Effect of Non - Renewable Energy on Manufacturing output in Nigeria

Abstract

The role of energy, especially non-renewable energy in promoting manufacturing sector activities and operations in developing countries like Nigeria cannot be over-emphasized. This paper investigated the effect of non-renewable energy on textile and clothing output as a sub-sector of the manufacturing sector in Nigeria using time series data covering the period 1986 to 2021. Expost -Facto design was employed as a guide,while the data used were sourced from the publications of Central Bank of Nigeria (CBN) and the World Development Indicators(WDI) for the Nigerian Economy. The ARDL regression technique was used to estimate depicting the relationship between the variables, while the econometric properties of the data were determined using the Phillip-Perron (PP) unit root test and the Bounds cointegration methods. Mean, kurtosis and skewness were employed to describe the data. The Paper concluded that non-renewable energy has no significant effect on textile and clothing output in Nigeria, and recommended among others that alternative energy sources, particularly renewable sources should be explored by the federal ministry of petroleum for enhanced economic growth, particularly of textile and clothing output.

Keywords: Non-Renewable Energy, Hydro-electricity Energy, Petroleum Energy, Gas Energy,Textile and Clothing Output

JEL CODES: Q39,Q11,Q49

1. Introduction

The manufacturing sector plays a catalytic role in a modern economy and has many dynamic benefits crucial for economic transformation. In a typical advanced country, the manufacturing sector is a leading sector in many respects. The sector is considered an avenue for increasing productivity related to import substitution and export expansion, creating foreign exchange earning capacity, and raising employment and per capita income in the domestic economy and has the potentials of fast-tracking growth in other sectors of the economy. In Nigeria, available statistics have revealed that the manufacturing sector’s contribution to the country’s Gross Domestic Product (GDP) used as a measure of growth in the economy has been on the declining in recent times. The Central Bank of Nigeria (2019) noted that the manufacturing sector's share of the overall gross domestic product (GDP) fell from 7.84 per cent between 1971 and 1980 to 7.33 per cent between 1981 and 1990. This percentage declined to 4.87 and 3.84 per cent between 1991 and 2000 and 2001 and 2010 and that the manufacturing sector contributed 9.4 per cent of GDP on average between 2011 and 2019. This means that the contributions of the manufacturing sector generally have been fluctuating, and this could be due to the epileptic nature of the supply of non-renewable energy resources.

The concern in literature is on the extent to which the use of energy sources, including non-renewable sources have impacted on the output level of the dis-aggregated components of the manufacturing sector in Nigeria. Evidence revealed that in 2020, Nigeria's average generation and transmission were 4,000 Mega Watts (MW) (although the generation occasionally hit the 5,000 MW mark), with average access of 3,000 MW being distributed to electricity consumers across the country (KPMG, 2021). The World Bank (2021a) reported that only 57 per cent of Nigerians have access to electricity compared to 100 per cent in Mauritius and Tunisia, 99.8 per cent in Egypt, 99.1 per cent in Algeria, 99 per cent in Morocco and Seychelles, 96.1 per cent in Cape Verde, 90.7 per cent in Gabon, 84.3 per cent in Ghana and 84.2 per cent in South Africa. These facts make Nigeria the country with the world's most significant energy access deficit. Yet, Henry, Ndem, Ujongand Ihuoma (2021) observed that the current electricity supply is grossly inadequate to cater to the power needs of manufacturers and the populace in general. This suggests that the supply of energy which by implication includes non-renewable energy could be considered as one of the challenges confronting households and manufacturing sector activities in textile and clothing firms in the country.

