Journal of Economics and Sustainable Development
ISSN 2222-1700 (Paper) ISSN 2222-2855 (Online)
Vol.5, No.27, 2014

Ghana's Power Reforms and Intermittent power supply: A critical Evaluation

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Abstract

Economic development thrives on the availability and reliability of power supply. This is because energy is a vital input to every economic activity. In this study, we trace the electricity reforms of Ghana, examine the challenges and provide recommendations to improve power supply and supply in Ghana. Key literature and policy papers on the power reform in Ghana are evaluated. Further, the role of the private sector in electricity supply is examined. The study recommends that policies such as net metering, flexible, independent and investor friendly regulatory framework, reliable off-taker and investment in LNG facilities to ensure availability of natural gas for thermal power generation.

Key words: Power Sector Reform, Electricity Demand, Electricity Supply, Intermittent power supply

1. Background

A cursory look at the literature on electricity supply reveals that, poor performance is often equated to state intervention. According to Karekezi et al (2001), this has led to the equation of power sector reforms with deregulation. This notwithstanding, Karekezi and Kimani (2002) identify two major forms of electricity reforms in Africa. These are structural change and privatisation. Structural change involves the unbundling of vertically integrated utility company into separate generation, transmission and distribution companies. Examples of countries that have used structural change include Ghana, Kenya, Uganda and Zambia. The privatisation on the other hand involves the transfer of ownership and/or control from the public sector to the private sector. Karekezi and Mutiso (1999) argue that, Africa's privatisation often take the form of commercialisation or corporatization such as in Kenya and Zimbabwe. Despite these interventions, power supply in Africa has not be reliable over the past decades. According to Karekezi and Kimani (2002), though power reforms have improved generation capacity as well as financial performance in certain utilities. However, they identify several challenges that reforms are yet to address. These challenges include poor performance at the transmission and distribution end; increased electrification of the poor; and; increased local participation in the power sector. It is

therefore necessary to undertake country specific studies in order to provide customised recommendations for improvement in the power sector.

About two decades ago, the government of Ghana reformed the power sector. Hitherto, Ghana had a semi-liberalised electricity sector dominated by Volta River Authority (VRA) and Electricity Company of Ghana (ECG). The VRA was established by Act 46 in 1961 to generate and transmit electricity. The ECG on the other hand, was established by a decree (Electricity Corporation Decree 1967, N.L.C.D 125). During the mid-1980s the distribution of electricity in the 4 Northern Regions (including BA) was added to the mandate of VRA whilst ECG handled the distribution for the rest of the country. The ECG and VRA also performs metering functions. The main objectives of the power sector reform were:

- Delegation of the responsibility for setting electricity rates to an independent commission, the Public Utilities Regulatory Commission (PURC).
- Establishment of the Energy Commission to be responsible for energy planning, technical regulation and licensing.
- Unbundling the hitherto vertically-integrated entity, the Volta River Authority (VRA), resulting in the establishment of the Ghana Grid Company as an independent system operator of the national transmission system. For instance, in 2005, Act 46 was amended for the transmission functions of VRA to be transferred to GRIDCO.

Despite these reforms, Ghana has been experiencing inconsistent power supply over the past three decades. The intermittent power supply seems to get worse by the day. This study therefore wishes to trace the history of the electricity reform and identify factors that may account for the intermittent power supply and provide recommendations.

2. Electricity Demand in Ghana

From 2000 to 2009, the uncurtailed peak demand growth rates was 44%, driven in large by three major factors: economic growth, urbanization, and industrial activity (PESEC, 2011). During the same period, installed capacity grew by 7%. The major users of electricity are the mines, small scale manufacturing and timber industries, commercial and domestic consumers. Most of the industries that were established in the 1960s have collapsed. VALCO which traditionally consumed the chunk of the electricity generated has shut down as cheap electricity is no longer available for its aluminium smelter. The domestic sector is the only area which is showing real growth but that is not a good yardstick for any prudent investment decision as the ability to pay is a major hindrance (Lartey, 2010). Figure 1.0 shows the electricity consumption per capita trend from 1971 to 2011. Electricity consumption per capita is estimated by dividing the aggregate electricity consumption by the total population. According to figure 1.0, 313.11495 KWh per capita was consumed in Ghana in 1971. However, 343.74526 KWh per capita of electricity was consumed in 2011. This represent a change of 9.78%. In terms of Sub-Saharan Africa, 320.49 KWh per capita was consumed in 1971 as compared to 534.93 KWh per capita in 2011, which represent a change of 66.91%.

