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# POWER GENERATION FROM MUNICIPAL SOLID WASTE IN NIGERIA TO ENHANCE ACCESS TO ELECTRICITY FOR SUSTAINABLE DEVELOPMENT

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**ABSTRACT**

This paper proposes a sustainable approach in tackling the menace of municipal solid waste in Nigeria. The country despite being the Africa's largest economy is only able to dispatch 4,000 megawatts of electricity. Nigeria's electricity access in relation to population is 42% lower than many countries on the continent. The paper applied quantitative methodology by analyzing existing literatures and propose means of converting municipal solid waste to scale up power generation and enhance access to electricity by the population, and also minimizing pollution in the environment by timely evacuation of garbage from the dumping sites. By building this power plant in at least each state, power generation capacity and access to electricity will improve, generate revenue and create job opportunities as well as decentralization of national power grid, which in turn will minimize the incessant grid collapse that is happening recently. It will also add more than 5,000 Megawatts of electricity to the country.

**Keywords**: Municipal Solid Waste, Dumping Site, Power Plant, Electricity.

## INTRODUCTION

Nigeria despite being the largest economy in Africa is far lagging behind many countries on the continent in terms of access to electricity. Nigeria energy access in relation to population as 42% lower than Equatorial Guinea 92%, Ghana 85%, Cameroon 70% and the North African countries (Egypt, Morocco, Libya and Tunisia) with greater than 99% (International Energy Agency (IEA, 2019)).

On the other hand, population growth and changes in our lifestyle is encouraging generation of more solid waste in our towns and cities which has become a challenge to most of the state governments to manage. Most of these solid wastes are unscientifically disposed and poses danger to the people's health and the environment.

Methane that is generated due to decomposition of solid wastes at the dumping sites has 24 times more global warming potential than $CO^2$. Nitrous oxide produced as a result of unrestrained burning of solid waste is 179 times more global warming potential than $CO^2$ (World Health Organization (WHO) in (Ramakrishna, 2000)).

**Problem statement**

This paper will attempt to address the issue of electricity shortage in Nigeria and elimination of solid waste from the environment for sustainable development.

**Aim and objectives**

The aim of this paper is to propose a biomass (municipal solid waste) electricity generation plant to power residential buildings.

**Objectives**

i. Sustainability
ii. Decentralization of grid
iii. Revenue generation
iv. Job creation
v. Health

**BIOMASS**

Biomass is a carbon-based material that comes from plants and animals waste. It can be used to generate energy. This type of energy has been in use from time immemorial. Wood that comes from plants is used as fuel for cooking or as a heating mechanism during the cold weather.

In modern times, biomass can be used to generate electricity by direct or indirect firing of the feedstock. When burned, heat is generated and can be directly converted to electricity.

**MUNICIPAL SOLID WASTE**

Municipal solid waste includes nonhazardous garbage, rubbish and trash from homes, institutions (e.g. schools), commercial establishments, and industrial facilities, garbage contain moist and decomposable (biodegradable) food wastes (encyclopedia Britannica). The idea of biomass conversion to electricity is extended to municipal solid waste. Municipal Solid Waste is one of the familiar biomass feedstock.

**METHODOLOGY**

Data collected in this research include textbooks, journals, newspapers and internet sources. Quantitative methodology is applied in analyzing the data and propose means of converting municipal solid waste to scale up power generation and enhance access to electricity.

Table 1. Power generation estimation from municipal solid waste in Nigeria for 36 states and FCT

