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A STUDY AND ANALYSIS OF ENERGY GENERATION AND CONSUMPTION IN DANGOTE CEMENT PLANT, IBESE, OGUN STATE, NIGERIA

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ABSTRACT

Energy supply for economic activities has been a major problem in Nigeria such that it does appear that solution to stable, reliable power supply is not yet in sight. Consequently, consumers (industrial, residential and commercial) have all resorted to self-generation to complement whatever supply (if any) that comes from the very unreliable national grid. For instance, the available power supply to the entire nation fluctuates between 3000MW and 3500MW. A study of monthly energy generation in Dangote Cement Plant for a typical year was carried out. This was compared with the equivalent monthly generation from the entire Nigeria's grid system. The results show that in 2013, at the early stage of commencement of production of operation in the plant), the total energy generated by the Dangote Power Plant was 406762.33 MWH while the total energy consumed by the company was 401903.72 MWh. Dangote's total energy generation in 2013 represents 1.4% of Nigeria's total generation from grid in the same year. The total distribution loss was 4858.61 MWH (which is 1.2% of the total energy generated by the company).Comparatively, the total generation from national grid in 2013 was 29628699. This study further shows that Dangote Cement, Ibese produces enough energy for its use and could even sell any excess if encouraged.

KEYWORDS: National grid, self-generation, consumers, Dangote Cement, Independent power producer.

INTRODUCTION

Electrical energy is the main component of energy which humankind uses for comfort and to perform other useful economic activities. Just as human beings require oxygen to survive, a nation needs sufficient energy if she must have meaningful development. That is why nations of the world today go far enough to exploit nature, tap its resources and convert them to electrical energy (Alamau, 2016). The developed countries such as U.S.A, France, Germany and Britain (among others) invest massively in energy development and thus are able to bring good things of life to their people. Developing countries remains backward in development because they have poor energy infrastructure. Consequently, their industries (where they exist) perform very poorly.

In Nigeria, many industries are known to have closed down. A lot more may be on the verge of closing down; all for lack of electricity / power. According to Adinuba (2015) about 150 multi-national industries such as Michelin, Dunlop, Glaxo and Pfizer have relocated to Ghana and elsewhere. Before constructing its own gas-powered power plant. Dangote Cement, Ibese was said to spend ₦250 million daily on diesel (AIT, 2014).
All this has contributed to the threatening unemployment in Nigeria with associated crimes. Besides, according to UNDP (2016), Nigeria's Human Development Index in many aspects of human life has continued to decline. Thus, the Independent Power Producer (IPP) like Dangote's, if studied and evaluated could encourage persons interested in energy development to model it towards improving energy availability and reliability in Nigeria.

LITERATURE REVIEW

According to Otenaike (2017) and FRN (2012), Nigeria has abundant energy resources. For instance, the country has crude oil, natural gas and coal / lignite reserves of 36.2 billion barrels, 187 trillion standard cubic feet (scf) and 2.7 billion tons respectively. This is in addition to large hydropower (11,500MW), and small hydropower (734MW) reserves, and other resources such as solar, wind and biomass. The generating units in Nigeria's power stations consist of thermal and hydro. As at December 2016, (NCC, 2016) the installed capacity of all thermal units was 10,372MW while that of hydro was 1938.40MW. This makes it a ratio of 16% hydro and 84% thermal. The nation's total installed capacity was 12,310.40MW.

Table 1.0 shows the Independent Power Producers (IPPs) connected to national grid as at December, 2016.

Table 1.0: Independent Power Producers' contributions to Nigeria's grid as at December, 2016.

S/N	Power Plant (Station)	Installed Capacity (MW)	Average availability (MW)
1	Rivers IPP	180.00	113.34
2	Omoku	150.00	74.24
3	ASCO	110.00	2.07
4	Trans - Amadi	100.00	51.65
5	Okpai	480.00	322.99
6	Ibom	155.00	111.00
7	Afam VI	650.00	532.00
8	PARAS	58.00	35.45
9	A.E.S.	294.00	0.00
	Total	2177.00	1242.74

Source: National Control Centre, Osogbo, Nigeria.

