

Improving Electric Power Supply using Distributed Generation for Sustainable Entrepreneurship Development in Nigeria

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Abstract:- Uninterrupted supply of adequate, safe, stable, affordable and sustainable electricity is the backbone of sustainable entrepreneurship development, industrial and economic growth. However, electricity is the major factor slowing down entrepreneurship development in Nigeria. Its supply is not only epileptic, but is inadequate with regular and frequent outages, interruptions and load shedding affecting daily business hours and activities in urban and rural areas. Currently, Nigeria relies on centralized power system dominated by thermal power and hydropower plants, which requires power to be supplied from the central power generating stations through the transmission and distribution lines to all the urban and rural communities. While the power generation, transmission and distribution capacity are inadequate, there is also total absent of transmission and distribution lines in many urban and rural areas which has affected daily life and businesses in these areas. The solutions to these involve building additional or expanding existing large power plants, expanding and extending transmission and distribution lines and equipment capacity to supply adequate electricity to areas without access to electricity. This requires huge funds and investment and can take longer time. The consequence is that many entrepreneurs resort to self-generation of power from generators using conventional sources of energy such as petroleum and diesel. This further increases the cost of starting and operating entrepreneurship businesses as well the negative effect on environment. Successive Government over the years, have made power reform policies with very little improvement in electricity supply. This paper examines the state of power supply in Nigeria and made recommendations towards improving power supply for a sustainable entrepreneurship development. One very important recommendation is for the country to shift from a centralized power system to a distributed generation with energy mix utilizing renewable energy sources in areas with abundant renewable sources.

Keywords:- Nigeria, Power Supply, Entrepreneurship Development, Renewable Energy Resources, Distributed Generations, Sustainable Power Supply.

I. INTRODUCTION

Entrepreneurship development is an indispensable factor in industrial and economic development of any country. It is a known fact that no industry and economy can grow without entrepreneurship development. It alleviates

poverty, creates jobs and wealth, and enables self-employment, industrialization and economic growth. The economy of many countries such as United States, China and India have benefited from entrepreneurship development [1].

However, the growth of entrepreneurship development in Nigeria is faced with several challenges in rural and urban areas. The major challenge militating against the growth of sustainable entrepreneurship development in Nigeria is poor and inadequate as well as total absent of power supply in many parts of the country [1, 2, 3]. In fact, there are very few businesses an entrepreneur can engage in without electricity or continue doing without sustainable electricity supply.

This Inadequate power supply means power is not enough to go round all the citizens and businesses at the same time. It leads to outages, interruptions and load shedding and this affects entrepreneurship business development in rural and urban areas. Despite several efforts, numerous reforms and policies by the Federal Government of Nigeria, the situation of power supply in Nigeria has not improved. Many entrepreneurs and other business owners' resorts to self-provision of power supply using back-up fossil fuel generators, which increases entrepreneurship capital and operating cost, causes both air and noise pollution to the environment.

To fully get the benefit of sustainable entrepreneurship development, a lasting solution to this challenge is required. This paper discusses the need for electricity supply improvement with the intention of sustaining entrepreneurship development using distributed power generation with energy mix utilizing renewable energy resources.

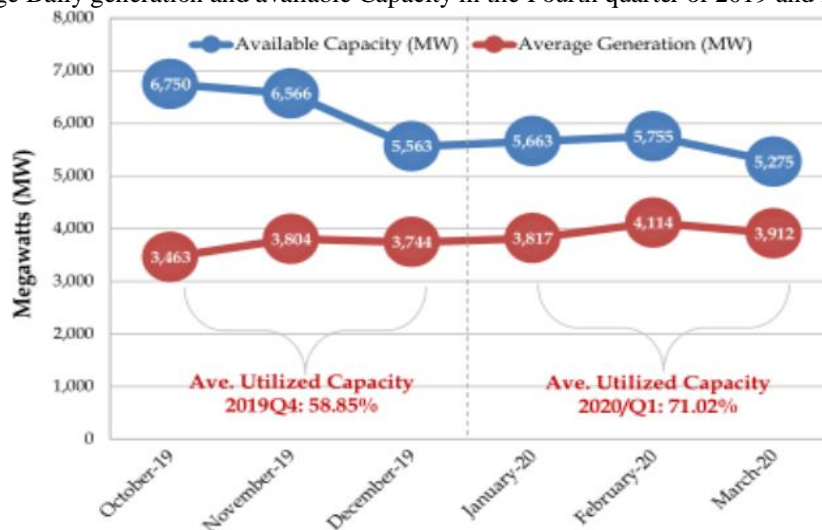
1.1 Present Status of Power Sector in Nigeria:

Since 2013, the generation and distribution system of the power sector are privatized while the country owns the transmission system. Table 1 and Table 3 provide a brief overview of the generation and distribution companies. There are 6 generating companies and 11 distribution companies. The generation companies run the 27 grid-connected generating plants which consist of plants formerly under Power Holding Company of Nigeria (PHCN), National Integrated Power Projects (NIPP) and Independent Power Projects (IPPs), while the distribution companies are responsible for the distribution of power supply in different parts of the country. Each distribution company covers

specific areas of the country. The total installed generation capacity as at now is above 12,000MW and average available generation capacity of about 7,000MW with the peak daily generation capacity of 4,500MW as at the first quarter of 2020, on 26 February, 2020 is available for transmission to distribution system [4, 5]. Figure 3 shows the daily average available and generation capacity from the fourth quarter (October-December) of 2019 to the first quarter (January – March) of 2020. It can be seen that the available generation capacity reduces due to the increase in the number of generation units undergoing maintenance and overhaul as well as inadequate gas supplies which made them unavailable for operation in these quarters. In terms of generation mix, there are two main types of generating plants; the fossil or thermal fuel and hydropower plants. The fossil fuels (natural gas and thermal) plants contribute higher (about 85%) while hydropower plants contribute lesser (about 15%) to the generation capacity and currently there is no contribution from renewable energy resources.

The generated power is supplied to only customers connected to the national grid. Currently some power projects are under construction that will add up to about 4850MW to the generation capacity out of which renewable energy sources e.g. wind and solar will add only 20MW (about 0.11% of generation capacity). These figure is far below the Government target in the power sector reform roadmap in 2013, which was set to increase installed hydro to 5,690MW, thermal to over 20,000MW and renewable 1000MW capacities by 2020. The federal government also planned to work towards adding 13GW of off-grid solar power by 2030 [6]. There Oare also plans by the Ministry of Power and Ministry of Water Resources to establish a partnership for several existing hydropower plants including Gurara 1 of 30MW, the 10MW at Tiga, 10MW at Oyan, the 8MW at Challawa and the 6MW at Ikere plants. In addition, the 700MW at Zungeru and the 40MW at Kashimbila hydropower plants currently under construction.

Figure 1: Average Daily generation and available Capacity in the Fourth quarter of 2019 and First quarter of 2020.



Source: Nigerian Electricity Regulatory Commission Quarterly Report First Quarter 2020

The transmission network of Nigeria has 330kV and 132kV lines and substations (e.g. 330kV/132kV, and 132kV/33kV). It has a total (theoretical) wheeling capacity of 8,100MW over transmission lines of 20,000 km but currently the transmission wheeling capacity is 5,300MW [7]. It is managed by the Government owned Transmission Company of Nigeria (TCN). For effective management, reduction of technical and commercial losses as well as improving the business process, the Federal Government of Nigeria further contracted the management of the transmission network to Manitoba Hydro International. Manitoba is to split the TCN into Transmission Service Provider (TSP) and Independent System Operator (ISO). TSP is responsible for the development and maintenance of transmission infrastructure while ISO manages the flow of electricity throughout the power system from generation to distribution companies.

The distribution system consists of all the distribution lines, and substations (e.g. 33kV/11kV, and 11kV/0.415kV). It is managed by the 11 distribution companies. Each distribution company has specific areas of operation and can purchase power from any of the generation companies of their choice. The distribution system is always faced with power demand that is above it distribution capacity as shown in Table 3.

Table 1: The Power Generation Companies and Plant type.

| S/N | Generation Company | Plant Type |
|-----|---------------------------------|------------|
| 1 | Afam Power Plc | Thermal |
| 2 | Egbin Power Plc | Thermal |
| 3 | Kainji/Jebba Hydro Electric Plc | Hydro |
| 4 | Sapele Power Plc | Thermal |
| 5 | Shiroro Hydro Electric Plc | Hydro |
| 6 | Ughelli Power Plc | Thermal |

Source: Nigeria Electricity Regulatory Commission.