According to the World Bank (2021b),lack of electricity supply has hampered business growth in the manufacturing sector, leading to yearly economic losses estimated at $26.2billion (N10.1 trillion), equivalent to about 2 per cent of the Gross Domestic Product. Nigeria is also endowed with large quantity of natural gas, making the country one of the gas energy producing countries in Africa, and the World in generally. This ordinary suggest that issue of gas energy as a form of non-renewable energy supply is not supply to be challenge faced by firms in the manufacturing sector of the economy. In the case of Nigeria, consumption of natural gas experienced an unstable trend, and the major symptoms of the failure of Nigerian energy policy implementation are its inability to harness abundant natural gas and non-renewable energy sources optimally. The discovery of petroleum made the commodity the life wire of the Nigerian economy, a situation that significantly made Nigeria a Dutch Disease economy and its negative multiplier effect on non-renewable energy supply and textile industry output cannot be over-emphasized. Eniayo (2018) noted that one of the most challenging factors to development in Nigeria is the poor quality, unreliability, and limited availability of power supply to the manufacturing sector. This could be linked to the report of Awodumia and Adewuyi (2020) that in Africa, Angola and Nigeria are the least consumers of petroleum per capita terms among these economies, but the rising trends are observed for Gabon being the leading consumer of petroleum resources in per capita terms followed by Egypt and Algeria in that order. Hydro-electricity energy is consumed by different economic agents of which sectors such as industrial, manufacturing, service sector seems to be investing heavily in generation facilities to complement the unreliable power supplies from the national grid. This means if there is a shortfall in the supply of this energy, manufacturing activities in the textile sub-sector and other components of the manufacturing sector may be affected negatively.

Nigeria economy had once a prosperous textile industry owing to its contributions to the country's Gross Domestic Product figures. National Bureau of Statistics (2014) reported that the second largest contributor to manufacturing output was the textile, apparel and footwear which at N792,693.12 million in 2010, represented 11.58% of total output. Its growth rate was put at N398,019.65 million or 50.21% in 2011, the total output of N1,190,712.77 million represented 14.57% of total output. This statistic suggests that the textile sub-sector of the manufacturing sector used to be an important player in the Nigerian economy. Owen, Ogunleye and Orekoya (2016) stated that the Nigerian Textile Industry used to be the largest employer of labour, second to government and has always been a major player in the manufacturing sector of the economy. Sadly, the textile industry has ceased to be an important contributor to foreign exchange earnings and employment generation in Nigeria. The inability of the Nigerian textile industry to compete is chiefly due to its failure to produce at lower cost which could also be attributed to the unreliable nature of non-renewable energy supply. Alugbuo (2022) asserted that the average power consumption in Nigeria is insufficient to maintain manufacturing enterprises' plants and machines operating at optimal levels, forcing them to rely on fossil fuel alternatives to power their plants and machines.

Over the years, several reform measures have been initiated with the aim of revamping the textile sub-sector of the manufacturing sector of the Nigerian economy. With the return to democracy, the National Economic Empowerment and Development Strategy (NEEDS), the seven-point Agenda and the Economic Transformation policy were introduced as economic reform policies geared toward addressing challenges of dismal power supply which is key to manufacturing sector activities. Again, the issue of wealth and job creation that form the core of the NEEDs policy failed to yield the desired results as the textile and clothing sector that could have helped in wealth and job creation considered as critical components of the NEEDS policy was not revamped. Aremu (2015) contented that these policy measures were the re-invention of SAP driven strategies which have impaired sustained growth and development in Nigeria over the years. Other policies initiated also are the mass metering policy where households and including manufacturing sectors are expected to have prepaid meters so that the issue of estimated billing could be nipped in the bud, and the Petroleum Industry Act (PIA) among others reform measures. Despite all these measures taken, the situation has not improved because it has been observed that the textile and clothing sub-sector is a shadow of its former self, while nom-renewable energy in the manufacturing sector is still national problem in Nigeria.