The IPPs constituted 2177MW (or 17.7%) of the country's total installed capacity.
Dangote Cement Plant, Ibese generates electricity at 11kV for use in the plant using natural gas. Natural gas is abundant, cheap and locally available in Nigeria.

METHODOLOGY

The required data were collected by undertaking some educational visits to Dangote Cement Plant at Ibese, Ogun State, Nigeria. Ibese lies on Latitude 6° 58' 0" North and longitude 3° 2' 0" East. The geology of the town and its environs comprises some formation which is marine and of Paleocene age.
Limestone several meters in thickness overlain by a shale unit almost three times as thick as the limestone is found in the area (Ayedun et al, 2012). Additional data were also collected from the National Control Centre, (NCC), Osogbo, Nigeria and more from relevant literature. Key areas covered include:

- Monthly energy generated and consumed in Dangote cement plant, Ibese, (Jan – Dec., 2013).
- Energy generation from grid (Jan – Dec., 2013).
- Installed and available capacities of the various Independent Power Producers (IPPs) connected to national grid (as at December, 2016).
- Daily energy generated and consumed in a typical month in Dangote cement, Ibese, (June, 2013). Unfortunately, Dangote Plant Ibese could not release data on energy generation and consumption for current years (probably due to company policy).

RESULTS AND DISCUSSION

Table 2.0: Energy Generated and Energy Consumed in Dangote Cement Plant, Ibese, Nigeria. in MWH (2013)

Month	Total Energy Generated (MWH)	Total Energy Consumed (MWH)	Difference between energy generated and consumed (MWH)	Differences (%)
January	10007	9852	155	1.5
February	34396	33949	447	1.3
March	37025.82	36583.06	442.76	1.2
April	36888.52	36381.55	506.97	1.4
May	37001.97	36504.65	497.32	1.3
June	37855.97	37348.89	507.08	1.3

July	37710.99	37256.8	454.19	1.2
August	33800.35	33327	473.35	1.4
September	30778.76	30465	313.76	1.0
October	37813.59	37373.2	440.39	1.2
November	35902.79	35617.06	285.73	0.8
December	37580.57	37245.51	335.06	0.9
Grand Total = 406762.33		**401903.72**	**4858.61**	**1.2**

Source: Dangote Cement PLC.

Note: Differences in % $= \frac{Difference\ (MWH)}{Total\ energy\ generated\ (MWH)}\ x\ \frac{100}{1}\%$

From Table 2.0, the difference between energy generated and energy consumed represents energy loss. The energy loss ranges from 0.8 percent to 1.5 percent. Table 2.0. scenario is illustrated graphically in Fig. 1.0, Fig 2.0, and Fig. 3.0. respectively.

Table 3.0: Energy Generated from National Grid and Dangote Cement Plant, (Jan – Dec. 2013)

Month	**Energy Generated from National Grid (MWH) A**	**Energy Generated by Dangote Plant B**	**% of Energy generated by Dangote Plant** $C = {}^{B}/_{A}$
January	2859251.79	10007	0.3
February	2642653.05	34396	1.3
March	2771657.43	37025.82	1.3
April	2482842.5	36888.52	1.5
May	2441193.15	37001.97	1.5
June	2274906.31	37855.97	1.7
July	2321376.33	37710.99	1.6
August	2339333.96	33800.35	1.4
September	2258891.23	30778.76	1.4
October	2532680.54	37813.59	1.5
November	2212423.61	35902.79	1.6
December	2491489.42	37580.57	1.5
Annual Total	**29628699.3**	**406762.33**	**1.4**

In Table 3.0, energy from Nigeria's national grid is compared with energy generated by Dangote, Ibese, plant. The relevant percentages by month are shown. This shows an appreciable effort by Dangote because, for instance, in June 2013, Dangote plant, Ibese, produced 1.7% of energy from the grid in the same month. The same deduction could be made for the rest of the months.

