Journal of Energy in Southern Africa 18(3): 18–26
DOI: http://dx.doi.org/10.17159/2413-3051/2007/v18i3a3383

# Rural electrification: the propelling force for rural development of Edo State, Nigeria

**S O Igbinovia**
*Electrical and Electronic Engineering Department, University of Benin, Nigeria*

**P E Orukpe**
*Control & Power Research Group, Department of Electrical Engineering, Imperial College, London*

***Abstract***
*Since the advent of technology, the ability for Man to do work has been enhanced by the discovery of various forms of energy and the efficient management of these energy resources. Thus, all over the world, the GNP of a nation depends on the energy consumption per capita and the growth in the macro-economics of the locality. This paper addresses the Edo State's Governments Rural Electrification Scheme, which has been in operation since 1957. The population of the localities, the area coverage in square kilometres and the index of industrialization of the Local Government Area (LGA) are presented. The number of electrified towns compared with the total number of localities per LGA by the successive governments' shows that the rate of rural electrification is 18%. Consequently, industrialization and the standard of living of Edo State's people are also seriously affected. It is recommended that to enhance the economic disposition of rural people, the federal government, state government, the local government authority, business operators in the localities and people involved, must put all their resources together to build stable and reliable electrification schemes all over the country, the back bone of any nations technological development and stable Gross National Product (GNP). The recommendations made will benefit other African countries in general.*

*Keywords: energy, rural development, economic growth, industrialization, employment, energy infrastructure.*

## Introduction

There are currently more than 1.5 billion people without access to electricity and it is estimated that no more than 20%, and in some countries as little as 5%, of the population in Africa (excluding South Africa and Egypt) have direct access to electricity. The figure falls to 2% in rural areas. Demand is expected to grow by about 5% annually over the next twenty years. Africa constitutes approximately 10% of the World's population, the total primary energy consumption of Africa is only about 3% of the total World primary energy consumption (BP, 2002) and a review study puts rural households average requirement between 1 583.2 – 2 324.5 Wh/day (UNIDO, 2006).

Nigeria, a typical country in Africa with a landmass of 910 770 sq. km, is the 9th largest country in the World with a population of 134 million. Urban dwellers make up 30% of this population, while the remaining 70% are rural dwellers and mostly farmers. In Nigeria, 73% of its population are without access to electricity (*Sunday Vanguard*, 2007 and Report submitted to Nigeria University Commission Abuja, 2005), and this makes efforts for development very difficult (Togola, 2005). Thus, electricity is a catalyst for economic development. It is important to increase access to energy services (Adegbulugbe, 2006) for rural areas in order to achieve the Millennium Development Goals (MDGs UN - Energy, 2005) in West Africa and Nigeria in general.

Poverty is most widespread in rural areas and tends to affect women more than men. This is because it is women who must fetch water, grind cereal and collect wood. In most cases, they have only their own might to rely upon and some crude tools with which to carry out these tasks. In addition, these tasks are highly time-consuming and this, along with the huge physical effort required, help keep women trapped in absolute poverty.

Energy is also closely linked to poverty reduction because it is central to practically all aspects of the core conditions of poverty – such as poor health, lack of access to water, sanitation and education.

An organized political community like Edo State, made of many villages of diverse culture and political-will, is being controlled by one government for now - the People Democratic Party (PDP), must be found to have some of, if not all the essentials of a developed community like electricity, roads, hospitals, water supply, information network system, agro-allied industries, small-scale industries etc. It is sad to note that apart from government presence in the local government areas in Edo State, as reflected in Table 4, there are no noticeable small scale industries and agro-allied industries, tourist centres, and recreation centres etc. that could boost the micro economies of the area and thus increase the Gross National Product (GNP) of its people.

Considering these stocks of fixed capital equipment and infrastructures, electricity is the major key for rural development, and if properly managed, can result in stable GNP which should be reflective of a community with a highly organized economy. It is important to note that even if the region has quality electricity available, the no presence and attitude of the government, individuals, public and private sectors in harnessing the natural and human resources to produce end products for both the financial and social status of the communities, very seriously contributes to lack of development. In the light of the above, we shall look at this topic under the following headings.