Figure 1.0 Electricity consumption per capita (KWh)

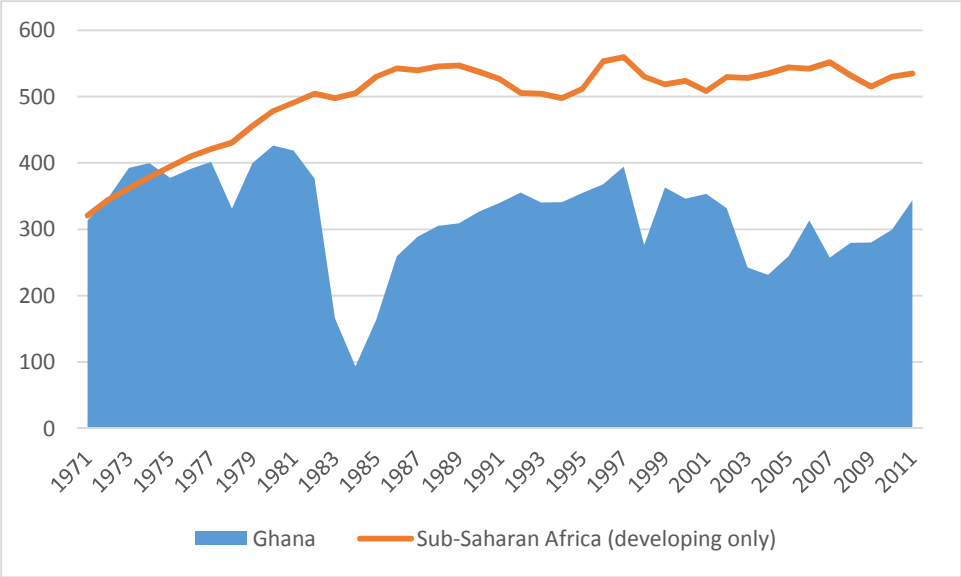
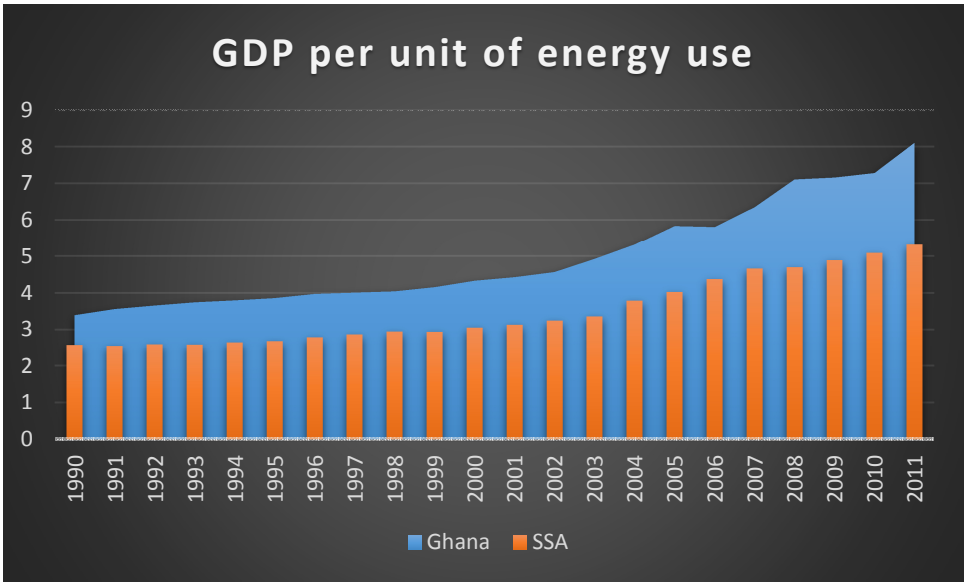


Figure 1.0 compares the electricity consumption per capita in Ghana and total electricity consumption in Sub-Saharan Africa. The change in consumption in Ghana from 1971 to 2011 in per capita terms is 9.78% whilst that of SSA is 66.91%. In figure 2.0, the GDP per unit of energy use from 1971 to 2011 in Ghana and SSA.