Evidence from the empirical study of Edet, Henry, Effefiom, Nyiputen and Bassey (2022) revealed that electricity supply has a negative and insignificant relationship with the manufacturing sector output. Although there exists a plethora of studies on non-renewable energy and manufacturing sector output, there is scarcity of studies that concentrated on textile and clothing output in particular. More so, most of the extant studies looked at the effect of aggregated energy consumption on manufacturing sector output generally, there is paucity of empirical studies on the disaggregated effect of non-renewable energy on textile and clothing manufacturing output in Nigeria. This is important because Abid and Sebri (2012) posited that the use of aggregate energy data may not be able to identify the impact of a specific energy type on industrial output and for comparisons of the effect of each of energy source. More so, most of the studies failed to cover the period 2021 despite the ravaging effect of the Covid-19 pandemic on the manufacturing sector in Nigeria. This paper seeks to investigate the effect of non-renewable energy on textile and clothing output in Nigeria spanning from 1986 to 2021. The specific objectives of this paper are to.

i. investigate the effect of coal energy on textile and clothing output in Nigeria
ii. determine the effect of petroleum energy on textile and clothing output in Nigeria
iii. examine the effect of gas energy on textile and clothing output in Nigeria

The following hypotheses were formulated based on the objective of the study and analyzed:

H01: Coal energy has no significant effect on textile and clothing output in Nigeria.

H02: Petroleum energy has no significant effect on textile and clothing output in Nigeria.

H03: Gas energy has no significant effect on textile and clothing output in Nigeria.

2. Materials and Methods

2.1 Conceptual Review

Non-Renewable Energy: Energy needed for manufacturing sector operations in Nigerian can be grouped into renewable and non-renewable depending on their sources and extent of being exhaustible when harnessed. Alugbuo (2022) had noted that Nigeria is endowed with a diverse range of energy resources, including crude oil, natural gas, coal, hydropower, solar energy, and fissionable materials for nuclear energy, but it consistently faces an energy shortage, which is a major impediment to the country's industrial and technological development. Elijah and Nsikak (2013) reported that energy source is classified as renewable if its usage is not exhaustible as such solar energy falls within this category, while the non-renewable energy are energy sources that are exhaustible in nature if used continuously. Non-renewable energy sources in Nigeria encompasses electricity hydro-electricity, gas and petroleum energy among others that play important roles in propelling manufacturing sector activities. Nigeria is endowed with a large deposit of natural gas which is found alongside petroleum in form of crude oil. Natural gas is considered an important source of energy supply often use to fuel trucks and other heavy machines and lorries used for the transportation of manufacturing sector inputs and products to various parts of the country owing to its perceived cost-effective nature when compared to other non-renewable energy sources. Electrical energy is used in industries to power heavy machinery and smaller appliances such as electrical to mechanical conversion (Olufemi, 2015). This implies that to make the textile sub-sector a driver of higher manufacturing sector output, there is need for improve supply of non-renewable energy in Nigeria as a developing economy.

The under-utilization of non-renewable sources in Nigeria seem to have contributed to the low output in the sub-sectors of the manufacturing sector of the Nigerian economy. According to Adamu and Darma (2016) reported thatNigeria was ranked second worst country in terms of gas flaring, its domestic energy demands keep increasing in the wake of inadequate alternative cleaner compare to oil energy sources like natural gas. Awodumi and Adewuyi (2020) argued that the trends of non-renewable energy like petroleum and natural gas consumption reported that Angola and Nigeria are among the least consumers of petroleum in per capita terms among the World economies. This could be one of the reasons why Nigerian gas master plan was designed as a strategy for making gas energy available for both domestic and manufacturing sector utilization. Olarinde and Abraham (2020) observed that despite Nigeria's endowment in energy, including hydro-electricity energy resources, there has been wide disparity in the country's energy demand to the supply over the last two decades, access to energy services has been continuously challenging.