## Electricity: Another form of energy

Energy has always been critical for economic growth, social development and poverty reduction (Dorf, 1978). As economies develop, energy consumption grows more or less in parallel. Adequate and affordable electricity must be made available to meet the demands of industry, commerce and domestic users and to enable the movement of people and goods. Thus, the impact of energy on economies is felt in unemployment, GNP, inflation, and trade. For example, as energy prices change, the rate of growth of GNP depends on the efficiency of energy production and utilisation.

Electric energy has been found to be stored in various sources like, wind, tidal, fossil-fuels, waterfalls, solar energy, thermion, magneto-hydrodynamics, and hydro-schemes, etc. by an energy conversion process governed by electromagnetic and thermodynamics laws, hence electricity is generated from any of the above mentioned energy resources. This generated electricity at different voltages depends on the installed plant capacity and is transformed at different voltages using sub-transmission lines, (e.g. national grid). Electric energy to the end users must be sustainable, reliable and stable to create enabling balanced economy. Electricity is one of the cheapest forms of energy utilization in the world, its initial cost, maintenance and running cost makes it unavailable in most of the rural areas in Nigeria; however, in Nigeria electricity is the major source of energy in use and we are yet to invest in other forms of energy. Tables 1 and 2 show the energy consumption per capital in some countries.

If one is allowed to compare the efforts of government in electrification, it will be surprising to know that in some rural communities, the only thing on the ground is how our colonial masters left the Energy Commission of Nigeria (ECN) and the Rural Electrification Board (REB). The extent a nation, state and rural settlement strives to be a technological giant depends so much on the importance the government places on electricity as the form of propelling force (energy power). Tables 1 and 2 show that despite the phenomenal growth of electricity consumption in Nigeria over the last two decades (168kwh/capita at 2000), it is low compared with the other 16 countries of the West African Sub region (UNDP, 2006), where Nigeria's per capita consumption was only 10th in 1980.

## The importance of rural electrification

The rural electrification of villages in Nigeria's states as seen in urban areas like Lagos, Kaduna, Abuja, Port Harcourt, Aba, Kano etc. will bring about changes in the following areas:

- Effective socio-political awareness;
- Enhanced changes in the community GNP;
- Economic growth;
- Industrial revolution (i.e. offspring of Small Scale Industries and Agro-Allied Industries, for example, Agbede Rice farm, cassava, and fruits processing plants);
- Mechanized farming and irrigation pilot schemes;
- Reduced rural-urban drift;
- Information technology at the doorstep of people;
- Advancement in the method of learning and educating people (standardization in laboratory/workshop tools and equipment);
- Enhancement in health sector control and management, thus population growth;
- Improved infrastructural development schemes; and
- Reduction in forestation problems (i.e. Desert encroachment).

It is in the light of the above that the government of Nigeria and Edo State, over the years, created bodies known as Mass Mobilization for Self Reliance (MAMSER), the Directorate of Food, Road and Rural Infrastructure (DFFRI), National Orientation Agency (NOA), Edo State Rapid

**Table 1: Electric energy consumption per capita (ARBT, 1999)**

| *S/No.* | *Country* | *KWh/capita* |
|---|---|---|
| 1 | U.S.A | 12711 |
| 2 | Senegal | 95 |
| 3 | Cote D'voire | 139 |
| 4 | Ghana | 347 |
| 5 | Nigeria | 168 |

**Table 2: Electric energy consumption per capita of West African sub region (UNDP, 2006)**
*Source: United Nations (UN). 2006f. Correspondence on energy consumption. Department of Economic and Social Affairs, Statistics Division, March. New York*

| *S/No.* | *Country* | *KWh/capita* |
|---|---|---|
| 1 | Nigeria | 108 |
| 2 | Niger Republic | 39 |
| 3 | Republic of Benin | 37 |
| 4 | Chad | 10 |
| 5 | Senegal | 115 |
| 6 | Burkina Faso | 16 |
| 7 | Cameroun | 168 |
| 8 | Ghana | 450 |
| 9 | Gambia | 70 |
| 10 | Guinea | 85 |
| 11 | Guinea Bissau | 18 |
| 12 | Ivory Coast | 220 |
| 13 | Liberia | – |
| 14 | Mali | 15 |
| 15 | Sierra Leone | 62 |
| 16 | Togo | 74 |

Responds Agency (ERRA), and Edo State Rural Electrification Board to support its citizens and enlarge on laudable projects that will alleviate the suffering of the people. Going by some of these mentioned merits of rural electrification; it is evident that it will reduce unemployment in the countryside, the crime rate and social evils in the society, and encourages acquisitions of different skills by people and enhances relative contentment of people.