Figure 2. GDP per unit of energy use



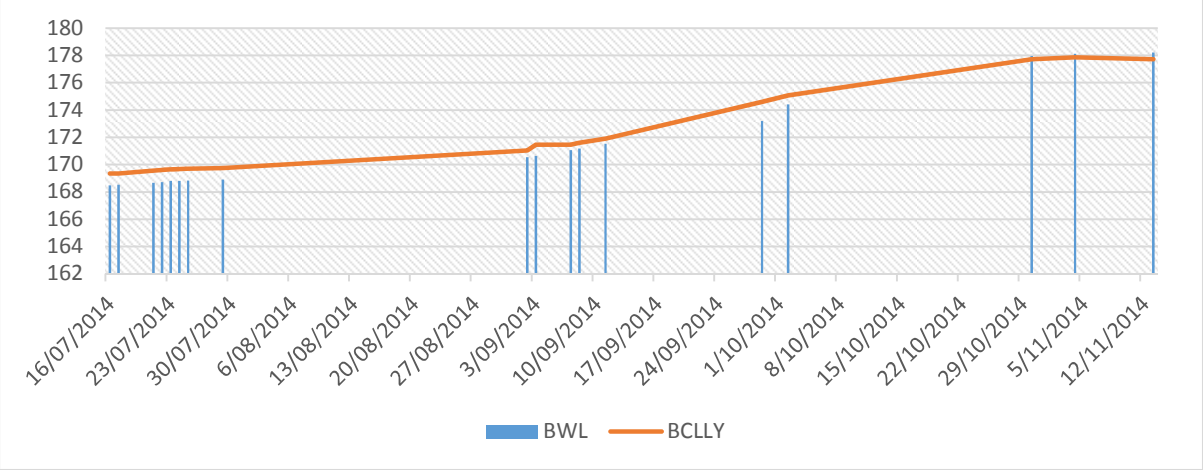
According to Ackah et al (2014), Adom et al (2011) and others, the major drivers of electricity demand in Ghana are changes in industrial output, changes in income levels, changes in population, changes in energy prices, changes in technology, changes in lifestyle, changes in efficiency levels and changes in the structure of the economy among others. The total estimated peak demand in Ghana is 1900 MW. This means there is an excess capacity of 940 MW even at peak demand. Unfortunately, Ghana has been experiencing inconsistent power supply over some time now.

3. Electricity Supply in Ghana

Ghana generates electricity from hydro and thermal sources. However, other sources such as solar is coming on board. The Akosombo Dam was completed in 1965 with a capacity of 912MW. According to the Volta Aluminium Act, 1962 (Act 96), the VALCO was incorporated to use 50% of the power plant's capacity. Other projects that have come on board include the Kpong Hydro Project (1982) which has a capacity of 160 MW. In

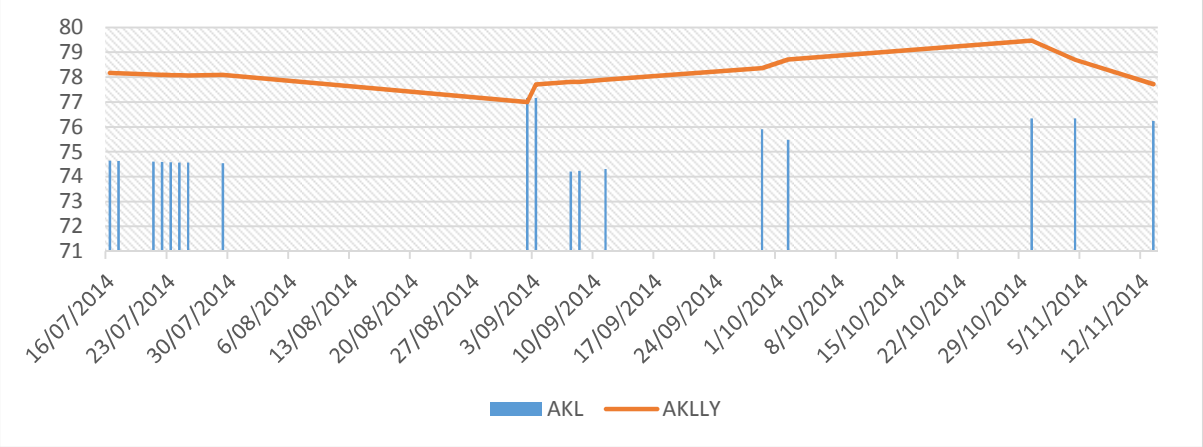
2005, the Akosombo Dam was retrofitted to increase power generation capacity from 915MW to 1020MW. The Bui Dam also came on board to add 400MW to hydro power generation.