Table 2: The installed and generated capacity of the generation plant

| S/N | Name of station and fuel type | Location | Year of installation | Installed generating capacity (MW) | Status |
|---|---|-----------------------|---|------------------------------------|--------|
| 1 | Kanji (Hydro) | Niger State | 1968 | 760 | PO |
| 2 | Sapele (Gas) | Delta State | 1978-1981 | 1020 | PO |
| 3 | Sapele (Gas)(NIPP) | Ogorode (Lagos State) | 2012 | 450 | PO |
| 4 | Afam IV-V (Gas) | Rivers State | 1982 and 2002 | 726 | PO |
| 5 | Afam VI (Combined cycle gas turbine) | Rivers State | 2009 - 2010 | 624 | PO |
| 6 | Egbin (Gas) | Lagos State | 1985/1986 | 1320 | PO |
| 7 | Egbin Berge AES (Gas) | Lagos State | 2001 | 270 | O |
| 8 | Jebba (Hydro) | Niger State | 1986 | 576 | PO |
| 9 | Shiroro (Hydro) | Niger State | 1989 | 600 | PO |
| 10 | Ughelli (Gas) | Delta State | Phase I: 1966 Phase II: 1975 Phase III: 1978 Phase IV 1990 | 900 | PO |
| 11 | Alaoji (NIPP- Combined cycle gas turbine) | Abia state | 2012-2015 | 1074 | PO |
| 12 | Ihovbor (Gas)(NIPP) | Edo State | 2012 and 2013 | 450 | PO |
| 13 | Calabar (Gas)(NIPP) | Cross River State | 2014 | 561 | O |
| 14 | Egbema (Gas)(NIPP) | Imo State | 2013 | 338 | PO |
| 15 | Geregu I (Gas) | Kogi State | 2007 | 414 | PO |
| 16 | Geregu II (Gas) (NIPP) | Kogi State | 2012 | 434 | PO |
| 17 | Papalanto (Olorunsogo 1) (Gas)(NIPP) | Ogun State | 2007 | 336 | PO |
| 18 | Olorunsogo 11(Gas)(NIPP) | Ogun State | 2012 | 675 | PO |
| 19 | Omosho (Gas)(NIPP) 1 | Ondo State | 2006 | 336 | PO |
| 20 | Omosho 11 (Gas) (NIPP) | Ondo State | 2012 | 450 | PO |
| 21 | Omoku (Gas)(IPP) | Rivers State | 2005 | 150 | O |
| 22 | Omoku II (Gas)(NIPP) | Rivers State | incomplete | 225 | NO |
| 23 | Aba Power Station(Gas) | Abia State | 2012 | 140 | O |
| 24 | Qua Iboe (Ibom) (IPP)(Gas) | Akwa Ibom State | 2009 | 191 | PO |
| 25 | Okpai (Combined cycle gas turbine) | Delta State | 2005 | 480 | O |
| 26 | Azura (IPP) (gas) | Edo state | 2018 | 450 | O |
| 27 | Zamfara (Hydro) | Zamfara State | 2012 | 100 | O |
| Total grid –connected power plants | | | | 14,050 | |
| 28 | Gbarain (Gas)(NIPP) | Beyelsa State | Under construction | 225 | UC |
| 29 | Mambilla (Hydro) | Taraba State | 2024 | 3050 | UC |
| 30 | Itohe Power plant (Coal) | Itohe, kogi state | 2015 - 2018 | 1200 (first phase of 600MW) | UC |
| 31 | Kano power station (hydro) | Kano | 2015 | 100 | UC |
| 32 | Dandi Kowa power station(hydro) | Gombe | 2018 | 40 | UC |
| 33 | Kudenda power plant (gas) | Kaduna | | 215 | UC |
| 34 | Wind Power Plant | Katsina | Started since 2007 | 10 | UC |
| 35 | Solar | | | 10 | UC |
| Total of power plants under construction | | | | 4,850 | |

O - Operational, NO – Non Operational, PO – Partially Operational, UC – Under Construction