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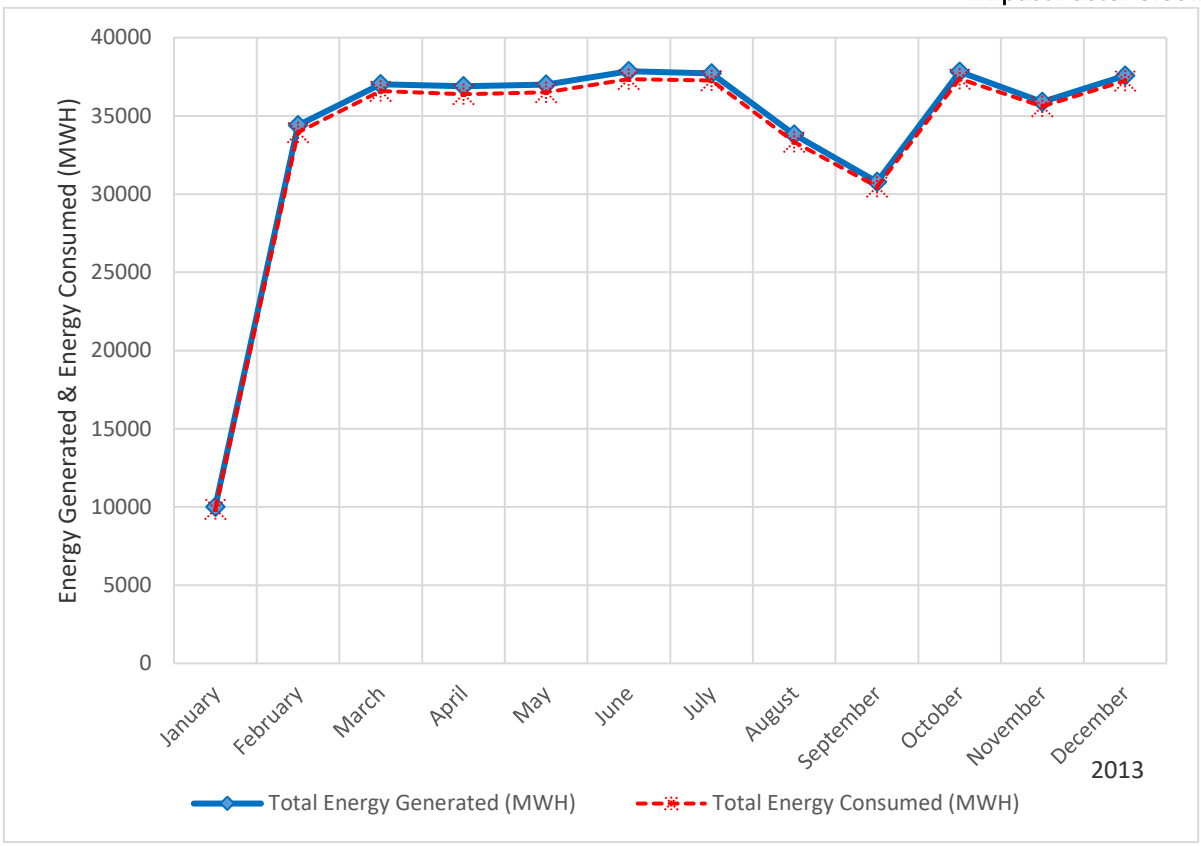

Figure 1.0: Graphical illustration of total energy generated & energy consumed, 2013 (MWH)