Figure 2 Water level in the Bui Dam



*BWL= water level n 2014 *BCLLY water level in 2013

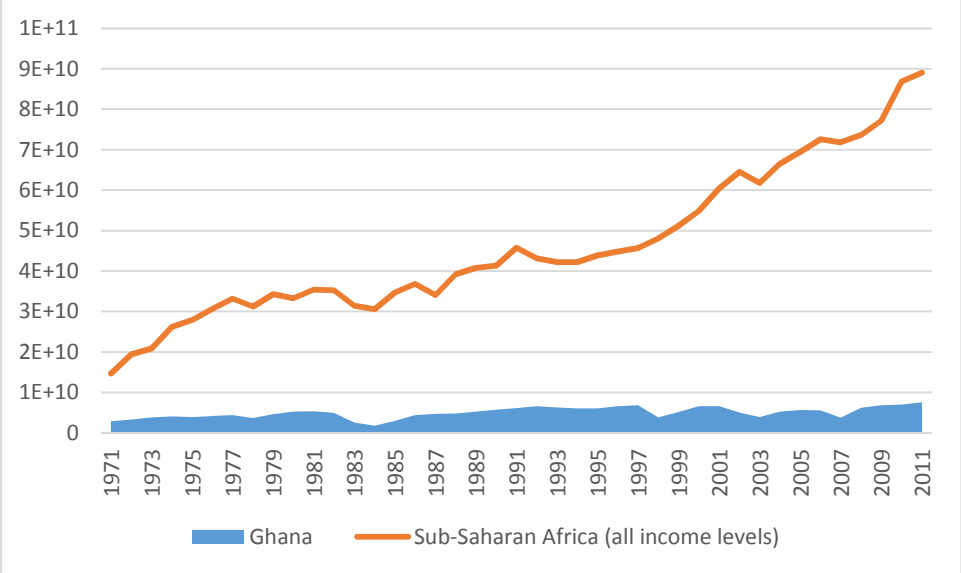
Figure 3 Water level in the Akosombo Dam



*AKL = water level in 2014 AKLLY = Water level in 2013

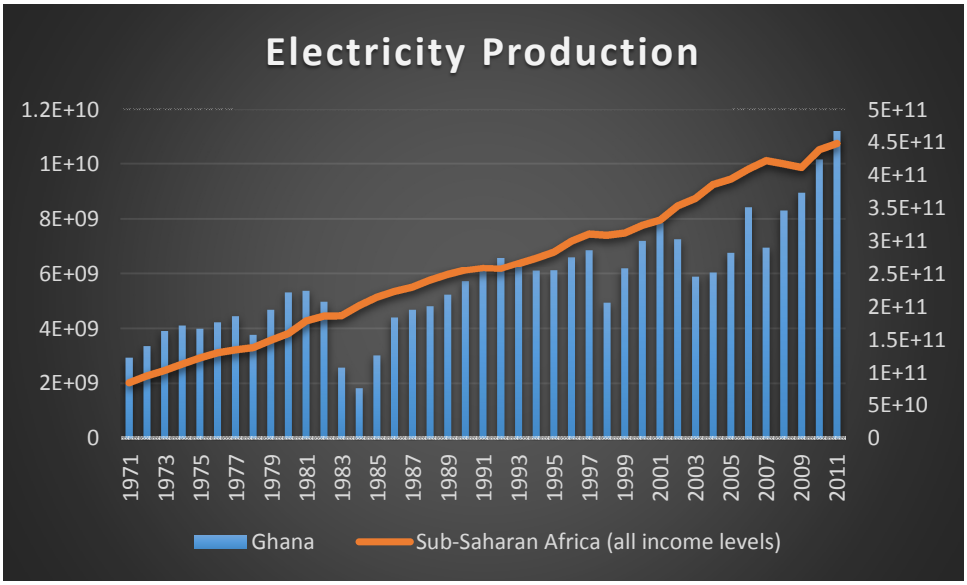
Figure 3.0 shows the hydro electricity production trend in Ghana and Sub-Saharan Africa from 1971 to 2011. Other sources of electricity in Ghana include VRA Siemens plant (49 MW), Mines Reserve Plant (80 MW), CENIT (110 MW), Sunon-Asogli (180 MW) among others. The total installed power capacity in Ghana is 2840 MW.