## Problems with rural electrification

Some of the problems of rural electrification need to be highlighted. The negative impact such developments have on the countryside and the urban areas include:

- Environmental pollution; which depends on the type of energy resources, mining and energy storage, and the conversion process associated with energy transformation and consumption per capita.
- Diminishes manual labour if not well controlled in developing countries, by encouraging mechanization of work activities, since not all work can be done by machines. This is, however, beneficial to women, as grinding of cereal will be done by electric blenders.
- Undue social-political influence on the people.
- The environment might become hazardous and unsafe for species if not well managed and controlled.

From the foregoing it's important to note that the socio-economic effect of rural electrification concerns several factors such as travel patterns, housing demand, expenditure/revenue, distribution and effects on local employers, etc. as these change the psychology and status of the people.

## Economy and policy

Before the Statutory bodies concerned with rural electrification (e.g. REB, Nigeria Electric Power Authority (NEPA) now known as the Power Holding Company of Nigeria (PHCN), and Independent Power Producers (IPPs) embark on the electrification of villages and urban areas, there must be a quantitative study on the relationship of energy consumption to GNP of the area in question, to bring about integrated development. This is evaluated using (Ngyaela, 1989):

$$\log(E) = a + b \times \log(GNP \quad (1)$$

Where $E$ = Energy consumption in billions of kilowatt hours; $b$ = the income elasticity in terms of the money invested in the energy conversion process and this depends on the nation's state of economic development among other factors; and $a$ = constant.

**Table 3: Relationship between energy consumption and GNP (Dorf, 1978)**

| *Nation* | *b* | $R^2$ |
|---|---|---|
| India | 1.89 | 0.97 |
| Italy | 1.77 | 0.98 |
| Canada | 1.37 | 0.99 |
| Brazil | 1.19 | 0.98 |
| Japan | 0.96 | 0.99 |
| U.S.A | 0.96 | 0.99 |
| Germany | 0.66 | 0.95 |
| United Kingdom | 0.48 | 0.84 |

To appreciate this type of study, the value of $b$ and correlation coefficient $R^2$ for some nations in the World are given in Table 3. By examining the table, one will observe that the income elasticity is somewhat related to the nation's stage of economic development among other factors. From this study, the efficiency of utilization of energy can be ascer-

tained, while energy use can be shown to be closely related to employment in that when energy consumption increases employment level rises (ARBT, 1999). It was stated that electricity consumption leads to economic growth without feedback, and as such energy growth policy in the case of electricity consumption should be adopted in such a way that it will stimulate growth in the economy and thus expands employment opportunities (Aqeel and Butt, 2001).

## The electrification profile of Edo State

The history of rural electrification of the countryside in the State started in 1969 with the then Military Government. The Rural Electrification Board (REB) was enacted into law in 1972 by the Promulgation of Edit No. 6 (Law of Electricity Board) with the commencement date 1st of December, 1971. The Board was saddled with the responsibility for the supply and development of electricity in those areas where PHCN does not maintain any undertakings or installations. The State as of today is made up of eighteen (18) Local Government Areas, with major towns and villages. Table 4 shows the towns and villages that have been electrified since 1960 to 2005; however, development started in the 1960's, but the work was completed and commissioned as early as 1972.