Textile and Clothing Manufacturing Output: Kwode (2020) pointed out that the manufacturing sector is involved in the production of two categories of goods; consumer goods and capital goods. Central Bank of Nigeria (2018) reported that between 1981 and 2018, only three out of thirteen sub-sectors contributed 78.6% to its overall output. These three sectors include food, beverage and tobacco (56.4%), textile, apparel, and footwear (16%), and cement (6.2%). Thus, a negative growth of the manufacturing sector is associated with a negative growth of the economy (CBN,2018). The textile sub-sector of the manufacturing sector in Nigeria has cotton and cotton wool as its major products which are used as raw materials in other industries. Globally, cotton production uses 2.5% of agricultural land, and consumes about 16% of pesticides, and it employs an estimated 60 million people worldwide and accounts for more than $450 billion in revenues annually (Snoek, 2017). Textile and clothing industry is the second largest polluting industry, after oil in the world. There is also rapid proliferation of textile products and this has shortened the life span of the products. For example, the number of times a cloth is worn before being disposed has reduced significantly by 36% (Bick, Halsey &Ekenga, 2018). Its products are very vast but clothing makes up 60% of the entire textile and clothing market (Koszewska, 2018). Production, supply and use of textile products require and consume huge number of non-renewable resources (Johnson, Echeverria & Venditti, 2020). This implies that for higher output in the textile and clothing firms in Nigeria, there is need for constant suppl of non-renewable energy that will promote effective utilization of the both heavy and light equipment for its operations.

2.2 Theoretical Framework

Neoclassical Growth Model: The neoclassical or endogenous theory was put forward by economists like Romer (1986). The theory is an improvement in the traditional Solow Growth model where technology is not considered an important factor that exerts influence on growth in the economy. The theory supports second law of thermodynamics which states that a minimum quantity of energy is required to carry out the transformation of matter. This implies that non-renewable energy consumption is an essential factor of production that can boost textile and clothing manufacturing sector production and output in the economy. The neoclassical growth theory takes the form of the conventional Cobb-Douglas production function which is expressed as follows:

$$Y = AK^{\alpha}L^{\beta} \qquad (1)$$

The model shows that K represents the stock of capital, L is stock of labour and A denotes the level of technological progress, while α and β are measures or coefficients of the factor inputs elasticity. Therefore, since A is endogenously determined in the new growth model, it is thought to relate to energy in some way. Hence, represents energy consumption because the amount of technology per unit of time requires some level of energy to work. Thus, technology in this context refers to plants, machinery and equipment such as that without adequate supply of energy; this technological stock will be obsolete. In order words, it is energy that determines the efficiency of the capital component of the function model. This is justified by the law of thermodynamics which holds that no production can occur without conversion of energy. This implies that the level of output of the textile and clothing sub-sector of the manufacturing sector in Nigeria depends on the amount of non-renewable energy consumed. Technically, it follows that non-renewable energy consumption may have positive effect on the output level of textile and clothing as a sub-sector of the manufacturing sector in Nigeria.

2.3. Empirical Review: empirical studies on non-renewable energy and manufacturing sector have been carried out by researchers, but with the findings differ due to factor such as variables captured, study Area and methodological issues. For instance, Mohammed, Buba, Agboola and Lola (2018)examined Nigerian textile industry: Evidence of policy neglect from 1985 to 2015. The findings indicated that overreliance on petroleum resources emboldened imports of foreign made products especially from China. Although this paper captures the textile industry which is a variable of interest, it failed to examine how non-renewable energy affect the output level of the textile sub-sector of the manufacturing sector in Nigeria.

Iwashokun (2019), examined the sources of energy supply and manufacturing output in Nigeriadata from 1981 to 2016 autoregressive distributed lag (ARDL) and Toda-Yamamoto techniques to appraise various. The result showed that hydroelectricity, gas and coal have a positive-significant link with manufacturing output in the short and long runs. In addition, the result also showed that all the energy sources investigated granger caused manufacturing output. Onwe and King (2020), investigated the relationship between electricity consumption and manufacturing sector output in Nigeria covering 1981 to 2019 using the ARDL technique. The result revealed that electricity consumption positively impacts manufacturing output in the short run but negatively in the long run. Therefore, the paper concluded that electricity consumption affected manufacturing sector output in Nigeria and recommended an urgent need to present a national economic plan to increase energy supply to the manufacturing sector. Adelegan and Otu (2020) examined the impact of energy consumption on industrial output in Nigeria. The study employed the autoregressive distributed lag (ARDL) technique and data from 1980 to 2018. The result revealed a direct-significant relationship between gas, electricity, and petroleum product consumption on industrial output in the long and short runs. However, the relationship between electricity consumption and industrial output was negative and insignificant in the short run. The study recommended that the government invest in alternative energy sources and harness the abundance of natural gas.