Figure 4.0 Electricity production from hydro sources (KWh)



The major sources of hydro electricity generation in Ghana are the Akosombo Dam, Kpong Dam and the Bui Dam. Together, these dams together have an installed capacity of 1580 MW.

Figure 5.0 Aggregate Electricity production (KWh)



Ghana produced 2909000000 KWh in 1971 and 7561000000 KWh in 2011. This represents an increase of 159.92%. For SSA, 505.34% increase in electricity production. There are plans for further generation capacity now and in the future include Takoradi 3 Plant (170 MW), Pwalugu Hydro Plant (48 MW), Kpone Thermal Expansion (110) and Domunli Thermal (450 MW).

4. Electricity Demand Studies

Studies on electricity have attracted a lot of attention in Ghana. This may be due to the relevance of electricity to the economy. This notwithstanding, findings from these studies have been varied. The variation is the findings

can be attributed to differences in methodology, variable selection and the sample period. For instance, Dramani et al (2012) investigate the relationship between electricity consumption and economic growth for Ghana during the period 1970 to 2010 and tested for the effect on structural breaks on demand. The findings indicate that the data series had structural breaks in 1979 and 1983. On the causality test, they find a unidirectional causality from economic growth to electricity consumption. Their findings confirm the growth-hypothesis which stipulates that when income increase, consumers and firms demand more electrical appliances and therefore consume more energy. Adom and Bekoe (2013) incorporated the role of policy regime changes since they argue such changes do influence demand behaviour. A regression analysis is run based on data for full-sample (1971-2008), pre ERP (1971-1983) and post ERP (1983-2008). The result was that the industry efficiency, industry value added, and real per capita GDP significantly affect long-run energy demand for the full-sample estimate. Further, Ackah et al (2014) employs the structural time series model and cater for the effect of non-observable factors. The findings indicate that education, price, income and efficiency influences the demand for electricity in Ghana.

6. Major Causes of the Power Crises

Ghana has experienced five major load-shedding over the past three decades. The first load shedding occurred in 1982- 1984, the second occurred in 1997/1998, the third in 2002/2003, the fourth in 2006/2007 and finally, 2012-2014. Apart from these major intermittent supply, the country experiences constant unreliable power supply. A number of factors have been attributed to the past and current load shedding.

To begin with, Ghana's electricity supply is mainly rain-fed. Hydroelectric dams account for between 60 to 70% of total power generated. This implies that, the amount of power supplied is influenced by the amount of rain in a particular year. For example, the 1982-1984 power crises was mainly influenced by the 1983 drought.

In addition, Ghana has inadequate generation capacity due to low reserve margin. According to a study by PSEC (2011), as at 2010, Ghana had a reserve margin of 10.1%. This is low as compared to the minimum margin of 25% established by the West Africa Power Pool (WAPP).

In a nutshell, since Ghana depends almost solely on hydroelectric and thermal technologies for commercial generation and electricity sector is highly centralised, and will continue to do so at least for the short to medium term, water risk, regulatory risk and fuel risks are inherent and therefore requires long term strategic decisions to overcome. This is because, though the government has outlined a number of potential projects in the electricity sector, many of these projects face several hurdles and potential delays in becoming operational ranging from securing reliable access to natural gas to project financing to legal disputes

7. Recommendations

The Millennium Compact Challenge 2, is very timely and vital to Ghana's energy sector. Though the 482 million dollars may not be able to solve the entire power problem, the conditions attached to the facility can lead to extensive reform. It is recommended that:

1. The almost permanent problems of poor performance at the transmission and distribution end has received little attention. One of the reasons for this state of affairs can be linked to the excessive emphasis placed on increased generation when a significant proportion of problems facing many African utilities pertain to transmission and distribution. One can argue that reforms have largely targeted the easiest part of the problem, namely, addition of new capacity when attention should have been focussed on the transmission and distribution sides of the electricity industry. Consequently, a strong case can be made that any future reform measures should primarily address the challenges that still face the transmission and distribution of electricity in the region.