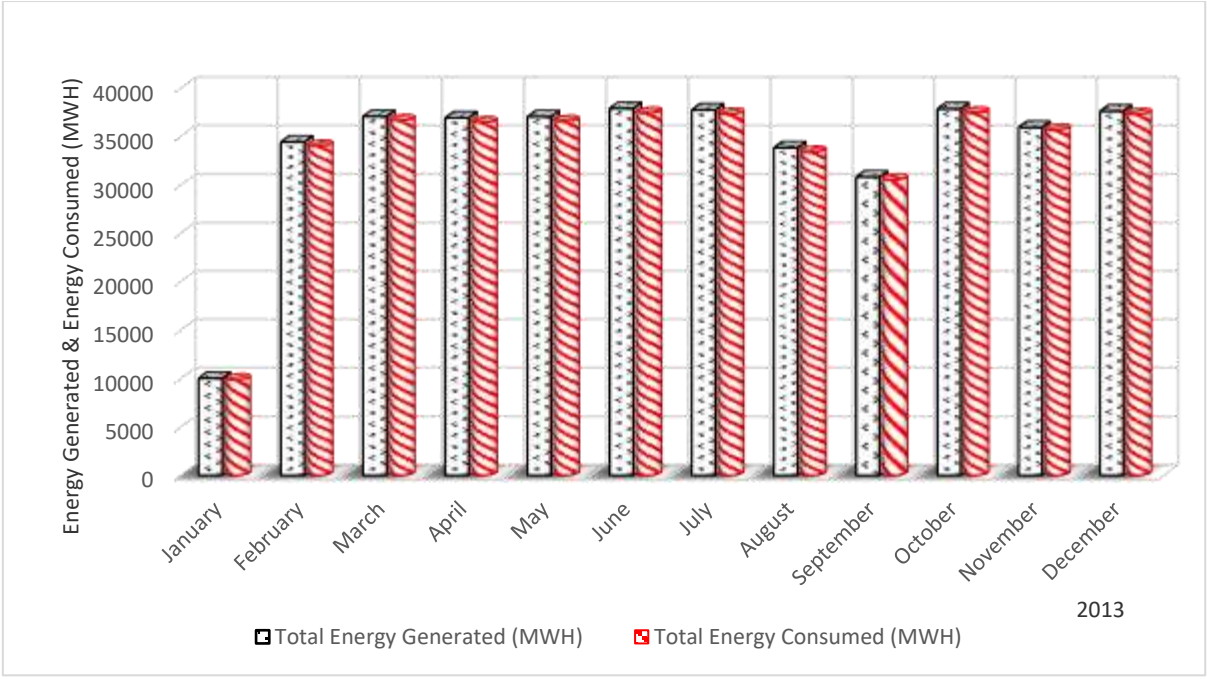

Figure 2.0: Bar chart depicting total energy generated & energy consumed, 2013 (MWH)

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Table 3.0: Total Energy Generated and Total Energy Consumed in MWH (Dangote Plant, Ibese, 2013).

Total Energy Generated (MWH) By Dangote, plant	Total Energy Consumed (MWH) In Dangote, Ibese.
406762.33	401903.72

Source: Dangote Cement PLC.

