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RENEWABLE ENERGY POTENTIALS: A SUBSTITUTE FOR FOSSIL FUELS UTILIZATION IN IMO STATE, NIGERIA

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ABSTRACT: *This paper discusses the renewable energy potential in Imo State. Despite the availability of these renewable energy resources, Imo State like any other state in Nigeria still depends solely on fossil fuel for their power generation. The extreme dependence on fossil fuels has generated serious negative consequences on the environment, climate and health. This Study highlights the benefits of renewable energy utilization as a substitute for fossil fuels if properly harnessed. It also pin-points the available renewable energy sources, biomass as a means of combating environmental pollution , remedial inputs to harnessing renewable energy resources in Imo State.*

KEYWORDS: biomass energy, renewable energy, Imo State

INTRODUCTION

Imo state is one of the south eastern states in Nigeria and is blessed with mineral resources both renewable and non-renewable. The state is rich in natural resources including crude oil, natural gas, lead, zinc, clay, fine sand and limestone. Imo state is bordered by Abia State on the east, River Niger and Delta State to the west, Anambra State on the north and Rivers State to the south [1] . The State lies within latitude 4^{o} 45$^{'}$ N and 7^{o} 15$^{'}$ N and Longitude 6^{o}50$^{'}$ E and 7^{o} 25$^{'}$ E within an area population of about 3927563 people based on the 2006 Population census [2] . In Imo State, large amount of municipal, domestic cum agricultural wastes are generated everyday especially in market places, villages and Industrial Area. These wastes are either disposed indiscriminately or inefficiently burnt or incinerated, giving rise to the Carbon-monoxide emission in the atmosphere and as such hazardous to the human health. These organic materials generates significant amount of waste and are not properly utilized for power generation but rather disposed in a very crude and primitive way. Nigeria generates about 542.5 million tons of organic waste which has the potential of yielding about 25.53 billion M^3 of biogas (about 169541.6MWh) an estimate of revenue generation of about $29.29 billion from both Ventures[3;4;5] . An Investigation on the decline of electricity generation of the Five eastern states of Nigeria; Abia, Anambra, Ebonyi, Enugu and Imo State showed that the electricity decline in generation in this region was strongly influenced by some socio-economic and physical features which includes; Distance to nearest power station,

urbanization, population density per state, No of manufacturing industries just to mention but a few [6]

Therefore , this paper is aimed at :

i. identifying renewable energy sources in Imo State
ii. The Benefits of Utilizing Renewable Energy Resources especially biomass
iii. Biomass for pollution control in Imo State
iv. Remedial Input to harness Renewable energy potentials in Imo State.

Environmental Setting of Imo State and renewable energy availability

Location: Imo State is bordered by Abia State on the East, River Niger and Delta State to the West, Anambra State on the North and Rivers State to the South [7] The State lies within latitudes 4°45'N and 7°15'N, and longitude 6°50'E and 7°25'E with an area of around 5,100 sq km [8]. The main cities in Imo State are Owerri, Orlu and Okigwe. . Imo River, being the major river in the State, drains through Abia State, where it is joined by Aba River from the North, and Akwa Ibom State into the Atlantic Ocean [9]. There are Njaba River, Oguta Lake, Utu River and Awbana River in the State [10] . Otamiri Riverand its 9.2 km length tributary, Nworie River flow in the State[11] . There are other rivers and creeks in the state including Onas Creek in Ohaji/Egbema, Okitankwo River in Umudi, and Ohia and Efuru Rivers in Okigwe [12] .

The sources of renewable energy in Imo State includes; Biomass energy, Wind, Solar, and Hydro-power energy. Renewable energy is a clean form of energy with little or no environmental pollution. The diminishing petroleum reserves and the adverse effect and environmental consequences of exhaust gas from fossil fuels has attracted an increasing attention world over by researchers, engineers, scientist for the utilization of renewable energy sources in power generation. There are various types of renewable energy sources such as solar, wind, hydropower, biomass energy etc currently present in Imo State. Out of these renewable energy sources, biomass is more economically viable for not just Imo State but for almost all the continents in the world. **Biomass** is a carbonaceous material and provides both the thermal energy and reduction for oxides, where as other renewable energy sources can meet our thermal need only. Biomass is a term used to describe all organic materials produced by photosynthesis, existing on the earth's surface. They include all water and land based vegetation and tree, all waste biomass such as municipal waste, biosolids (sewage), animal waste and agricultural waste [13] . Burning biomass is not the only way to release its energy. Biomass can be converted to other usable forms of energy like methane gas or transportation fuels like ethanol and bio-diesel. Biomass energy resources are abundant in Imo State. Biomass resources are mostly utilized as wood fuels used both domestic and industrial purpose as a source of heat. Biomass material (Municipal Waste and bio solids) are found in some part of Imo Metropolis. Fig 1,2 & 3 gives pictures of typical Municipal waste dump site in Imo State. These biomass materials are dumped and sometimes incinerated indiscriminately instead of harnessing its power generation potential.