2.Reform of Electricity Company of Ghana

This can follow three main options. These are:

Options

- Management Reform
- Franchising or Concessions
- Private Sector (PS) Asset Ownership

Management Reform

- Involves contracting out ECG Management to an experienced, internationally reputable distribution utility operator. The objective is to introduce modern management practice and business processes into ECG in order to improve performance.
- The Operator will operate for a period (say 2-3 years) and will have contractually enforceable deliverables to improve performance.
- Operator will appoint staff to key positions to be jointly identified with ECG (say MD, Operations, Finance, Commercial, Engineering, MIS functions etc.) with counterparts to serve capacity building and technology transfer. Management Operator will have a say in the appointment of Heads of other Directorates.
- Restructure the Board to include appropriate number of independent Directors to ensure balance.
- Difficulties in implementation of this option includes setting and meeting the benchmarks for the Management Operator, especially if timely capital investment by Government is required to assure attaining the contracted performance targets.
- Another difficulty is responsibility for asset management during the management contract period, ie. who takes responsibility for poor performance attributable to the state of equipment or lack of it.

Concession

- Involves restructuring into a holding company and carving out appropriate special business units (SBU) which will form the basis to form concessions. Ultimately the concessions could be given out for private participation.
- The SBUs will be constituted from the current ECG regional areas of operation.
- Functional, accounting and asset separation of ECG operating assets are required to facilitate this.
- A variant of this structure is to convert ECG into a holding company as a transition to fully achieving its separation into concessions.
- Difficulty is that there is no analytical underpinning to support achievable gains by having concessions compared to the economies of scale currently enjoyed by a single ECG as presently constituted.
- Further, a customer base of 2.6 million is not too large by industry standards to warrant smaller concession areas. This customer base is the equivalent of a medium sized distribution utility in say Thailand, or Brazil. It is not a size that is too unwieldy to manage.
- Until a firm analytical basis can be found, it may not be an option worth pursuing. Though it remains a popular choice.

PS Asset Ownership

- Involves the sale of all or part of ECG to an experienced and first class internationally reputable distribution utility.
- This is the most desirable option since it minimizes or eliminates the most significant challenge facing ECG which is Government interference. The Board is not appointed or answerable to the Government only, so it is more accountable.
- This option is suitable for the medium to long term. This is because, the current state (financial and technical) of ECG is not attractive enough to investors. Consequently, the offer price for a stake in the asset may not be attractive to Government.

- As a mechanism, PS asset holding may start from 51% to assure control (Transactions Advisor may determine this).
- A transitional phase to improve the technical, financial and operational performance of ECG prior to PS asset ownership will be required.

Transitional Phase

- Introduce Management reform for 2-3 years along the lines of Option 1. This is sufficient time to allow for capital investments and improved business processes and performance.
- Introduce independent Directors on the Board to enhance sufficient independent decision making.
- Verifiable and contractual output targets to be included in Management contract. Operator should have the option to procure a stake in ECG after the end of the Management period. The theory is that this will provide sufficient incentive to perform well during the Management period.
- Arrangements to commence to offer a stake to PS in 3rd year (the optimum timing could be determined by a Transactions Advisor at the time)

This is an important goal since it will enhance productive and economic activities, promote the safety of women and children and create jobs, there are few issues we will like to raise:

5. Design of framework for private participation

There should be a simple, short and objective process for private participation. It should not take more than 30 days for businesses negotiations with ECG, Energy Commission, and Ministry of Energy on the setting up energy companies. There should be a simple and effective way to conduct due diligence, marketing to potential investors, preparing the transaction structure, conducting bidding process. Again there should be an objective criteria which should be communicated to international and local investors on how they can set up energy companies.

6.Special fund and training to promote local participation in mini-energy generation plant: Example from Rwanda

Rwanda's Private Sector Participation in Micro-hydro Power Supply for Rural Development (PSP Hydro) is supported by the government and financial institutions alike. Rwandan banks, with no previous experience of projects in the energy sector, have now started offering loans to developers of micro-hydropower plants. International investors have begun investing in companies supported by the project. The first three privately run micro-hydropower plants (96kW, 500kW and 438kW) have been connected to the electricity grid in Rwanda and supply over 16,000 people with electricity. Three more micro-hydropower plants are in the development phase.

7.Explicit and simple guidelines on LNG investment

It is argued that the most important factors are governmental policies, consumption markets, and engineering efficiency. Whilst the investor will see to engineering efficiency, the other two factors are under the control of the government. With electricity demand outstripping supply, increased domestic natural gas consumption and the potential to export electricity to the West Africa Sub-region, investment in LNG will definitely pay off. However, due to huge initial capital outlay for such projects, there should be clear, transparent, investor-friendly and well communicated government policy on investments in LNG. In addition, there should be economic incentives to entice investment into the sector.