Table 3: The Distribution Companies and Areas of coverage

| S/NO | Distribution Companies | Areas of Coverage | Distribution Capacity (MW) | Peak Load Demand (MW) |
|--------------|------------------------------------|---|----------------------------|-----------------------|
| 1 | Abuja Distribution Company | FCT, Niger, Nasarawa, Kogi states. | 515 | 835 |
| 2 | Benin Distribution Company | Edo, Delta, Ekiti, Ondo, states. | 392 | 100 |
| 3 | Enugu Distribution company | Imo, Anambra, Ebonyi, Abia, Enugu states | 612 | 1017 |
| 4 | Eko Distribution Company | Lagos (Victoria Island, Lekki, Lagos Island, Apapa, Epe, Ikoyi, etc.) | 796 | 1105 |
| 5 | Port Harcourt Distribution Company | Rivers, Bayelsa, Cross River, Akwa Ibom States | 486 | 773 |
| 6 | Ibadan Distribution Company | Oyo, Ogun, Osun, Kwara States | 878 | 1193 |
| 7 | Ikeja Distribution Company | Lagos (Ikeja, Surelere, Ikorodu, Badagry, etc.) | 1,400 | 1335 |
| 8 | Jos Distribution Company | Plateau, Nasarawa, Bauchi, Benue, Gombe States | 378 | 507 |
| 9 | Kano Distribution Company | Kano, Jigawa, Kastina States | 365 | 596 |
| 10 | Kaduna Distribution Company | Kaduna, Sokoto, Kebbi, Zamfara States | 344 | 520 |
| 11 | Yola Distribution Company | Adamawa, Bornu, Taraba, Yobe States. | 138 | 176 |
| Total | | | 6,304 | 8,157 |

1.2 Causes of Inadequate and Poor Power Supply in Nigeria.

It is a common knowledge that the electric power supply in Nigeria is poor and inadequate. Many parts of the country do not have access to electricity, those that have access to electricity hardly have regular supply of electricity supply up to six hours a day. Some of the causes of poor and inadequate power supply in Nigeria are as follows.

i. Inadequate Generation Capacity:

One of the major causes of poor and inadequate electricity supply in Nigeria is inadequate installed and available generating capacity. With the current available electricity generation capacity of about 7,000MW and with the daily peak generation of 4,500MW, the per capita power capacity is 35W which is highly inadequate. The available daily generation capacity is never constant, varied between 27% and 60% of the generation capacity, and the transmission and distribution losses accounted for about 28% of the generated capacity [8]. This further reduces the power available to customers. Going by the international standards of 1,000MW per Million inhabitants for an industrialized nation, Nigeria with a population of over 200 million will need a power generating and available capacity of at least 200,000MW which is far greater than the present available power capacity and the 10,000MW proposed by 2020. From 2013 till now, the target for several power projects implemented by Government of Nigeria has not been met because of corruption, political interest, implementation bottlenecks, vandalisation, inadequate gas supply and aged equipment.

ii. Inadequate Transmission and Distribution Capacity:

Even if the country can generate the needed power, another challenge is the inadequacy of the transmission and distribution capacity. Transmission and distribution capacity include all the lines, transformers and accessories required to convey electricity to the end users. Currently, the transmission grid covers only about 40% of the country.

This is a great barrier to the growth of the power sector in Nigeria. There are many parts of both urban and rural areas in the country without transmission and distribution lines, transformers and other accessories. In addition, some of the transmission and distribution lines and equipment are old, weak and do not have the ability to transfer power efficiently. Also the structure of Nigeria power system is another challenge, it is radial only fed from one end with frequent breakdown due to faults on the transmission lines and equipment. Once there is a breakdown at any portion of the lines, it affects the entire network. In fact, Nigeria transmission network is characterized with regular collapse dominated with frequency and voltage instability and violation.

iii. Technical and Commercial Losses on Power Network:

Nigeria power network experiences high power losses. Power loss occurs at generation, transmission, distribution and at the point of consumption. The power losses changes from time depending on the state of the generation equipment, transmission, distribution and end use devices. On average there is about 50% losses at the point of generation and between 17% to 45% of power losses on the transmission and distribution lines and equipment [9, 10]. These losses are caused by aged equipment, wear and tear at the generation equipment, absent of extra high voltage transmission in some parts of the country, energy theft along transmission and distribution lines, long length of low distribution lines, etc. energy theft reduces the profits of DISCOs and energy available to the paying customers. Power is also lost at the point of consumption; unmetered customers waste a lot of power, leaving electrical devices ON when not in use.