Fig1. Picture of Municipal Waste in Nekede Area of Imo State


Fig2. Picture of Municipal Waste in Amakohia Area of Imo State


Fig3. Picture of Municipal Waste in Emekuku Area of Imo State

Wind energy which is also a renewable energy source is relatively available especially in the harmattan periods between the periods of November through December. Wind turbines are used by Wind energy systems to generate electrical energy by diminishing the power in wind. Wind

energy can be in stand-alone applications or can be produced centrally and distributed to the electric grid. Wind plants or wind turbines are available in a variety of configurations with various outputs. Typically, these plants produce either direct current (DC) or alternating current (AC) electricity. DC wind plants are used to charge batteries or produce heat/electricity without storage. AC wind plants are used to produce electricity for direct use or to supply energy to a utility grid. Water-pumping wind energy systems are another type of wind energy application; these use wind to produce mechanical energy to pump water, typically for agricultural applications. There is little or no literature review on wind potentials in Imo State. Also the geothermal energy is yet to be established in the state either due to limited research centre in the south eastern Nigeria or probably to the insensitivity of most state sate government in Nigeria to fund research centre development [14].

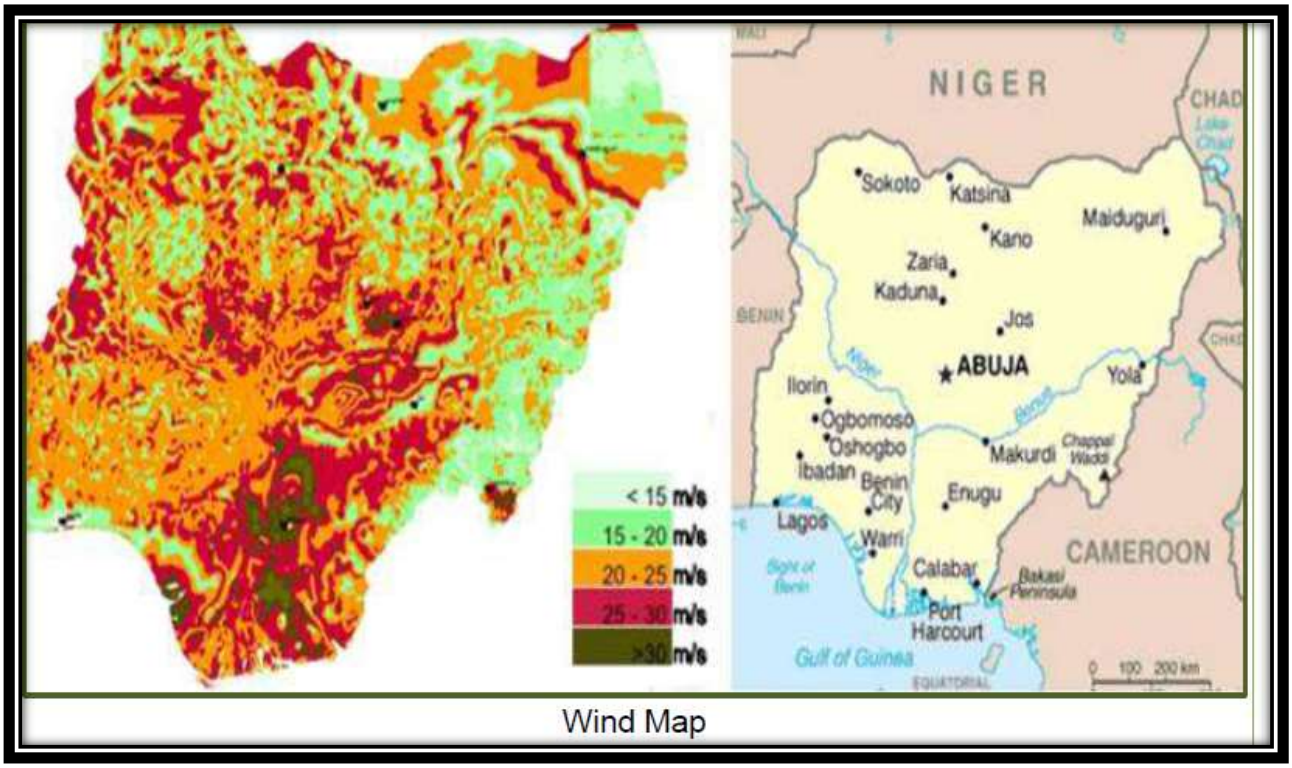

Fig4: Wind Map showing Velocity of in Various Part of Nigeria
Source :(Federal Ministry of Power)

Solar Energy a renewable energy source is the radiant energy that is emitted by the sun from a nuclear fusion reaction that creates electromagnetic energy [15] . The knowledge of the amount of solar radiation in a given location is essential to determine the energy potential in a particular location . Solar energy is abundant, free and clean. In Imo State, the dependence on fossil fuel is on the high side and as such modern technological application of solar energy such as solar pumping machines, solar power bore-holes, large scale domestic hot water system, solar cells in residential for electricity generation is under-utilized. According to the statistics from the International Energy Agency (IEA), total Nigerian.