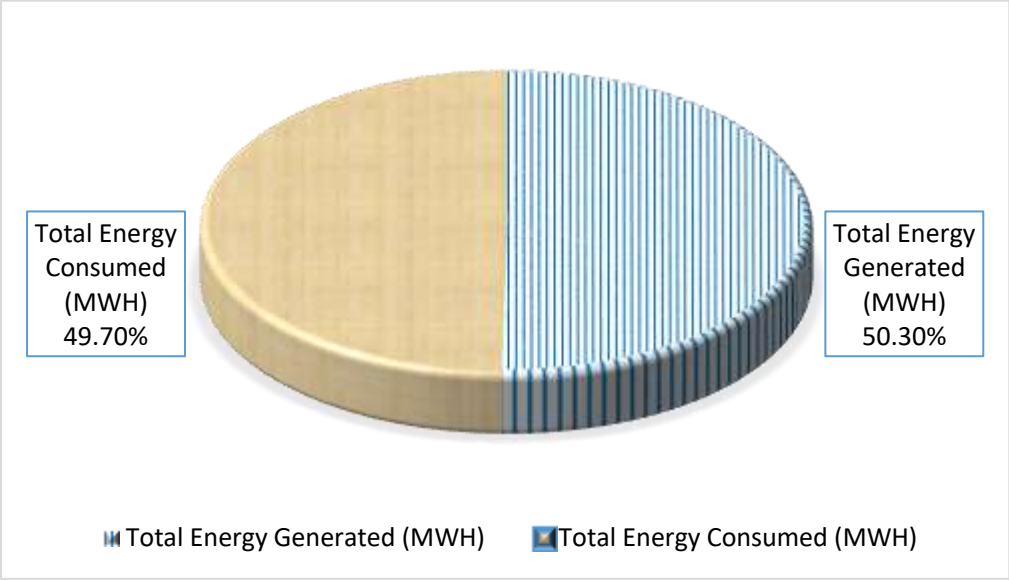

Figure 3.0: The percentage of total energy generated & energy consumed, 2013 (MWH)

Table 4.0: Total Energy Generated from National grid and Energy generated from Dangote Cement Plant, Ibese, Nigeria in MWH

Month	Energy Generated from National Grid (MWH) in 2013	Energy Generated from Dangote Plant (MWH)	Energy from Dangote as a percentage of total energy from grid (%)
Annual Total	29628699.3	406762.3	1.4

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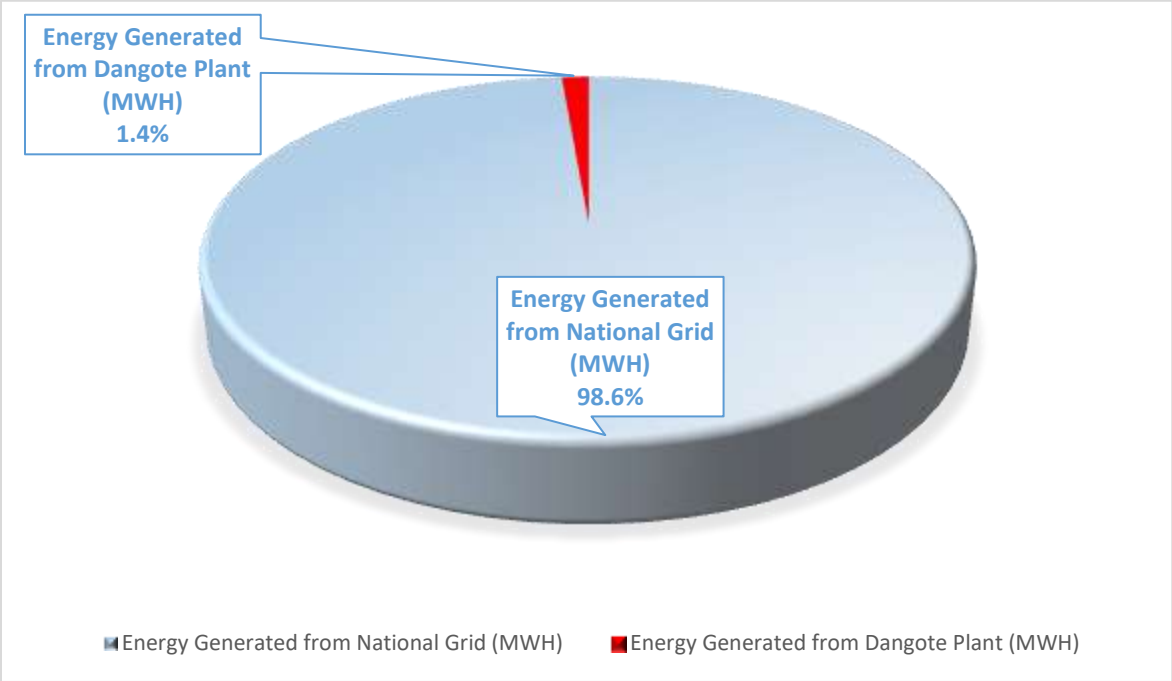

Figure 4.0: The percentage of total energy generated from grid & energy generated from Dangote plant, in 2013

Table 5.0: Daily Energy Generated and Energy Consumed in a typical month. (June, 2013) in Dangote plant, Ibese.

