricity consumption for household services has been steadily increasing from 100% to 185 % between 2008 and 2013 which is very high relatively by comparing with industrial sector electricity consumption trend percentage.

However, the demand for electricity has been increasing at slow pace due to sluggish industrialization growth. Hence there is a need to generate more electricity for industries in near future in addition to demand from household sector.

Government of Rwanda has also embarked on the initiative of privatizing state - owned EWSA as Rwanda Energy Group during 2014 and targeted to expand the existing electricity generation capacity from 144.28 MW in 2014 to 595 MW by 2017 and further expanding to 1450 MW by 2025 through medium- to long term plans during 2018 to 2025 which consists of 310 MW of hydropower, 460MW of geothermal power, 350 MW of methane -based power, 300 MW of peat based power, 20 MW of HFO with estimated investment of \$2.796 billion (Africa Development Bank Group - Rwanda Energy Sector Review and Action Plan 2013).

EDPRS - 2 (2013-2018) proposed two measures i.e. the development of a clear roadmap for investment in electricity generation and leveraging private sector investment in the sector to increase energy generation capacity to meet future demand.

Operating Performance

The operating financial performance of EWSA/REG indicated the trends in cost of sales and operating expenses that have been steadily increasing among other elements such as sales revenue, gross profit, net profit from the base year i.e. 100% (cost of sales 2007) to 386.80 (cost of sales 2014) whereas i.e. 100% (operating expenses 2007) to 264.66 (operating expenses 2013) which are significantly high comparatively with sales trend percentage.

The sales revenue trend percentage has been steadily increasing from the base year 2007 to 2014 i.e. 100% to 226.87% with exception during 2010 i.e. 77.55% which can be admitted partially a discrepancy due to the financial year change. Gross Profit trend percentage increased i.e. from base year 2007 with 100% to 174.05% with exception during 2010 i.e. 88.98% which can be admitted partially to the financial year change. However gross profit was reduced from 174.05% in 2012 to 1.19% in 2014 even though sales revenue was increasing during the same period. Further, Net Profit has shown a negative trend between 2007 and 2014. It is decreased from 100% in 2007 to -232.07% in 2014 even though sales revenue has been increased during the same period. This analysis purports the idea that the electricity operations in Rwanda are showing mixed trend.

Recommendations

The power supply is an important sector as it is directly linked to the other sectors of economy. In Rwanda, there are abundant power resources, such as hydro-power, geothermal, solar, methane gas, peat power and other forms of renewable energy, yet there is widespread power insufficiency in the country. In 2014 the access to electricity off grid and on grid covers only 20% of the whole country. Out of this the capital city consuming around 60% of total electricity supply. The department of Energy, within the Ministry of Infrastructure (MINIINFRA) is responsible for the policy making for the energy sector in Rwanda. Electrical power generation, transmission and distribution is taken care of by Rwanda Energy Group. Based on the analysis made in this paper, the following recommendations are offered for improvement.

1. Explore and utilize local and renewable energy sources such as geothermal, methane gas, peat - power generation, solar resources to replace expensive imported fuels.
2. Develop its Hydropower resources as outlined in GoR strategy to substantially increase installed power capacity in the country.
3. Implementation of Investment Programs in energy sector attract more FDIs
4. Initiate and implement measures to ensure that energy resources will be in harmony not in contradiction with the green growth strategy of the nation.
5. Reinforce and streamline the electricity access rollout program (EARP) is to increase electricity access to the industry and the people.
6. Continue to use of energy saving products to reduce power consumption without negative consequences on output.
7. Clean and affordable energy should be made available for realizing nations industrialization plans.
8. Put in place appropriate strategy and action plan for joint development of Lake Kivu methane gas and petroleum exploration with DRC.
9. Carryout analytical studies on energy supplies and demand, evaluation and programming of actions for energy sector activities for putting in place right strategy.
10. Improve and evaluate the operational performance on a regular base by using appropriate financial analytical tools and cost control techniques.
11. The Private Sector should take initiative to establish energy generating and supplying projects like power plants, strategic water storage facilities.

Conclusion

Electricity play as a catalyst for the overall growth of an economy, electricity provides favorable path for the growth of commodity producing sectors, but only significant role in the socio-economic development of the citizens of the country. Rwanda, a landlocked country with more than 12 million population and most of them live in rural areas, more dependency on agriculture for the livelihood, still the rate of access to electricity is very low. The capital city alone consumers more than 50-60% of the national electricity generated, leaving only 30-40% for the rest of the country. The

growth of various electricity supply sources exhibits a high volatility, this attributed to the decline in the water level of major sources of hydro power stations, inconsistency in the rainfall, increase in the oil prices, low level of investments, lack of human capital.

The country's total electricity depends on thermal power which accounts around 50% of the total supply, followed by minor and major hydro-production. The importation of electricity by Rwanda has been continuously decreasing in the recent past due to an increase in the domestic production. The contribution of solar and methane gas supply is phenomenally low, however, in future, these sources also play a substitutes for the major energy sources of Rwanda.

The growth of customer base is continuously increasing over the period under study, which means the demand for electricity consumption is increasing not only from the capital city Kigali, but also from the growth towns like Muhanga, Huye and from the rural Rwanda.

There is a considerable improvement in the investments in the energy sector in the recent years in terms of number of energy projects and the estimated value of investment in the energy sector.

Policy implementation

The goals set by Rwanda Vision 2020, MDGs in Rwanda and EDPRs are not unachievable. However, one should recognize electricity is an important input in the process of realizing those stated goals. Electricity is a backbone for realizing those goals. The electricity legal and regulations

need to be investor friendly, which enables and attracts more investments in conventional energy supply and other renewable sources of power supply, it is high-time to discuss about the energy efficiency at the source level, rather than at the end user level.

It has been argued that energy price in Rwanda is high and tariff is around on an average USD 18.85cent/Kwh. This is uniform rate across Rwanda. This tariff is very high for rural inhabitants, who depend on agriculture and allied activities for their livelihood, where 50% - 60% of national electricity supply consumed by the capital city Kigali. In order to increase the accessibility of electricity, distribution of CFL or other energy saving appliances alone does not help; on the other hand, creation of affordability is very essential. The government of Rwanda with its producers and distributing agency can subsidize (a) the electricity tariff, (b) monthly rent for meter and (c) application and guarantee fee.

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