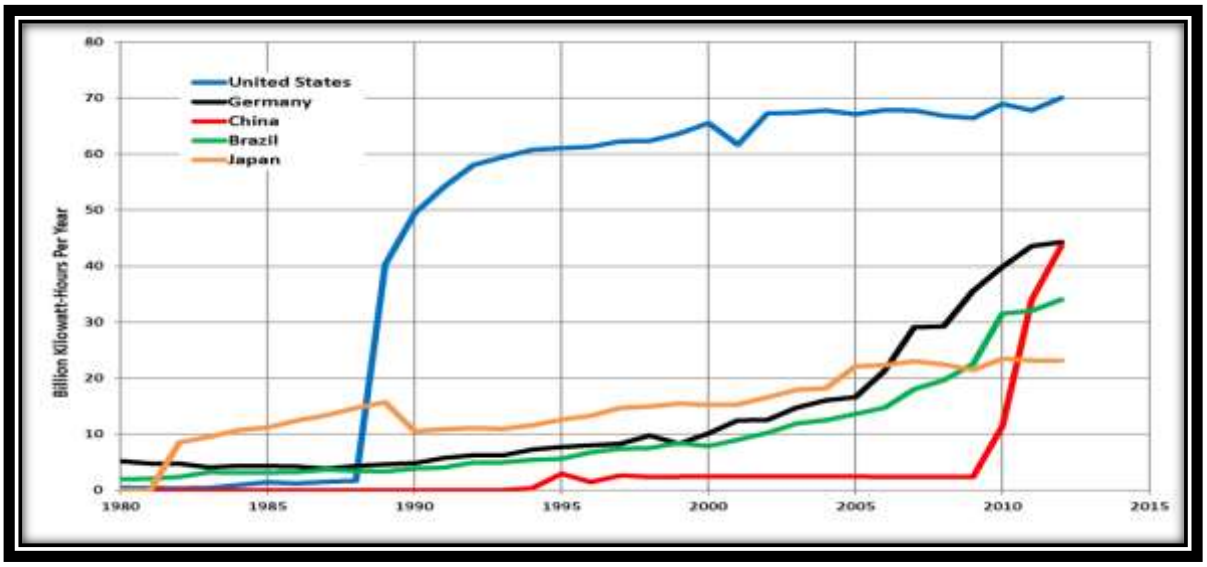

Fig. 5: Utilization of Renewable Energy among the selected Countries between 1980-2015
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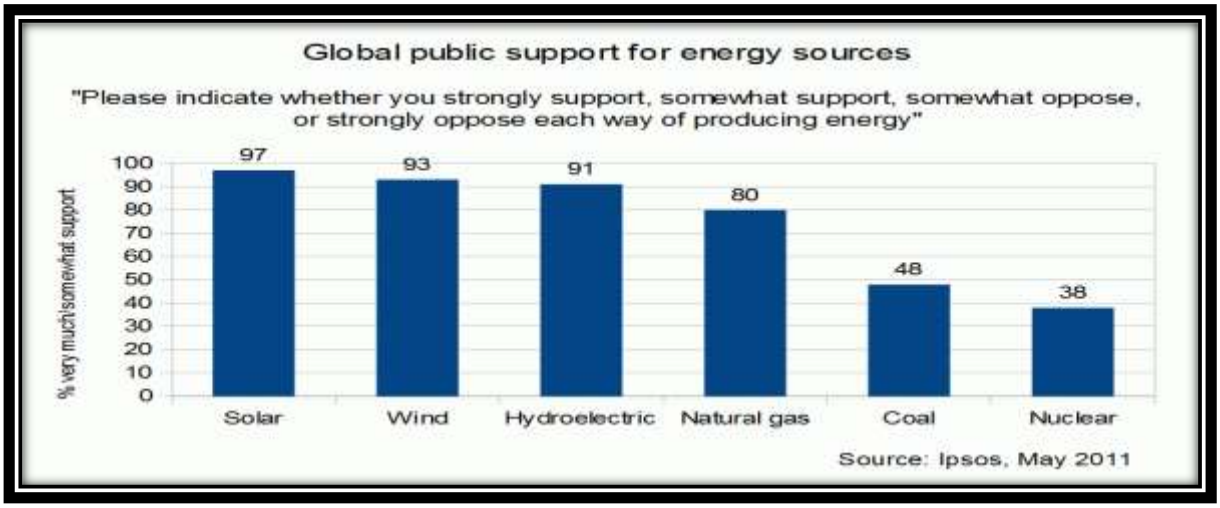

Fig.6: showing Global Public support for energy sources
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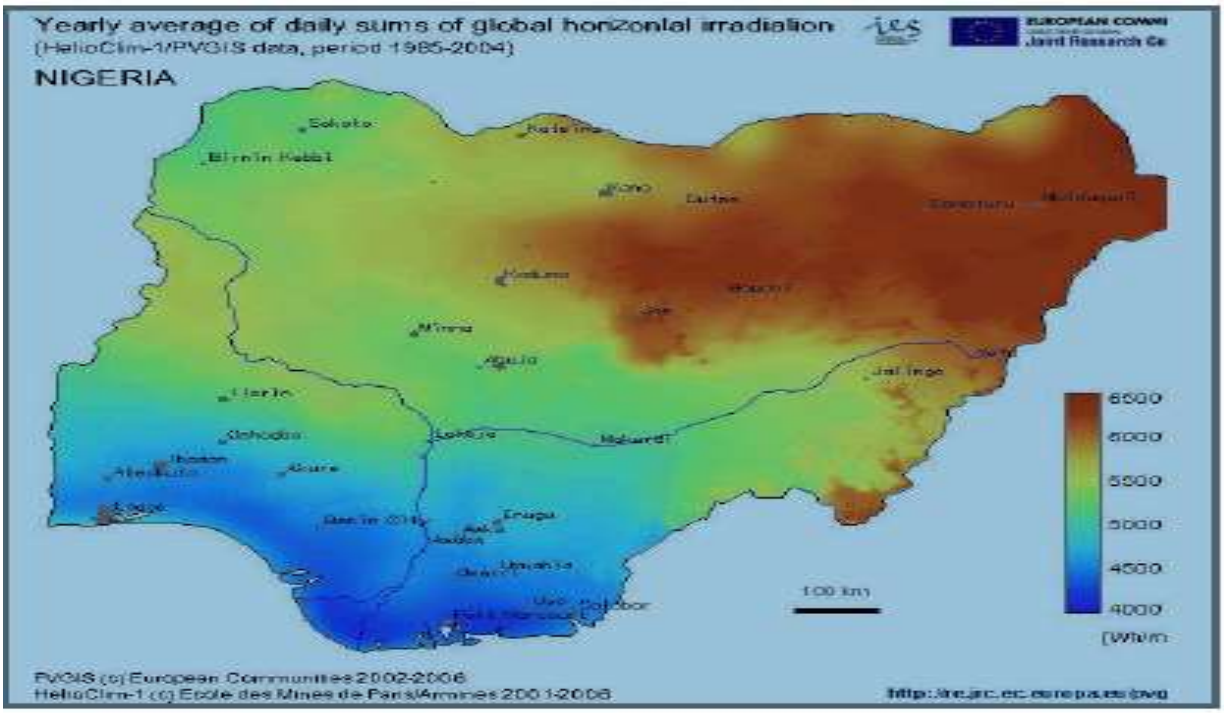
Primary energy supply was 118,325 Kilotonne of Oil Equivalent (ktoe) excluding electricity trade in 2011. As depicted in the figure below, biomass and waste dominated with 82.2%. Renewable energy sources only accounted for a small share of the energy supply. For instance hydropower only accounted for 0.4%.Wind and solar are also utilized, but at an insignificant level at present (International Energy Agency (IEA)). The strength of solar radiation at the outer edge of the earth's atmosphere when the earth is taken to be at its average distance from the sun is called the solar constant, the mean value of which is 1.37×10^6 ergs per sec per cm^2, or about 2 calories per min per cm^2.Out of the energy transmitted from the Sun, the upper atmosphere of Earth receives about 1.5×10^{21} watt-hours (thermal) of solar radiation annually. This huge amount of energy is more