8. Credible Off taker

ECG has been struggling as an offtaker. We believe that, moving forward, ECG should have a separate fund aside which is purposely used for paying for power generated. This fund can be invested secure but high yielding investment to generate some interest. Again, allowing resourced private investment in power distribution can also help promote efficiency and allow for alternative credible offtakers.

H. Rural Areas: Women in rural areas are usually into bakery, cold store, hairdressing and other economic activities that can lift their standard of living. Limiting the project to urban and peri-urban areas will reduce the impact of the project. This is because, only 52% of the rural population have access to electricity as against 90% access in urban and per-urban areas. We suggest that MiDA looks at small scale biomass plants, grid and off-grid plants and producer subsidies for energy companies which settle in rural areas.

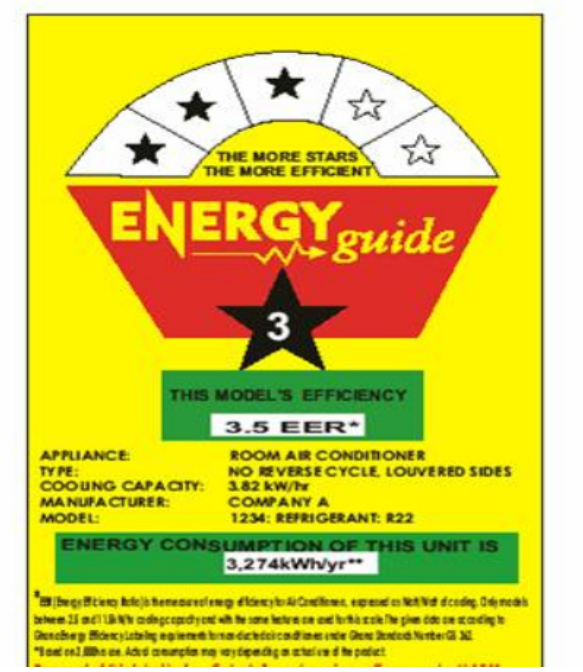
9. Again, though the Access project encourages legal connection, we believe that financial incentives can make this goal achievable. For instance, MiDA defrays partial cost of the connection, then this is spread over a certain period for the consumer to pay.

10. We also believe there should be pro-poor targeted interventions such as consumer subsidies or tariff payment plan (Eg. 1 cedi a day) in the economic and market enclaves. This will enhance access and encourage consumers to pay their bills.

11. Disconnected customers: Some customers/MSMEs owe electricity bills over a long period of time. Due to this, some of these customers have had their electricity access disconnected. We suggest that there should be a payment plan for these customers within the economic enclaves.

12. Appliance Efficiency Labelling: Electrical appliances imported, produced or used in the country should have energy efficiency labels. This measure is supported by the Legislative Instrument 2005 (LI 1815).

Figure 1. Sample label



Source: Energy Commission

13. Energy efficiency and demand side management (EE/DSM)fund: Taking South Africa's example, ECG can be required to implement an EE/DSM fund as a condition for the approval of Eskom's price/tariff increases.

The Energy Commission will set licence conditions for major distributors to develop EE/DSM plan and implementation schedule. The Energy Commission will set a benchmark criteria for distributors, energy service companies and major consumers to access the fund.

14. Comprehensive study: Since most of the activities highlighted under project 6 are already been implemented by Ghana Energy Commission, it will be prudent to undertake a comprehensive nationwide study on the success, failures and the impact of the projects on energy efficiency improvements.

15. Standard offer approach: With this system, energy saved will be treated energy generated by customers. This can be sold to the power companies. Initially, bulk consumers like the mining companies can be targeted before a nationwide rollout.

16. Customer Education on Energy Efficiency measurement and reporting: Customers should be educated on how they can measure and report energy efficiency gains. CFLs can be encouraged especially in rural areas where plans are afoot to provide them with solar system. This is because, CFL last 10 times longer than the incandescent bulbs and consumes about 1/3rd electricity.

17. Past and ongoing reforms of the electricity industry have largely failed to address the challenge of expanded electrification. Urban settlements as well as selected rural areas. This will ensure that private investors are simply not cherry-picking by purchasing the most profitable portions of the electricity industry and leaving the unprofitable portion (e.g. rural electrification) to the state. Thirdly, is the need for power sector reform to address the tariff question especially with regard to the poor? The most obvious intervention that can be made for the poor is provision of subsidies. However, this should be optimally designed to reduce inefficiencies and make sure the poor, rather the rich benefits.

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