Days	Total Energy Generated (MWH)	Total Energy Consumed (MWH)
1-Jun-13	1299.55	1285.37
2-Jun-13	1399.69	1381.99
3-Jun-13	1207.81	1192.67
4-Jun-13	1327.82	1312.19
5-Jun-13	1319.41	1303.28
6-Jun-13	1154.24	1138.38
7-Jun-13	954.44	938.98
8-Jun-13	1279.4	1265.5
9-Jun-13	1479.79	1461.6
10-Jun-13	1409.33	1393.39
11-Jun-13	1477.67	1462.45
12-Jun-13	1294	1279.26
13-Jun-13	991.46	974.98
14-Jun-13	1056.08	1039.4
15-Jun-13	1197.79	1178.22
16-Jun-13	1379.63	1360.52
17-Jun-13	1395.69	1375.2
18-Jun-13	1384.66	1364.2
19-Jun-13	1318.68	1301.01
20-Jun-13	1209.15	1187.85

21-Jun-13	1403.94	1384.85
22-Jun-13	1430.03	1411.19
23-Jun-13	397.99	381.74
24-Jun-13	1191.22	1173.5
25-Jun-13	1433.15	1416.94
26-Jun-13	1258.63	1243.68
27-Jun-13	1265.97	1250.02
28-Jun-13	1362.11	1346.43
29-Jun-13	1203.75	1187.14
30-Jun-13	1372.89	1356.96

Source: Dangote Cement PLC.