than 23,000 times that used by the human population of this planet, but it is only about two-billionth of the Sun's massive outpouring—about 3.9×10^{20} MW. Solar radiation is attenuated before reaching Earth's surface by an atmosphere that removes or alters part of the incident energy by reflection [16].



Solar Map

Fig.7: Map of Nigeria Showing Solar Distribution

Table1: shows the energy potential of renewable generation in Nigeria.

Energy Resources	Estimated Reserve
Large Hydropower	11,250 MW
Small Hydropower (<30 MW)	3500 MW
Fuel Wood	11 million hectares of forest and woodland
Municipal Waste	30 million tonnes/year
Animal Wastes	245 million assorted animals in 2001
Energy Crops and Agricultural Residue	72 million hectares of agricultural land
Solar Radiation	3.5-7.0 kW h/m2/day
Wind	2-4 m/s at 10 m height Wind speeds in Nigeria range from a low 1.4 to 3.0m/s in the Southern areas, except for coastal line and 4.0 to 5.1m/s in the North. The Plateau area particularly interesting.

Source: (International Energy Agency (IEA))

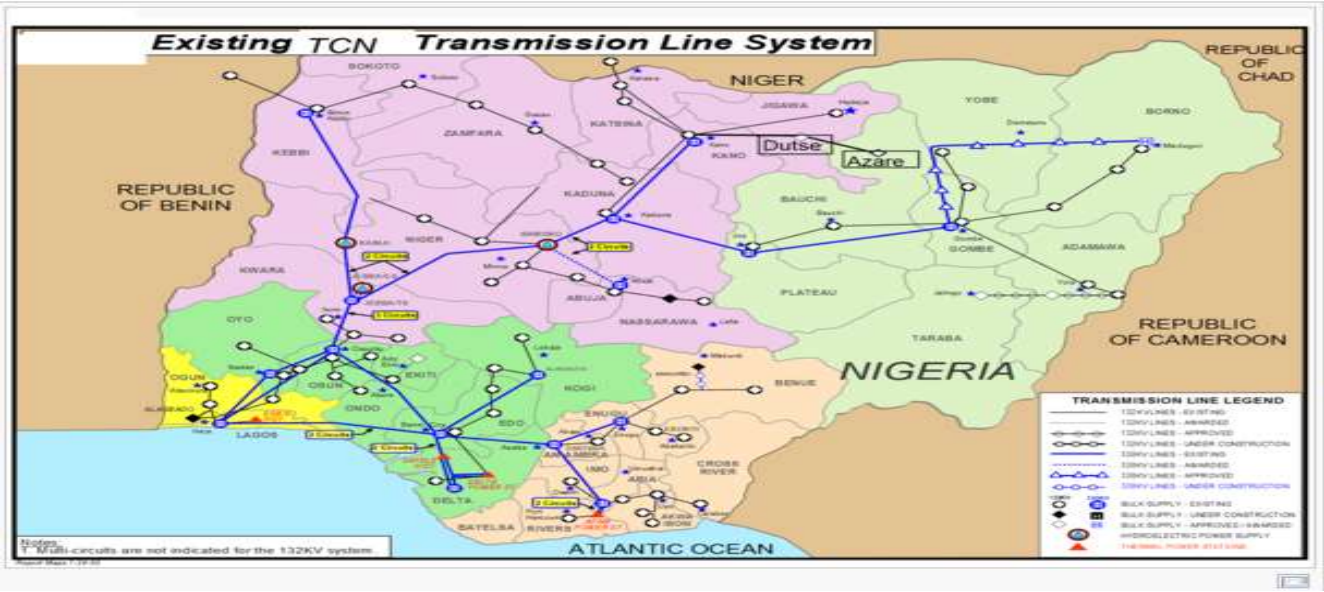


Fig 8: Transmission and Distribution Network in Nigeria.
Source: (Federal Ministry of Power)

Utilization of renewable energy potentials in Imo : The renewable energy resources in Owerri are greatly under-utilized. The utilization and harnessing of the renewable energy potential of these biomass resources for the production of bio-fuels will help to reduce the over reliance and dependence on fossil fuels for power generation and in turn helps to reduce environmental pollution ,greenhouse gas emissions. Imo state is blessed with numerous rivers and lakes yet the exploration of renewable energy source has not received great attention in Imo state both in literature and utilization.

Fig.9: Picture of a Renewable Energy Resource (Otamiri Lake) in Imo State.

Biomass for pollution control Imo State: Air Pollution is a huge concern faced by the world today and impacts all of us in so many different ways. Importantly, our ability to effectively address air pollution is fundamental to our pursuit of promoting sustained economic growth and sustainable development in Imo State and Nigeria at large. Air pollution has serious negative impacts on human health, socio-economic development, ecosystems and cultural heritage. Burning fossil fuels also releases air pollutants in the likes of sulphur oxides (SO_x), nitrogen oxides (NO_x), volatile organic compounds, carbon monoxide (CO), and other toxic compounds. SO_2 and NO_2 react in the atmosphere to produce particulate matter. NO_2 and some volatile organic compounds react in the atmosphere to produce ground-level ozone [16]. Environmentally, biomass has some advantages over fossil fuels such as coal and petroleum. Biomass contains little sulphur and nitrogen, so