iv. Government Policies:

Several policies and reforms have been made by Government of Nigeria over the years yet there is still insufficient power supply. From the change of name of

National Electric Power Authority (NEPA) in 2005 to Power Holding Company of Nigeria (PHCN) to the road map for power sector reform which was developed to privatized the generation and distribution while transmission sector remain with the nation. Some of these policies are very encouraging but end up on paper due to lack of interest and political will to implement them. For instance, since the privatization of the generation and distribution to private investors, there has not been any remarkable expansion of the generation and distribution capacity by the operators of the private companies.

v. Mismanagement of Fund and Corruption:

Corruption is an important concern in power sector militating against adequate and regular power supply in Nigeria. Funds meant for power projects are either mismanaged, diverted or embezzled. Also, the company or contractor fails to implement power system contracts according to drawings and specifications because of financial remuneration or kick back to those involves in the process of awarding the contract. The results is use of substandard materials that will not stand the test of time, breakdown of equipment and most cases total shut down or abandonment of the project. The same thing applies to management and technical staff of the GENCOs, TCN, and DISCOs. Many times monies meant for maintenance and repairs are diverted leading to long down time of the faulty power plant. At the distribution level, corruptions are many at revenue collection points.

vi. Infrastructural Decay and Poor Maintenance Culture:

There is a total decay in the Nigeria power system network. There is virtually no town in Nigeria that one will not see a broken down transmission and distribution infrastructures. From substandard and under sized conductors, poor and inappropriate connections to faulty and overloaded distribution and injection transformer substations. This is because there is no proper electrical design and layout for some of this installation and generally ineffective maintenance and poor system management culture in Nigeria. Most of the generating plants cannot generate up to installed capacity because they have been neglected over the years, without preventive and corrective maintenance. This also takes us to the fact that the generating, transmission and distribution companies lacks competent staff to maintain and correct faults when there occur and this has led to long down time of the network. Infact, [11] acknowledged administrative lapses, attitude of work and corruption as contributors to poor and inadequate supply of electricity in Nigeria. Funds meant for maintenance is either inadequate, mismanaged or diverted.

1.3 Effect of Poor and Inadequate Power Supply on Entrepreneurship Development:

The effects of poor and inadequate power supply on entrepreneurship development cannot be over emphasized. Many entrepreneurship businesses depend on electricity. It is a critical factor to consider when starting and folding up entrepreneurship businesses. Thus electricity influence entrepreneurship business investment decision [12]. When

the supply is absent, inadequate and irregular, it dampen the spirit of taking business risk which has resulted to high unemployment and poverty. Some of the effects of poor and inadequate power supply on entrepreneurship development are;

i. Increase in Capital and Operating Cost:

Entrepreneurship development relies on stable and regular supply of electricity. When the public power supply fails, entrepreneurship development investors resort to self-generation of power using portable generators. They spend a lot of money buying generators and a lot monthly buying petrol or diesel and generator maintenance. This extra cost is usually transferred to the customers hence increases the cost of starting and operating entrepreneurship businesses. It is common to see entrepreneur's price list with public power supply and with generator. The one with generator is always higher. This discourages entrepreneurship development and increases the cost of starting and running entrepreneurship business.

ii. Poor Quality of Service:

Poor and inadequate power supply results to poor quality of service. Many times entrepreneurship businesses are temporally shot, inconsistencies in operation and loss of business hours or folding up when there prolonged outages or absent of power supply. The consequence is that it discourages customers, results loss of patronage and revenue.

iii. Inability to pay off credit:

Many entrepreneurs get credit facility from Friends, relations and Banks for an agreed period of refund with or without interest. When the power supply is not regular and they are unable to generate power from their back-up generator, it results to loss of revenues and inability to pay off their loan.