It is the responsibility of the government in power, the employers of labour and the community to come together, as illustrated in Figure 1, to embark on infrastructures that can bring about integrated development of the area. In Nigeria, amenities, ecological and socio-economical issues have been left in the hands of government only, which accounts for the slow pace of rural integrated development, as mentioned earlier, the standard of electrification in any area in Nigeria is under the control of government, which must be confirmed to have met I.E.E. regulation before being connected to the existing national grid (infinite bus bar) by the Rural Electrification Department of PHCN, and the Electrical Inspectorate Division of the Federal Ministry of Mines and Power. These two bodies after the inspection of the construction and necessary test of transmission/distribution lines and associated equipment, always issue certificates to the contractor before final payment can be made to them by the client.

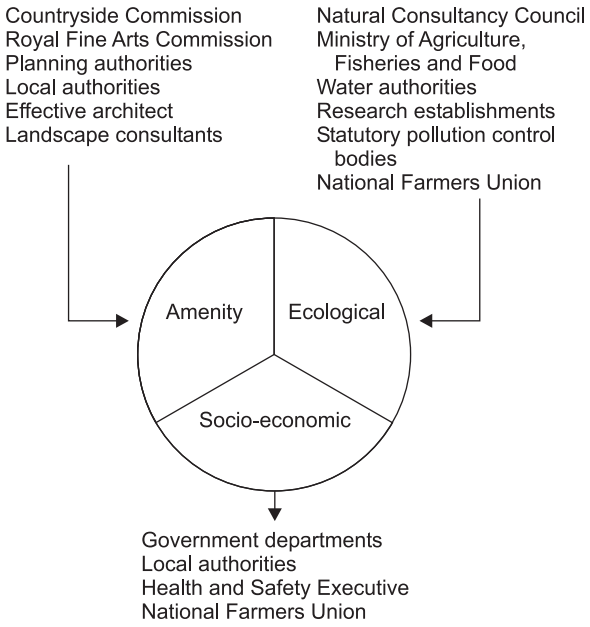


**Figure 1: Regulatory bodies involved in development and management of electrification schemes**

## Constraints and challenges

Table 4 shows how far the government of Edo State has gone in providing electricity to its communities, while Table 5 shows the number of generation stations with their installed capacity. After close examination of Tables 1, 4, 5, and personal observation of what happens in Nigeria in general, some of the problems that can be deduced as limiting the growth of rural integrated development include:

- Lack of funds for the capital-intensive projects;
- The LGA, State and Federal Government are saddled with the sole responsibility of providing electricity to citizens;
- Insincerity on the part of government officials (i.e. over estimation and approval of substandard jobs);
- Non-continuity with government policies;
- Attitude of the end user (e.g. vandalization, lack of protection for government facilities, etc);
- Rate of return on investment is almost zero;
- Lack of technology to produce the sub-transmission material and equipments;
- Location of towns and villages from the nearest National Grid/transmission lines @ 11kV and 33kV respectively (DEREB, 2003);
- To increase electricity access rates, grid expansion is needed as well as non-grid solutions; and
- The total installed generating capacity of 6 094MW as shown in Table 5 and the available capacity of 2 400 MW (as at the time of this study) are grossly inadequate compared to the country's population.

## Recommendations

From the foregoing investigation based on rural integrated development and the lapses in terms of electricity provision in the State, and going by the country's population and abundant hectares of land, it suffices in order to provide affordable quality electricity to all nooks and crannies of the state, so as to raise the present level of technological development and social awareness. In view of this,