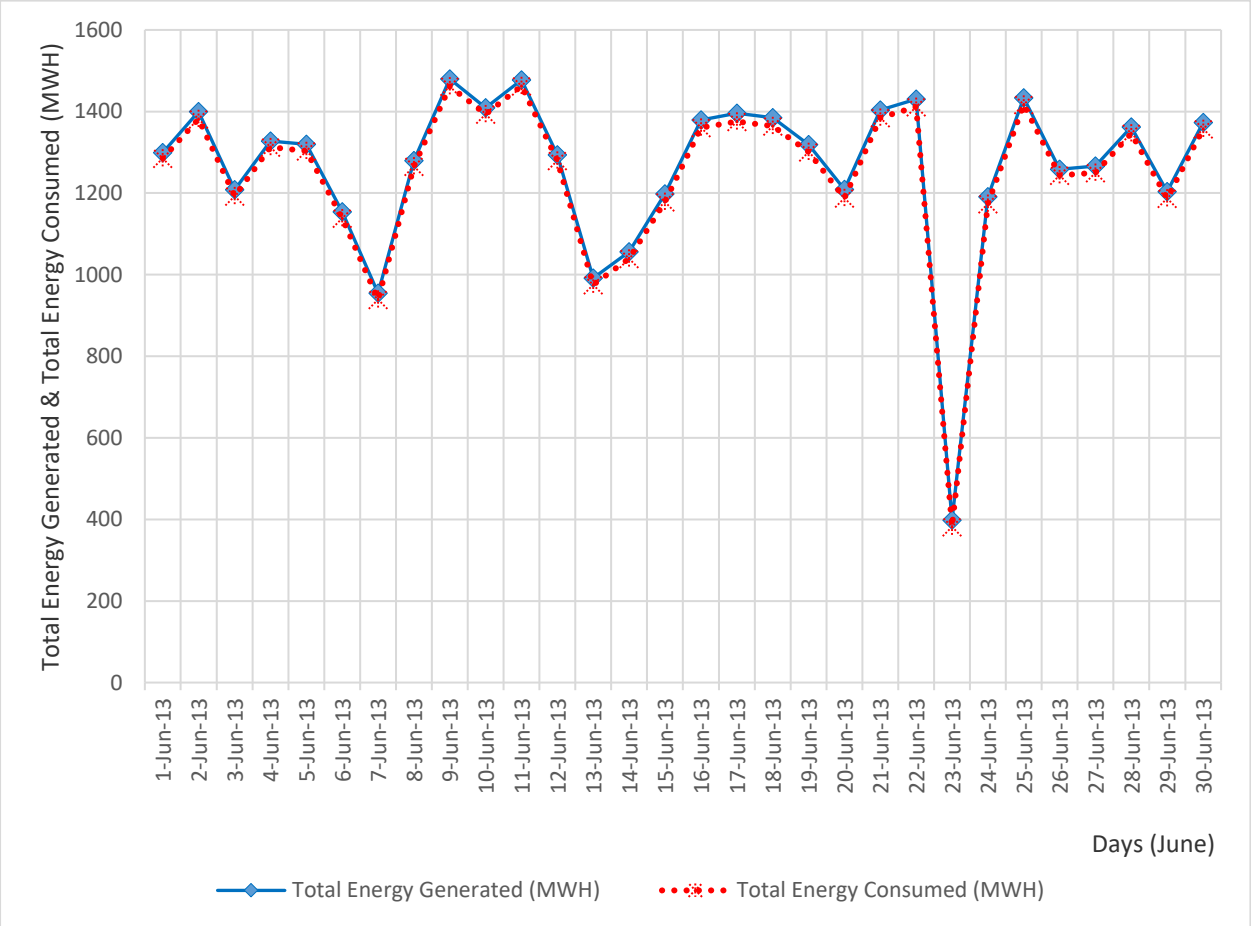

Figure 5.0: Graphical illustration of total energy generated & energy consumed in 2013 (MWH)

In Fig 5.0, observe that losses were minimal and there was a drop in energy generation and consumption in June 23, 2013.

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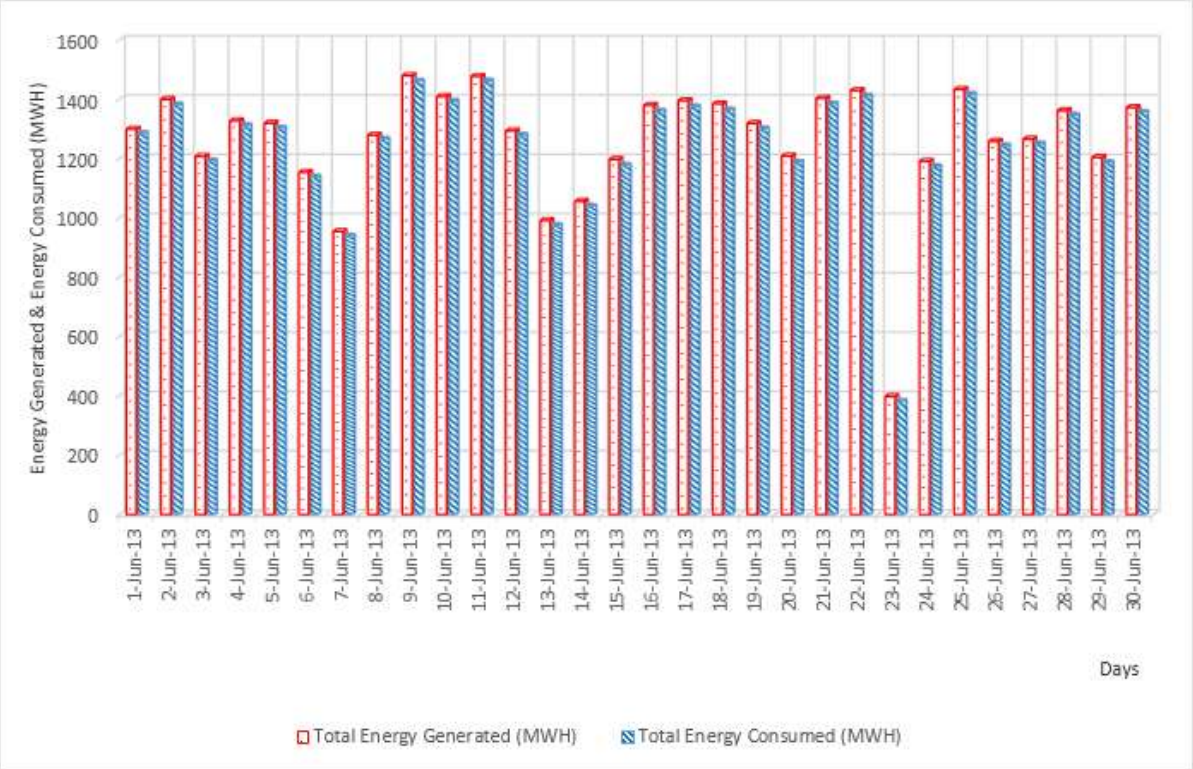