| S/N | State | Population 2006 | 2022 Estimation | MSW in tons | Megawatts |
|---|---|---|---|---|---|
| 1 | Kano | 9,401,288 | 13,761,482 | 16,927 | 355 |
| 2 | Lagos | 9,113,605 | 13,340,376 | 16,408 | 345 |
| 3 | Katsina | 5,801,584 | 8,492,283 | 10,446 | 219 |
| 4 | Kaduna | 6,113503 | 8,948,866 | 11,007 | 231 |
| 5 | Bauchi | 4,653,066 | 6,811,097 | 8,378 | 176 |
| 6 | Oyo | 5,580,894 | 8,169,240 | 10,048 | 211 |
| 7 | Rivers | 5,198,716 | 7,609,812 | 9,360 | 196 |
| 8 | Jigawa | 4,361,002 | 6,383,578 | 7,852 | 165 |
| 9 | Niger | 3,954,772 | 5,788,943 | 7,120 | 150 |
| 10 | Ogun | 3,751,140 | 5,490,870 | 6,754 | 142 |
| 11 | Sokoto | 3,702,676 | 5,419,929 | 6,667 | 140 |
| 12 | Benue | 4,253,641 | 6,226,424 | 7,659 | 161 |
| 13 | Borno | 4,171,104 | 6,105,607 | 7,510 | 158 |
| 14 | Anambra | 4,177,828 | 6,115,450 | 7,522 | 158 |

| | | | | | |
|---|---|---|---|---|---|
| 15 | Zamfara | 3,278,873 | 4,799,571 | 5,903 | 124 |
| 16 | Delta | 4,112,445 | 6,019,743 | 7,404 | 155 |
| 17 | Imo | 3,927,563 | 5,749,115 | 7,071 | 148 |
| 18 | Kebbi | 3,256,541 | 4,766,882 | 5,863 | 123 |
| 19 | Ondo | 3,460,877 | 5,065,986 | 6,231 | 131 |
| 20 | Akwa Ibom | 3,902,051 | 5,711,771 | 7,025 | 145 |
| 21 | Adamawa | 3,178,950 | 4,653,305 | 5,725 | 120 |
| 22 | Edo | 3,233,366 | 4,732,959 | 5,822 | 122 |
| 23 | Plateau | 3,206,531 | 4,693,678 | 5,773 | 121 |
| 24 | Enugu | 3,267,837 | 4,783,417 | 5,884 | 124 |
| 25 | Osun | 3,416,959 | 5,001,700 | 6,152 | 129 |
| 26 | Cross River | 2,892,988 | 4,234,718 | 5,209 | 109 |
| 27 | Kogi | 3,314,043 | 4,851,953 | 5,968 | 125 |
| 28 | Abia | 2,845,380 | 4,165,030 | 5,122 | 108 |
| 29 | Gombe | 2,365,040 | 3,461,915 | 4,258 | 89 |
| 30 | Yobe | 2,321,339 | 3,397,946 | 4,179 | 88 |
| 31 | Ekiti | 2,398,957 | 3,511,562 | 4,319 | 91 |
| 32 | Taraba | 2,294,800 | 3,359,098 | 4,139 | 87 |
| 33 | Kwara | 2,365,353 | 3,462,373 | 4,279 | 89 |
| 34 | Ebonyi | 2,176,947 | 3,186,587 | 3,919 | 82 |
| 35 | FCT(Abuja) | 1,406,239 | 2,058,434 | 2,539 | 53 |
| 36 | Nasarawa | 1,869,377 | 2,736,370 | 3,365 | 71 |
| 37 | Bayelsa | 1,704,515 | 2,495,047 | 3,068 | 64 |
| **Total** | **Nigeria** | **140,431,790** | **197,060,834** | **252,875** | **5,305** |