II. IMPROVING POWER SUPPLY IN NIGERIA

2.1 Rehabilitation and Maintenance of Power System Infrastructures:

This is an immediate approach to improving power supply. There should be a well-structured rehabilitation and maintenance of the existing power system infrastructures; the generation, transmission and distribution infrastructures. The Generation Companies (GENCOs) should ensure that all existing power plants are maintained and repaired by a well trained and experienced technical staff to improve their performance. In the event that the spare parts are not available due to age, such power plant should be totally replaced with the modern state-of-the- art generating plant. There is also need for proper monitoring of gas pipelines to check mate vandalisation, rehabilitation of gas pipelines and improvement of gas supply to thermal power plant. Government should ensure that natural gas is sold to GENCOs at a friendly price. Regular patrol of transmission lines, as well as maintenance and quick correction of faults on transmission lines is required. Many times the distribution companies leave repairs and replacement of faulty distribution infrastructures to customers and the

customers look for a cheaper way of doing it resulting to future problems. The distribution companies (DISCOs) should ensure that all conductors are of the standard type and size, substandard conductors type and size should be replaced with the correct types and sizes, all distribution transformers tested, aged and nonfunctional transformers replaced with new ones, electrification designs and layouts should be reviewed so that transformers are not in any way and at all times not overloaded. Strong regulations to specify the qualifications and requirements for any technical staff working on distribution infrastructures should be strengthened. These will go a long way to improve the present state of power supply.

Many of the power generating equipment are old and obsolete, they are either partially or totally not operational. It requires that they are properly maintained with specialized technical workers, upgraded or better still replaced with modern state-of-art generating plants and equipment that will generate sufficient and reliable power supply. Many of the generating plants (about 85%) are thermal power plants that uses natural gas, many times there is shortage of gas supply due to vandalism, increase in price of gas and gas workers unrest [13]. There is need for proper monitoring of gas pipelines, rehabilitation of gas pipelines and improvement of gas supply.

2.2 Planned Upgrading and Expansion of Power system Infrastructures:

Electricity demand depends on population growth and projected economy. Planned upgrading and expansion of power system infrastructures and capacities should be carried out with reference to the projected population growth and the economy. The Generation Companies, Transmission Company of Nigeria (TCN), and Distribution Companies (DISCOs) in collaboration with Government should develop a blueprint on how to upgrade and expand power system infrastructures to provide wider coverage of transmission and distribution infrastructure and provide sufficient electricity supply for future demand say next 10 years, 20years, and 30 years. Under this approach, more large generating plants should be constructed, high and extra high voltage transmission should be constructed across the length and breadth of the country to reduce loses along the transmission lines, the structure of power system should be changed from radial to ring to reduce collapse due to faults in any part of the network, more transmission substation and distribution substation should be built. Modern technology such as Flexible Alternating Current Transmission System (FACTS) should be incorporated into the country's transmission network. This involves the use of power electronic devices and static equipment to provide control of one or more parameters of AC transmission system to enhance controllability and increase power transfer capability. FACTS increase the reliability of AC grid, reduces power delivery costs; they improve transmission quality and efficiency of power transmission by inductive or reactive power grid. SCADA should be incorporated into the transmission network to improve the power transfer capability. All these can be done in phases knowing the projected target.

2.3 Diversifying Power Generation:

Nigeria is endowed with a lot of energy resources such as Coal, natural gas, petroleum products, hydro, solar, wind and biogas. However, it is noted that 80% of power generation (12,500MW) comes from natural gas and 20% of power generation comes from hydroelectric source and non from other renewable energy sources. It is time for the country to think outside the box and aggressively embark on diversification of power generation by harnessing and integrating into the national grid renewable energy sources, such as solar, wind, biogas, and hydro [13]. This will reduce over dependence on conventional sources of energy such as Coal, petrol, diesel, and natural gas and providing sustainable and environmentally friendly source of power supply. Federal government of Nigeria awarded contract for the construction of a 10MW wind power plant in Katsina state since 2007, this project is yet to be completed. Government and stakeholders in power sector should ensure project is delivered in record time. In view of the topography of Nigeria with various forms of settlement and landmass, they are challenges linking many settlements to the national grid, and therefore a centralized power system as it is the case now cannot give adequate and regular power supply to the masses especially those in the rural areas and areas not connected to the national grid. Therefore, power generation should be decentralized to allow power to be generated using renewable energy sources and supply close to the consumers.