Figure 6.0: Bar chart depicting energy generated & energy consumed by day in June 2013 (MWH) at Dangote plant, Ibese.

CONCLUSION

Energy generation and consumption has been studied and analysed for months of January to December, 2013. Also, the daily energy generation and consumption in the factory for a typical month (June, 2013) was also analysed. The industry was willing to release energy data for the year 2013 only. Similarly, energy generation data collected from the National Control Centre (NCC), Osogbo, Nigeria for 2013 were analysed and compared to those from the Dangote, Ibese, power plant. From the study, it could be said that the power plant at Dangote cement, Ibese, is performing well. It generated a total energy of 406762.33MWH in 2013 which when compared with 29628699.32MWH generated by the grid represents 1.4 percent of Nigeria's total energy generation for the year (2013). This is significant in a country facing serious energy crisis. Also, Dangote can generate surplus energy (more than the industry can use). Besides, there was very minimal energy loss (1.2%) as there was very little difference between energy generated and consumed. Thus, the efficiency of energy transformation was high.

RECOMMENDATION

- The exhaust heat from the Dangote power plant is wasted. It can rather be used in heating and cooling through chiller, boiler and other industrial processes and operations.
- Dangote plant has the potential for generating and selling electricity to other consumers via the grid. The industry should therefore be encouraged.
- Electricity generation in Nigeria is largely dependent on natural gas. No electricity is generated from coal, though coal is available in large quantity locally. The coal – fired power station in Oji, Enugu State, Nigeria has been dead for long. Coal should be exploited for electricity generation in the face of Nigeria's energy crisis. (Okoye, 2018)

REFERENCES

[1] Adinuba, C. D. (2015, March 8), Electricity: How Jonathan is Punishing Igboland, Sunday Sun, P.15.
[2] AIT (2014), African Independent Television, Newspaper Review, August 18.
[3] Alamau (2016), African Energy Commission: Accelerating Africa's Economic Growth through Efficient Energy production.

[4] Ayedun, H., Oyede, R. T., Osinfade, B. G., Oguntade, B. K., Umar, B. F. & Abiaziem, C. V. (2012). Groundwater Quality Around new cement factory, Ibese, Ogun State, African Journal of Pure and Applied Chemistry. Vol. 6, No. 13,
[5] FRN (2012), Federal Republic of Nigeria, Investment Opportunities in the Nigerian Power Sector.
[6] NCC (2016), Grid Operations: Annual Technical Report, National Control Centre, Osogbo, Nigeria.
[7] Okoye, C. U. (2018), Enhancing Electricity Generation Capacity in Africa Through Revamping coal – fired power plants: A case study of Nigeria, paper presented at the 40th Anniversary International Conference of Commonwealth Association of Technical Universities and Polytechnics in Africa (CAPA) held in Abuja, August 27 – Sept 01, 2018.
[8] Otenaike, S. & Onifade, G. (2017), Coal as a source of Electricity Generation in Nigeria, The Consulting Engineer, May – August, Vol. 4, No. 1.
[9] UNDP (2016), United Nations Development Programme, Human Development Report.