**Table 4: Towns and villages electrified in Edo State**

| S/no | Local govt area/capital | Area coverage ($km^2$) | Population | Localities electrified |
|---|---|---|---|---|
| 1. | Oredo (Benin City) | 262 [- *] | 359 973 | Ogba Scheme, Ebo & Irri Schemes<br>Edo State House of Assembly<br>Government House |
| 2. | Ikpoba-Okha (Idogbo) | 868 [17*] | 211 969 | Ikpoba Hill Staff & Andrew Wilson / Evborhiarhia Housing Estates<br>Idogbo, Oka, Egba, Olazagbon<br>Utezi and Ulegun Electricity Schemes<br>Iyanomon/Obaretin Schemes<br>Obagie Complex |
| 3. | Egor (Uselu) | 88 [7*] | 229 681 | Upper Erhunmwunse Scheme |
| 4. | Uhunmwode (Ehor) | 2066 [60*] | 98 719 | Eguaholor Complex<br>Ugo-Neki Scheme |
| 5. | Orhionmwon (Abudu) | 2388 [52*] | 147 085 | Igbanke Scheme<br>Evbuesi Complex<br>Ugo-Niyekorionmwon<br>Ogba Scheme<br>Umoghumwun Nokhua & Urhonigbe Schemes<br>Abudu Headquarters<br>Oben<br>Otobaye |
| 6. | Ovia S-West (Iguobazuwa) | 2859 [42*] | 80 692 | Iguobazuwa & Udo Schemes<br>Rehabilitation of Usen Scheme<br>Ofosu Scheme<br>School of Agric. Iguoriakhi Scheme |
| 7. | Ovia North-East (Okada) | 2369 [59*] | 121 769 | Okha, Okada, Utese, Uhen and Ogbese Ekiadolor & Oluku Schemes<br>Ovbiogie, Iguodia, Iyowa & Utekon<br>Rehabilitation of Benin-Okada<br>Rehabilitation of Evboneka scheme<br>Usen Rehabilitation Scheme<br>Iwu Electrification Scheme<br>Okada Community<br>Ekiadolor |
| 8. | Esan South-East (Ubiaja) | 1290 [116*] | 93 152 | Ubiaja Scheme<br>Ewohimi/Iyagun Scheme |
| 9. | Esan North East (Uromi) | 343 [108*] | 77 265 | Uromi Complex<br>Egbele, Unuwazi Scheme<br>Onogholo, Ukoni & Awo Schemes<br>Uromi/Eguare |
| 10. | Esan West (Ekpoma) | 495 [85*] | 86 594 | Irhuekpen Scheme<br>Uhiere & Opoji Schemes<br>Ogine Scheme<br>Illeh<br>Ambrose Alli University Electricity Project to the Dam<br>Ebudin Scheme |
| 11. | Esan Central (Irrua) | 278 [93*] | 66 379 | Irrua & Ewu Schemes<br>Ozugholo & Eidenun<br>Ivue-Ugbalo-Ibore Schemes<br>Ibore Water Works & Ugbalo Schemes<br>Ohen Schemes<br>Egoro - Naoka Scheme<br>Idumuwu - Ebelle |
| 12. | Igueben (Igueben) | 393 [111*] | 48 724 | Ebelle Scheme<br>Ekpon Electricity Project<br>Amahor Scheme |
| 13. | Akoko-Edo (Igarra) | 1263 [170*] | 123 686 | Igarra, Ibillo & Uneme-Nekhua Schemes<br>Bekuma, Ekpe & Ekpedo Schemes<br>Uneme-Osu & Ikpeshi Schemes<br>Lampese |
| 14. | Etsako Central (Fugar) | 703 [164*] | 40 985 | Ayogwiri Scheme<br>Fugar & Iguode Schemes |
| 15. | Etsako East (Agenebode) | 1133 [189*] | 97 142 | Agenebode Scheme<br>Egori & Okpella Complex<br>Igodor<br>Okphia |
| 16. | Etsako West (Auchi) | 943 [130*] | 126 112 | Agbede Scheme<br>Afushio Electricity Project<br>Ikpeshi Electricity Project |
| 17. | Owan West (Sabongida) | 826 [89*] | 68 309 | Eme-ora, Ovbiokhia & Oke-ora Complex<br>Cocoa Research Institute of Nig. Uhunmora |
| 18. | Owan East (Afuze) | 1230 [107*] | 92 066 | Afuze & Iwarake Schemes |