2.4 Promoting Energy Efficiency:

The distribution companies should embark on an aggressive public awareness and education of customers on the need and benefit to save energy at home and industries by using energy saving and efficient electrical devices and appliances such as LED, energy saving fans, energy saving refrigerators, turning off electrical devices and appliances when not in use, turning security and perimeter lights in the daytime, by liaising with electrical products and sales companies to supply more of energy saving appliances at subsidized price. Government can make laws and policies that will promote the use of energy saving devices and appliances and discourage the use of energy waste devices and appliance. This will help in the reduction in power and energy demands from electrical system without affecting normal activities carried out in buildings, and industrial plants which in turn relief the distribution equipment's of some operation stress, thereby ensuring continuous operation and electricity supply. The energy saved in the process can be utilized by another customer or an entrepreneur.

Energy efficiency can also be achieved by efficient measurement of energy consumed by customers using prepaid meters. Prepaid meters should be installed such that it will be difficult for customers to bypass or illegally connect to distribution system. In addition, sophisticated tacking system to track illegal connection should be incorporated into the distribution system. This will change the mindset of the users to electricity consumption and force the customers to efficiently manage their consumption. In

doing this, various irregularities in commercial and billing process will be minimized.

2.5 Proper Management of Funds:

There should be an improved management and governance in power sector. All fund budgeted for power system projects should be properly managed and accounted for. A strong supervisory mechanism should be put in place to monitor and manage power system project, maintenance and repairs. Any body found wanting should be adequately punish according to the Law to server as a deterrent.

III. DISTRIBUTED GENERATION FOR SUSTAINABLE ENTREPRENEURSHIP DEVELOPMENT IN NIGERIA

According to World Energy Issues Monitor 2020, about 40% of the population does not have access to electricity [5]. Among is the population of Nigeria who lives in rural and remote areas and have no access to electricity due to lack of national grid and generating plants. Also there

are many urban areas without national grid and distribution lines and has no access to electricity too. The cost of building of large power plant, upgrading and expanding as well extending transmission and distribution to areas that have no access to electricity is very high and these may take longer time to achieve. Until these are done, the immediate solution would be to generate electricity locally and consume locally. This paper presented a scenario that will change the power supply situations and recommended that the country should move away from over dependence on conventional sources of energy to a mix power system in the form of decentralized and distributed generation utilizing sustainable renewable energy resources and technologies. DG involves the use of small generators using any power production technology, scattered throughout a power system or integrated within the distribution systems closer to the customers and provides the needed electric power supply. Figure 3 shows a typical configuration of a distributed generator. The choice of the energy mix depends on the energy sources available in the location.

