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ELECTRICITY DEMAND AND CONSUMPTION IN A MANUFACTURING INDUSTRY

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ABSTRACT

Industrialization the world over owes its growth to the discovery of electricity. Most machines and plants are driven by electric motors; residential and industrial lighting is predominantly electrical; and the communication and entertainment industry are largely dependent on electricity. This paper is an analysis of the demand and consumption pattern of electricity in a manufacturing industry in Ibadan. Based on the supply pattern of the electricity to meet the needs of the organization, the paper concludes that there is a need to improve electricity supply to the manufacturing industry to cut down its production cost which has been on the increase due to energy as one of its prime causes.

1.0 INTRODUCTION

Electricity serves as a carrier of energy to the industrial sector of the economy. It is a major and critical input in the production process. The supply of electricity for industrial use is done by the National Electric Power Authority (NEPA), which has the sole responsibility for the generation, transmission, distribution and sales of electricity at economic rate. NEPA, however has not been able to meet the electricity requirement of its industrial users, because of frequent power outages.

The centrality of electricity to economic development makes the effect of these power outages more pronounced. These outages have reduced the productivity of the affected firms and thus the level of economic activities (GDP) of the economy. Productivity loss results from loss of man-hours in the production process as a direct result of the outages, and man-hour wasted to affect repairs/install spare parts or source raw materials damaged due to the outages.

As a means of avoiding all the negative consequences of power outages, a critical component in the manufacturing activities of most firms have been the use of alternative energy sources such as generators to make up for short-fall in electricity supply. These new dimensions according to the Manufacturers Association of Nigeria (MAN), to increase the cost of operations by2%. The Central Bank of Nigeria (CBN) also noted that there has been notably investment in the acquisition of generators for production purposes (N40.9m in 1992 and N15.4m in the first half of 1993). And all these have added additional costs to the cost of production and has had negative effect on investment decisions in the country.

The objective of this paper is to highlight this negative trend, which is adversely affecting the profitability of most firms, by showing the energy demand and consumption pattern of a manufacturing industry based in Ibadan.

2.0 REVIEW OF LITERATURES

Scholars of human social evolution and of technological change virtually equate the progress of mankind with the use of animal and mechanical power to replace human labour. The Prometheus myth and anthropological evidence alike find in the controlled use of fire one of the great steps forward in human evolution. Yet the classical economic theories of growth and development associated with such names as Adam Smith, David Richardo and Karl Marx, paid almost no attention to energy, since they limited key factors of production to land, labour and capital, with natural resources somewhat fuzzily assimilated into the concept of land.

This paradox probably results from two causes. On the intellectual plane, it was only during the mid-nineteen century that there developed a rigorous conceptual understanding of energy. The laws of thermodynamics and electromagnetism were not discovered until after the basic

formulations of classical economics. On the practical plane, energy – in contrast to land, labour and capital – remained unchanged until very recently. Both historical and cross-sectional inter-country studies have indicated a close long-term correlation between energy consumption and economic growth as measured by national accounts.

Jarosi and Grayson (1972) used the mathematical relations:

$$\text{Log } E = a + b \log GNP$$

to carry out a quantitative study of the relationship between energy consumption to GNP for thirty nations; where E is the energy consumption in million of metric tons. This study showed correlation between GNP and energy ranging from 0.84 to 0.99 for the period 1953 to 1965; the statistical reliability of the regression was uniformly high. However, there was a wide range in the factor b, often called the income elasticity. The value of b and the correlation coefficient R^2 are given in Table 1, while Table 2 shows the Energy – GNP ratio for selected nations in 1971.

Dorf (1978) developed a model of the interactions of the social process of an industrialized nation (Figure 1). The model portrays the important interaction of energy, economics and the environment. Energy and economics interact directly through supply and demand, prices, and capital investments. The energy market place is a result of the population, investment capital, government policies, technology, energy sources, and energy demand. In theory the market place balances all these factors and yields an equilibrium of supply and demand by means of prices and controls. Thus as the world's energy market place changes, a redistribution of economic wealth occurs.