it does not produce the pollutants that causes acid rain. Growing plants for use as biomass fuels may also help keep global warming in check. That's because plants remove carbon dioxide--one of the greenhouse gases-from the atmosphere when they grow. The combustion (direct or indirect) of biomass as a fuel also returns CO_2 to the atmosphere. However this carbon is part of the current carbon cycle which will be taken by plants for the process of photosynthesis. Biomass is therefore practically free from sulphur, nitrogen and heavy metals, and as such has a very lower ash content of about 1-3 Wt% than coal. Hence, unlike fossil fuels, biomass if harnessed and used as fuel in biomass power plants for electricity generation in Imo State is not likely to pollute the atmosphere with harmful oxides of Sulphur and Nitrogen.

FACTORS THAT AFFECTS LARGE SCALE UTILIZATION OF RENEWABLE ENERGY

Poverty is one of the fundamental issues hampering large scale utilization of renewable energy resources [14]. The poverty rate in the country is very high . This statement is in consonant with the finding that, the poverty rate in Ebonyi Sate is about 73.6% [9]. - Lack of awareness , lack of Manpower and Government insensitivity plays major roles in the setbacks on the utilization of renewable energy [14].According to[14], Awareness on the advantages of these huge natural renewable resources can be made through the media, schools, mobile networks, social networks and other related institutions, manpower training in renewable energy in the state, and government should be more committed to harnessing of renewable energy for the betterment of her citizenry.

CONCLUSION

Harnessing the renewable energy resources is a positive approach to achieving energy availability and sustainability in Imo State. Developmental efforts have been made by the federal government to overcome the menace of the irregularity in the power sources and as such encourage independent energy providers. Imo State should strive to overcome her power challenges by opening up the renewable energy sources such as; waste to energy as currently practiced in Lagos State, extensive biofuels industry, and also pay reasonable attention to biomass renewable energy technology for increased manpower in the State. The Imo State Government should open up an energy research centre in her own state university to enable research and exploration on the available renewable energy sources in the state bridging the lacuna between the developed and developing state and it will go a long way in encouraging private energy providers to investment in the state own power sector which will in the long run create more job for Imolites in turn an increased state government revenues and earnings.

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