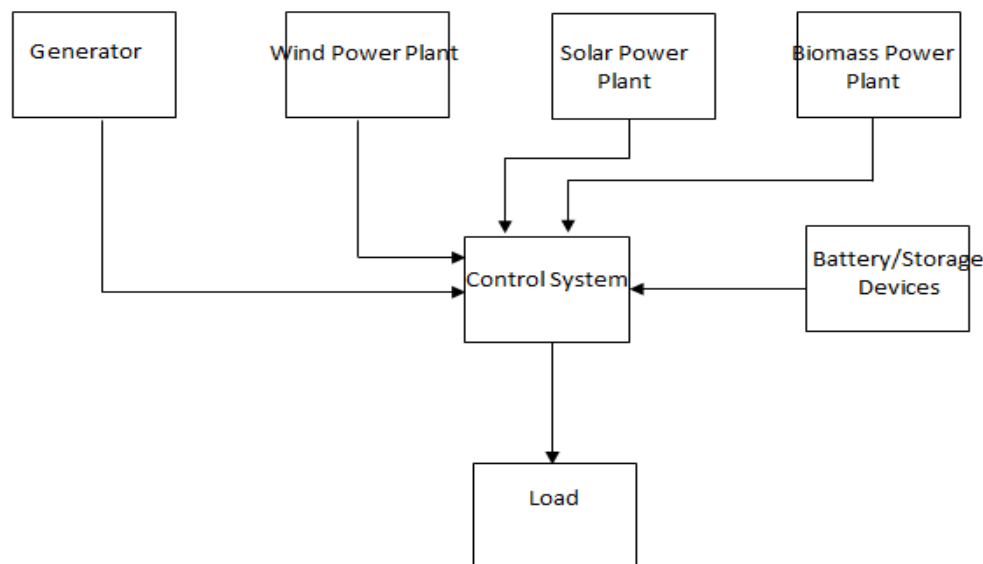


Figure 2: Block diagram of distributed generation

3.1 Benefit of distributed generation:

There are benefits the country can derive from distributed generation. It provides alternative sources of power supply. With DG, electricity is produced and use within the location, therefore no need for transmission lines and equipment and the results is saving in cost of production and supply of electricity, reduction in losses due to absent of transmission lines. It is an easy way to improve the quality, reliability and quantity of power supply, it enables large power generation plants, upgrading and expansion of transmission and distribution infrastructures to be done in the future. It leads to reduction of electricity bills. DG is often used as back-up power to enhance reliability or as a means of deferring investment in transmission and distribution networks, avoiding network charges, reducing line losses, deferring construction of large generation facilities, displacing expensive grid-supplied power, providing alternative sources of supply in markets and

providing environmental benefits. However, depending on the system configuration and management, such locally distributed generation integrated to power system has several merits from the view point of environmental restriction and location limitations, as well as transient and voltage stability in the power system.

3.2 How to achieve sustainable power supply using distributed generation.

There are a lot Government of Nigeria can do to deploy distributed generation.

3.2.1 Comprehensive Renewable Energy Study:

Distributed generation is highly supported by renewable energy resources. It is important for the country to know the statistics of the renewable energy resources in terms of location and quantity across the country. This is necessary because renewable energy resources vary from

one location to another, not all location have adequate renewable resources for deployment. This can be achieved through study and research. The ministry of power and energy, energy commission of Nigeria, Universities and polytechnics as well as other related research centers can be empowered through grant and scholarship to achieve this.

3.2.2 Review of Energy Policy:

Most times, energy policy is reviewed only when new government takes over power, which shouldn't be. The best practice is to regularly evaluate existing energy policy and plan. Government should review the existing energy policy with high commitment to decentralize the power system and allow distributed generation utilizing renewable energy resources. Such policy should include developing and enforcing standards, regulations and codes for renewable energy technologies in distribution generation and with the potentials for integration to the national grid.

3.2.3 Encouragement of private participation:

Private sector participation is very key for achieving sustainable power supply. Government should encourage private sector participation by providing policies that will encourage their participation in the deployment of distributed generation using renewable energy resources. The following are ways private investors can be encouraged; just like agriculture and food production, government can give grants or loans to private sectors for the development of small power plants in distributed generation, feed-in-tariff where, renewable energy developers or investors sell surplus of their generated power to the public power supply companies at a fixed rate higher than the rate for public power supply. Also, Government can give Fiscal support such as tax exemption of imported renewable energy equipment, tax holiday on generation incomes, as well as providing technological and environmental support.

3.2.4 International Cooperation:

Many countries such as USA, China, India, EU are already ahead in the use of decentralized power system using renewable energy resources. There is nothing wrong with establishing International Corporation with these countries in terms of related technical skills acquisition, purchase of materials and equipment, implementation of the new energy system.

IV. CONCLUSION

The driving force for an accelerating economic growth and entrepreneurship development of any society is the maximum availability and accessibility of electricity. Especially in this modern age, where almost all entrepreneurship activity depends on electricity for its absolute functionality, based on this certainty, the federal government of Nigeria has privatized various segments of the power sector with the aim to improve power availability across the country, yet this has not proven any significant progress.

The problem of poor and inadequate power supply in Nigeria is as a result of inadequate power generation capacity of the country. The Population of the country and businesses are growing day by day yet the generation capacity revolves around 3500MW to 4000MW. This has resulted to inadequate power available for consumption resulting to frequent load shedding, power outages, interruptions and overloading of the power system infrastructures. And this has been the greatest challenge confronting the growth of sustainable entrepreneurship development in the country. Other factors that contribute to poor and inadequate power supply is inadequate transmission and distribution capacity, the structure and configuration of the power system, which at present is radial, lack of diversification, absence of decentralization, absence of regular review and evaluation of power system and energy policies, poor implementation of energy policies, mismanagement of funds and corruption in the power sector among others. The immediate ways of solving these problems is to rehabilitate and maintain existing power system infrastructures, Promoting energy efficiency, while the long term solution is a planned upgrading and expansion of power system Infrastructures but a more sustainable approach is diversification and decentralization of the power system to include a mix energy distributed generation utilizing renewable energy resources.

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