It is clear from the foregoing, that for most developing countries including Nigeria, which still face rapid population growth and seek high growth rates in income per capita, and whose structural transformation imply a rise in energy intensity, that energy costs and security of energy supply must be issues of cardinal concern.

3.0 CONCEPTUAL FRAMEWORK

In the analysis of the electricity demand and consumption pattern of the manufacturing industry under consideration, due cognisance will be given to the following special characteristics of electricity that distinguishes it from other raw materials.

1. Its pervasiveness, which makes it a part of all production of goods and services as well as an important item of final consumption.
2. Its inability to be recycled (a direct consequence of the second law of thermodynamics). and
3. Its low elasticity of substitution taken collectively (as distinct from individual fuels).

4.0 RESEARCH FINDINGS AND DISCUSSIONS

4.1 The Company

The production organisation under consideration is a manufacturing company located in Ibadan, which is involved in the manufacturing and sales of beer, stout and malt products. It has been doing this in the past 50 years.

4.2 Electricity Consumption Units

Fig. 2 shows the electricity consumption unit in the plant and Table 3 shows the characteristics of the generator used by the organization; Table 4 shows the electricity production of the organization and the total consumption pattern for the organization for a period of 10 months of 2001.

From the total power produced by the company only 9% of it is supplied by NEPA while the remaining 91% are produced by the company. Also 82% of the power produced is for processing and production purposes while the rest is for other subsidiary services such as lighting, air conditioning etc. The total purchased power from NEPA for the period under review stood at N5.4m, while the cost of running the generating set, including the cost AGO (N22.00/litre) monthly cost the company N660,000 (AGO) and repairs and maintenance overhead came to N150,000 monthly including the personnel that maintain the generator; bringing the total monthly cost to that of N810,000 monthly or N8.1m for the period under review, this company also spends an additional sum monthly of N450,000 monthly for the purchase of LPFO for the production of steam for the boilers.

5.0 SUMMARY AND CONCLUSION

From the foregoing, there is a need for improvement in the supply of electricity for industrial use to cut down on the use of generators, which is increasing the production costs for manufacturing activities. For the company under review, energy costs have been one of the predominant factors that have been responsive for escalating costs of their products in the last 5 years.

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TABLE 1: RELATIONSHIP BETWEEN ENERGY CONSUMPTION AND GNP

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
USA	0.96	0.99
Germany	0.66	0.85
United Kingdom	0.48	0.84

TABLE 2: THE ENERGY – GNP RATIO FOR SELECTED COUNTRIES (1971)

NATION	ENERGY PER DOLLAR OF GNP
USSR	3.30
Norway	2.69
Canada	2.63
United Kingdom	2.31
USA	2.24
Netherlands	1.96
W. Germany	1.65
Japan	1.62
Italy	1.53
France	1.23

TABLE 3: TECHNICAL DATA OF COMPANY'S GENERATOR

ITEM	DESCRIPTION
Brand Name	MWM Engine TBD 501 – 6E
Engine Capacity	1820 KW
Displacement	275 Litres (6 Cylinders)
Fuel Tank Capacity	3000 Litres (AGO)
Fuel Consumption	1668 KW
Power Output	2085 KVA
Volts / Ampere	11000 / 109
Cos ϕ	0.8
Density of Diesel	0.85 kg/m3
Bore / Stroke	360mm, 450mm

TABLE 4 (a): ELECTRICITY CONSUMPTION PATTERN OF THE COMPANY (JANUARY – OCTOBER 2001) (KWH)

MONTH	GENERATOR	NEPA (N450/KWH)	TOTAL
January	1446274	141550	1587824
February	1114530	3810	1118340
March	1482616	43210	1525826
April	1272730	2180	1274910
May	1124109	140240	1264349
June	1270709	268210	1538919
July	1208842	178000	1386842
August	1251168	279810	1530978
September	1086660	151410	1238070
October	1239575	NA	1239575
TOTAL	**12497213**	**1208420**	**13705633**