The formula used for calculation of the 2022 population estimate is

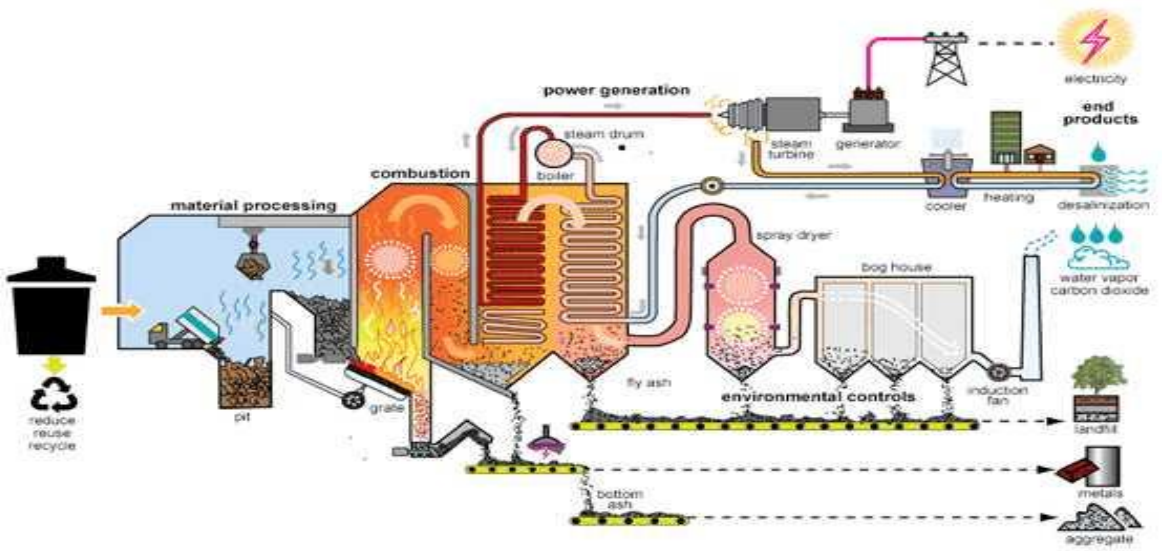
$x(t) = x_0 \times (1 + r)^t$

- where $x(t)$ is the final population after time $t$
- $x_0$ is the initial population
- $r$ is the population growth
- and $t$ is the total time (number of years)

The average number of MSW per/kg/person used is 1.2 kg where it is multiplied by the population estimate and converted to tons.

The number of megawatts is achieved by multiplying the number of tons by 0.021mw which is the number of megawatts of electricity obtained per ton of MSW.

Fig. 1 A typical municipal solid waste electricity generation plant




**Source:** EIA https://www.eia.gov

## RESULT AND DISCUSSION

### Sustainability

The source of feedstock for the generation of the electricity will be municipal solid waste and when the electricity is being generated, it will return to power the houses that generate the solid waste (biomass). This process will be kept iterating itself.

### Decentralization of grid

Recently, national grid has been suffering from incessant collapse and each time it happens, the country almost goes into total darkness. If we will have at least one biomass power generation plant in each state that would independently power some segment of settlements, then the pressure on the national grid will drastically reduce and hence improve its efficiency.

### Revenue generation

The electricity that is produced from these municipal solid waste will be sold to consumers and hence generate revenue for the government.

### Job creation

Establishing these plants will require manpower both during construction and after completion by staffing the plant for management and operational purpose hence creating job opportunities.

### Health

By evacuation of municipal solid wastes from the streets, healthy living condition will improve and spread of diseases by insects from the dumping sites to human beings in the environment will be arrested. It will also minimize pollution, reduce emission of greenhouse gases and protect the ozone layer.

## CONCLUSION

The paper has established the fact that Nigeria can utilize municipal solid waste to generate electricity, and it comes with several remunerations;

- The country can scale up power generation to enhance access to electricity.
- Fight climate change by minimizing excess emission of methane gas from dumping sites.

- Create job opportunities, and
- Generate revenue for the government.

These are some of the ingredients for sustainable development.

**REFERENCES**

1. Encyclopedia Britannica. Municipal Solid Waste Management. https:// www.britannica.com.

2. FEMP (2016), Biomass for Electricity Generation WBDG - Whole Building Design Guide. U.S. Department of Energy Federal Energy Management Program (FEMP). http://energy.gov/eere/femp/federal-energy-management-program

3. Litowitz L. S., Brown R. A. (2012), Energy, Power, and Transportation Technology. The Goodheart - Wilcox

4. Oumarou M. B., Dauda M., Abdulrahim A. T., Abubakar A. B. (2012), "***Characterization and Generation of Municipal Solid Waste in North Central Nigeria***". International Journal of Modern Engineering Research (IJMER) Vol.2, Issue.5, Sep-Oct. 2012 pp-3669-3672 ISSN: 2249-6645. https:// www.ijmer.com

5. Swithenbank J., Nasserzadeh V., Goh. R. (undated), Waste Management and Minimization - Solid Wastes for Power Generation. Encyclopedia of Life Support Systems (EOLSS)