** Indicates the distance the LGA Headquarter is from Benin City*

**e since 1960 to 2005 (DEREB, 2003 and DNPC, 2000)**

| *No. of locality* | *Transformation voltage* | *Year commissioned* | *Client* | *Industrialised* | *Remarks* |
|---|---|---|---|---|---|
| 16 | 11/.415KV | 1972 | REB | Average | |
| | 1No.500KVA,11/.415 KV | 2000 - 2002 | REB | | |
| | 1No. 1000KVA Generator | 1996 - 2000 | State Govt | | |
| 61 | 11/.415KV | 1999 | REB | Average | |
| | 11/.415KV | 1999 - 2002 | REB | | |
| | 33/.415KV | " | REB | | |
| | 2Nos. 200KVA, 33/.415KV | 1999 - 2002 | REB | | |
| 7 | 33/.415KV | | REB | Below average | Ongoing project |
| 167 | | | REB | Low | Defunct |
| | | | NDDC | | |
| 133 | 11/.415KV | 1973 | REB | Low | Defunct |
| | 11/.415 KV | | REB/NDDC | | |
| | 33/.415KV | 2002 | NDDC | | Defunct |
| | | | REB/NDDC | | |
| | 33/.415KV | 2002 - 2003 | REB/NDDC | | |
| | 1No. 200KVA,11/.415KV | 2000 - 2002 | REB | | |
| | 1No. 300KVA,33/.415KV | " | " | | |
| | 1No. 200KVA, 33/.415KV | " | " | | |
| 128 | 11/.415KV | 1973 | REB | Low | Defunct/ongoing |
| | 11/.415KV | 1974/2002 | | | |
| | 33/.415KV | 1999 - 2002 | | | |
| | 11/.415KV | | REB | Low | Ongoing project |
| | 11/.415KV | | REB | | |
| | 2Nos.300KVA,11/.0415KV | | REB | | " |
| | 1No.100KVA,11/0.415KV | | REB | | |
| 76 | 11/.415KV | 1973 | REB | Low | |
| | 33/.415KV | 1999 - 2002 | REB | | |
| 15 | 11/.415KV | 1973 | REB | Low | |
| | 11/.415KV | 1999 - 2002 | REB | | |
| | 11/.415KV | 1999 - 2002 | REB | | |
| | 1No. 200KVA 11/.415KV | " | REB | | |
| 21 | 11/.415KV | 1973 | REB | Low | |
| | 11/.415KV | 1988 | REB | | |
| | " | 1993 | REB | | |
| | 11/.415KV | 1996 | REB | | |
| | 11/.415KV | 1999 | REB | | |
| 28 | 11/.415KV | 1973 | REB | Below average | |
| | 11/.415KV | 1987 | DFFRI/REB | Low | |
| | 33/.415KV | 1996 | REB | | |
| | 33/.415KV | 1999 - 2002 | REB | | |
| | 11./415KV | 1999 - 2002 | REB | | |
| | 33/.415KV | | REB | | |
| | 1NO.500KVA,11/.415KV | 2000 - 2002 | REB | | |
| 16 | 11/.415KV | 1993 | REB | Low | Ongoing project |
| | 33/.415KV | 1999 - 2002 | REB | | |
| | 33/.415KV | | REB | | |
| 88 | 11/.415KV | 1973 | REB | Average | |
| | 11/.415 KV | 1974 | REB | | |
| | 33/.415KV | 1996 | REB | | |
| | 1No. 200KVA, 33/.415KV | 2000 - 2002 | REB | | |
| 35 | 11/.415KV | 1974 | REB | Low | |
| | 11/.415 KV | 1987 | REB | | |
| 67 | 11/.415KV | 1974 | REB | Low | |
| | 11/.415KV | 1987 | REB | | |
| | 1No.200KVA, 11/.415KV | 2000 - 2002 | REB | | |
| | " | " | REB | | |
| 53 | 11/.415KV | 1974 | REB | Below average | |
| | 33/.415KV | 2002 | REB | | |
| | 33/.415KV | | | | |
| 44 | 11/.415KV | 1992 | REB | Low | |
| | 1No.300KVA, 11/.415KV | 2000 - 2002 | REB | | |
| 77 | 11/.415KV | 1974 | REB | Low | |

the following recommendations are hereby proposed:

- The LGA's, Council, State and Federal Government formulate a workable agreement on how the rural areas in Nigeria will be provided with the basic amenities and infrastructures. For example, the issue of non compensation to State Government by PHCN for the various project assets during the take over need to be addressed by the Federal and State Governments all over the country.
- The present deregulation in the power industry and energy sector should be pursued with all vigour by the Federal, State and Local Government Authorities (LGA's).
- Legislation should be put in place to protect government investment.
- The service of professionals in the different field of endeavours should be consulted and encouraged.
- The Federal Government should encourage the idea of new technology to harness energy, such as Flexible Alternating Current Transmission Systems (FACTS), Wide Area Monitoring and Control and Wind Power (Saunders and Terwiesch, 2006). These new technologies will not only help in providing alternative means of energy, but will also reduce carbon emission that has become a problem globally. Harnessing other forms of energy sources that can be extended to the poor is vital (Sarr and Thomas, 2005). This is a long term goal and the process can be initiated now.
- Since government utilities cannot alone meet up electricity demand, it becomes imperative for non-specialists like banks, factories, companies and other major marketers located in the area to be encouraged to come together and build power schemes, which should be managed by them on a long-term funded scheme. For example, banks need a constant supply of electricity on a daily basis to be able to meet with information technology demand.
- Enhance access to energy services to reduce poverty and enable economic growth in a sustainable manner should be addressed (UN ESCAP, 2006). To buttress this point, by 1972, approximately 99 percent of United States farms had electricity services, and it was found that the farmers' share of the country total national electricity demand including house use was about 3.5 percent (Heichell, 1976).
- Due to poor power station performance, non-payment of bills incurred by government departments and electricity theft, priorities for reform should include the following (Hammons *et al.* 2000):
  (i) Power utilities should be corporatized and commercialised.
  (ii) Large customers should have a choice of energy supplier, so as to encourage stiff competition.
  (iii) Pricing policies should be proper to bring about power supply flexibility, financial reap-off and users satisfaction.
  (iv) Private finance should be used to build and operate new high voltage transmission lines and distribution networks.
- Government should put in place regulatory policies, new policies and new market instrument to

**Table 5: Major plants of the national grid (NSE, 1997-98)**
**Source: Okoro (2002)**

| *Power station* | *Installed capacity (MW)* | *Source of energy* | *Year of commission* | *Type of exciter* | *Age of plant (years)* | *No. of units* |
|---|---|---|---|---|---|---|
| Ijora | 98 103 | Coal gas | 1923/1956 | Thyristor | 23 | |
| Ijora | | | 1964/1965/1978 | Control | 27 | 3 |
| Oji | 30 | Coal | 1956 | Thyristor | 47 (scrapped) | 4 |
| Delta | 912 | Gas/oil | 1966-1990 | Rotating, Thyristor Controlled | 11 - 35 | 20 |
| Afam | 711 | Gas/oil | 1965 - 1982 | Rotating/ | | |
| Thyistor | 19 - 30 | 18 | | | | |
| Kainji | 760 | Hydro | 1968,1976, | | | |
| 1978 | Rotating | 23 - 33 | 8 | | | |
| Sapele | 1020 | Gas/oil | 1979/1981 | Thyristor | 20 - 23 | 10 |
| Jebba | 540 | Hydro | 1986 | Thyristor Controlled | 20 - 23 | 6 |
| Egbin | 1320 | Gas/oil | 1986 | Thyristor | 15 | 6 |
| Shiroro | 600 | Hydro | 1990 | Thyristor | 11 | 4 |
| Isolated power station | 10.30 | Fuel/diesel | | | | |
| Total capacity | 6094W | | | | | 79 |

encourage investment in the area of electricity energy for sustainable development (EFE, 2007).

## Conclusions

Since the construction of sub-transmission lines and a distribution network is a very capital intensive venture, and depends on whether the required materials and equipment are available locally or not. The prevailing Federal Government policies, the State Government and Local Government Authority should carry out feasibility studies of all the countryside to determine the rate of return on investment of amenities, and embark on the nerve of integrated development (rural electrification) of the area in phases rather than using political weight. Thus, sustainable electricity infrastructure is needed.

As electricity theft is rampart in Nigeria, security of power infrastructure and supply is necessary for sustainable development, thus the judiciary should be authorized to prosecute individuals or groups who vandalize, defaulting contractors and clients, since these are adverse factors that affect the constant supply of electricity to areas that are already electrified. Thus, there is need for the government to use mass media to educate the people about the importance of amenities sited in their area and benefiting communities should be involved in protecting, maintaining and running the commissioned projects. Hence, improving information and advice services to consumers is necessary to bring about this awareness. The idea of complete government ownership of energy infrastructures should be discouraged, to erase from the mind of the utilities operators and consumers that the power supply system is government property and so no proper accountability and maintenance culture is developed.