TABLE 4 (B): SUMMARY OF ELECTRICITY CONSUMPTION

ITEM	TOTAL
Processing + Production	11247982
Lighting, air-conditioning and others	2457651
TOTAL	**13705633**

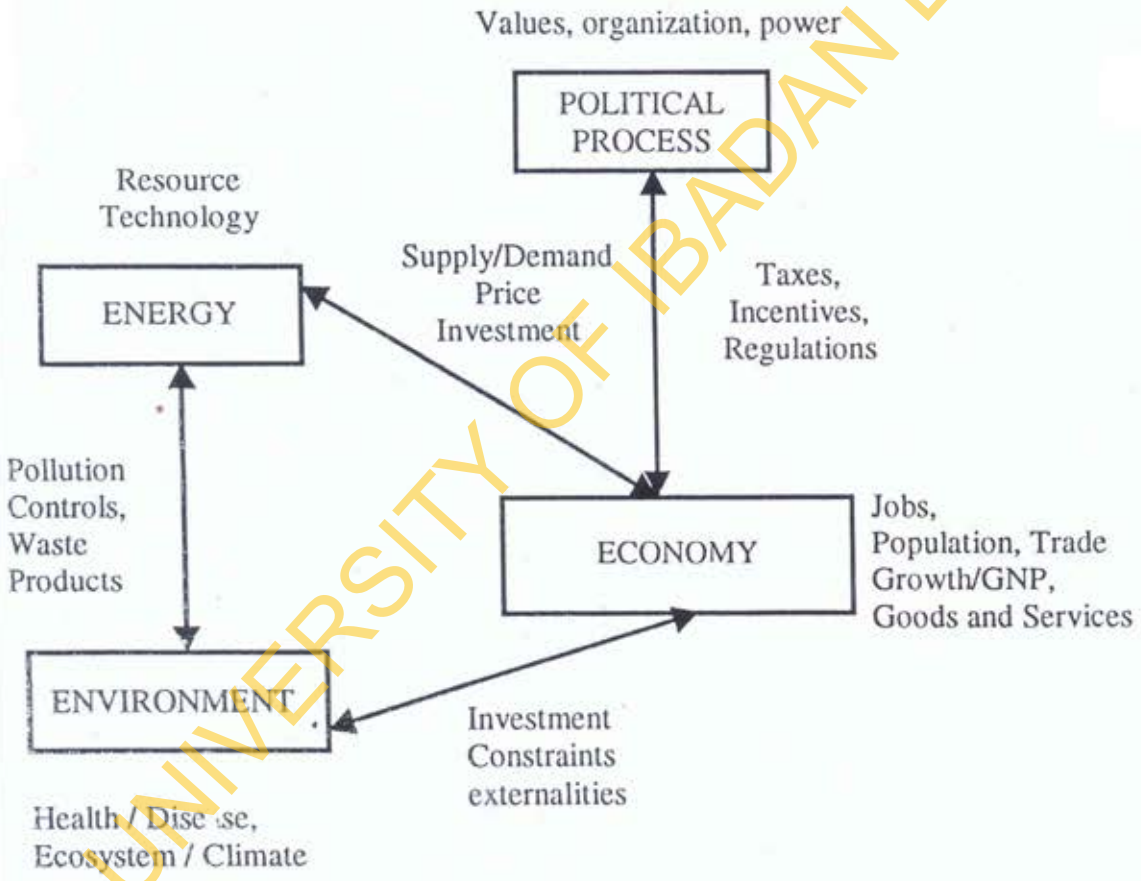