To reduce the huge cost of electric energy transmitted as reflected in Table 4 to the end users especially in remote locations, the government should encourage individuals, corporate bodies, and project developers to invest in mini-micro hydro-schemes and renewable energy (e.g. biomass from cattle and agricultural waste, as well as sustainable use of firewood) schemes at the villages where these energy resources are in abundance to bring about rural-urban integrated development, thus reducing rural-urban migration and socio-economic problems. Also, this will help to create employment opportunities, poverty reduction, as well as benefit the environment.

In this paper, the effort of government in making electricity available to regions in the state, problems militating against its steady supply and ways of overcoming these adequacies have been proposed. Conclusively, we need a sustainable electricity infrastructure established in all localities of the state and the country to evolve rational development of the community and the people, and so power utilities should be corporatized and commercialised

## References


Adegbulugbe, A. O., *Increasing access to energy services for rural areas in order to achieve the MDGs in West Africa.* Plenary & Special Sessions Speaker, in Energy Week 2006, by World Bank Group, Washington DC, USA, 2006.

*African Review Business Technology (ARBT)*, August 1999.

Aqeel, A.and Butt, M. S., *The relationship between energy consumption and economic growth in Pakistan*. Asia-Pacific Development Journal, 2001, Vol. 2, No. 8, pp. 101-110.

*BP Statistical Review of World Energy*, 2002.

Company, Reading Massachusetts, 1978, pp 399-417.

*Documentation of Edo State Rural Electrification Board (DEREB)*, Benin City, Nigeria, 2003.

*Documentation of National Population Commission (DNPC)*, Edo State Office, Benin City, Nigeria, 2000.

Dorf, R. C. (1978) *Energy Resources, and Policy*. Addison Wesley Publishing

Engineering Forum for Energy (EFE), *Engineering Energy: Delivering the 2007 Energy White Paper goals*, 6 June 2007, IET Savoy Place London.

Hammons, T. J., Blyden B. K., Calitz, A. C., Gulstone, A. B., Isekemanga, E., Johnstone, R., Paluku, K., Simang, N. and Taher F., *African electricity infrastructure interconnections and electricity exchange*. IEEE Trans. on Energy Conversion, 2000, Vol. 15, No. 4, pp 470-480.

Heichell G. H., *Agricultural production and energy resources*, American Scientist, 1976, pp. 64, 72.

MDGs UN-Energy, *The Energy Challenge for Achieving the Millennium Development Goals*, New York, United Nations, 2005.

Ngyaela, H., *Annual Seminar Organised by NSE in Maiduguri State, Nigeria*, 1989.

NSE, *Proceedings of Quarterly Lectures of the Nigeria Society of Engineers, Minna Branch*, 1997-98.

Report Submitted to Nigeria University Commission, *Abuja, on the establishment of a private university by Urhobo Foundation, Oghara Town Delta State, Nigeria, 2005.*

Sarr, S. and Thomas, J. P., *The role of renewable energy in the development of productive activities in rural West Africa: the case of Senegal*, 2005.

Saunders, S. and Terwiesch, P., *IEE Clerk Maxwell Lecture 2006 on 'Where be the Dragon?'* IEE Savoy Place, London, 2006.

Sunday Vanguard, *Source; Population Reference Bureau, Washington DC, USA*, January 14, 2007 pp.15.

Togola, I., *Renewable energy solution perspectives for Africa*. Mali-Folkecenter, 2005.

UNIDO Regional Centre for Small Hydro Power in Africa,

*Small hydro power for productive use in rural areas, a commemorative publication*, UNIDO-RC-SHP in Africa, Abuja, Nigeria, 2006.

United Nations Development Programme (UNDP), *Human Development Report*, 2006.

United Nations Economic and Social Commission for Asia and the Pacific (UN ESCAP), *Enhancing regional cooperation in infrastructure development including that related to disaster management*, 2006.

*Received 18 April 2006; revised 8 June 2007*