FIGURE 1: A MODEL OF THE INTERACTIONS OF THE SOCIAL PROCESSES IN AN INDUSTRIALIZED NATION

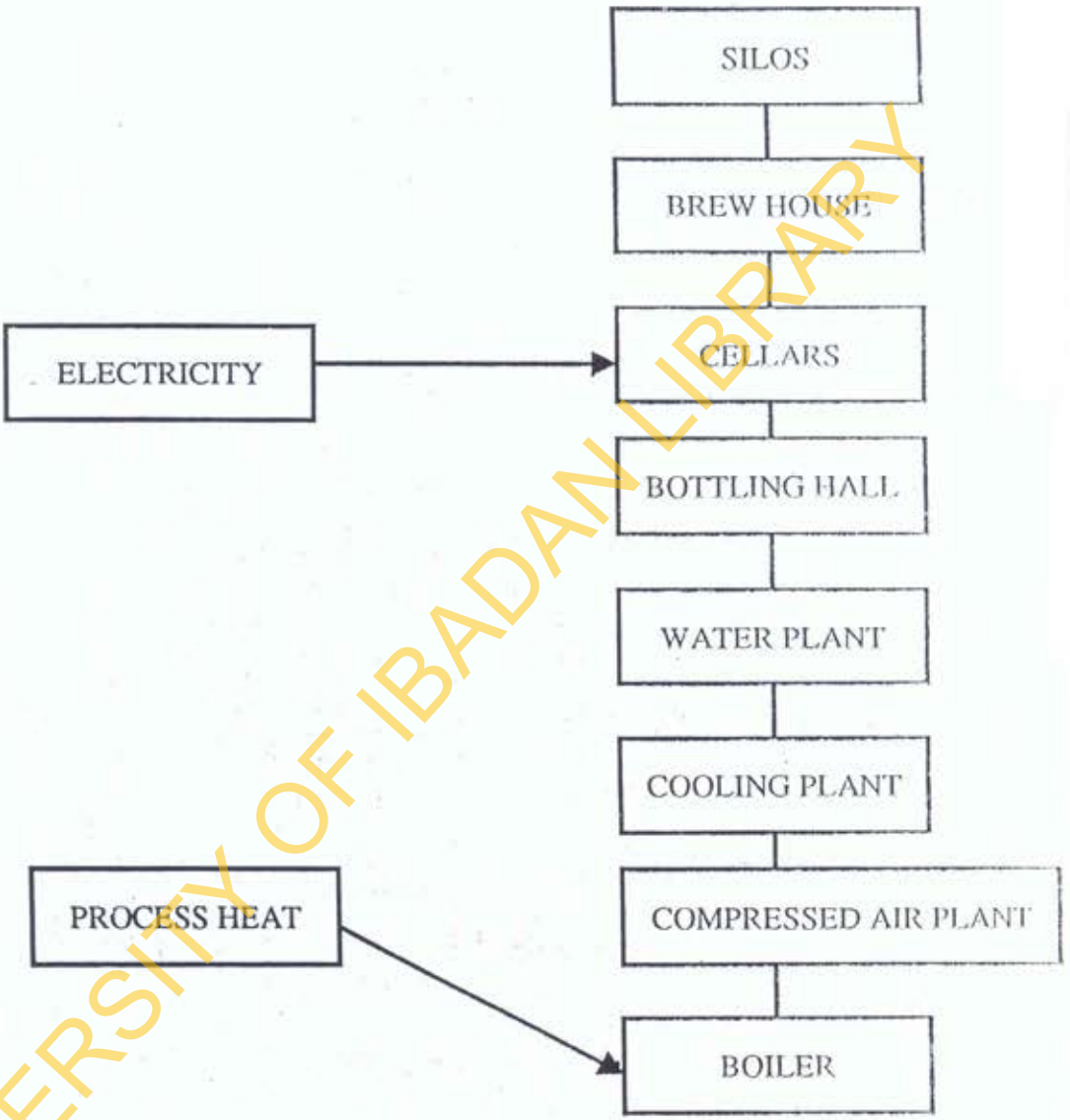

FIGURE 2: ENERGY CONSUMPTION POINTS