Haseeb, Kot, Hussain, Mihardjo and Saługa (2020) examined the dynamic relationship between the textile industry and energy intensity. China, Indonesia, India, Pakistan, Bangladesh, Malaysia, South Korea, Thailand, Japan and Vietnam are dominant in textile manufacturing from 1990 to 2018. The results revealed that textiles and clothing production have a positive and significant impact on energy intensity in all countries. The results of Granger causality in quantiles confirm a bidirectional causal relationship between textiles and clothing production and energy intensity in all selected countries except Thailand and Japan, where a uni-directional causal connection between textile and clothing manufacturing and energy intensity can also be found. This study is relevant to the current research because it was on textile industry and energy, but it failed to specifically examine the effect of non-renewable energy on output in the textile industry.

2.4. Data and Model

Research Design: The study used the *expost-facto* deign as its guide. The justification for the choice of this approach is that the study employed the used of time series or secondary data that have been collected and documented such that the researcher cannot manipulate the existing data on the variables of interest.

Sources of Data: This study used annual time series data on hydro-electricity, petroleum and gas energy respectively as components of non-renewable energy and textile and clothing manufacturing sub-sector output in Nigeria spanning from 1986 to 2022. The data used were obtained from the Central Bank of Nigeria (CBN) Publication and the World Development Indicators (WDI) considered as reliable sources of data for econometric analysis. The choice of 1986 was predicated on the fact that major economic reforms in both energy and real sectors of the economy, including manufacturing sector of the Nigerian economy started with the introduction of the Structural Adjustment Programme (SAP) in the aforementioned year. The choice of 2021 on the other hand was based on the fact that it covers the Covid-19 pandemic period that exposed the economy if Nigeria to a recession and dismal performance the economy, including the manufacturing sector.

Method of Data Analysis: The study employed the single equation modeling technique and the conventional Autoregressive Distributive Lag (ADRL) modeling approach was used as a technique for model estimation. Thus, in line with the principles of regression analysis, the unit root test was carried out as the first preliminary test basically to ascertain the number of times a variable or series has to be differenced to achieve stationarity. The study used the Phillip-Perron (PP) unit root test of stationarity test. To determine the extent of cointegration as a measure of long-run relationship between the variables, the study used the bounds co-integration test analysis developed by Pesaran and Shin (1999) and Pesaran*et'al.*, (2001) which is considered more superior than the conventional ADF unit root test technique. Dada (2019) noted that the ARDL or Bounds test technique is valid regardless of whether the regressors in the model are purely I (0), purely I (1) or mutually co-integrated. The decision rule associated with the bounds test of cointegration are that:

i. If F-statistic coefficient falls below the lower bound of 1(0) orders of integration, the null hypothesis will be accepted and the conclusion is that there is no long-run relationship or co-integration between the variables.

ii. If F-statistic coefficient falls above the 1(1), the null hypothesis will be rejected and the conclusion is that there is a long-run relationship or co-integration between the variables.

iii. If F-statistic coefficient is in-between 1(0) and 1(1) bounds, the results are inconclusive.

Model Specification: The relationship between the disaggregated components of non-renewable energy which include Petroleum Energy Consumption (PEC), Coal Energy Consumption (CEC) and Gas energy consumption (GEC) and textile and clothing manufacturing sector outputs (TCO) takes the following generic form of the ARDL model:

TCO = f (PEC, CEC*, GEC) …………………………………………………….(2)*

***A-priori* Expectation**

The effect of the different components of non-renewable energy on textile and clothing output may differ it terms of their size and magnitude. However, based on theoretical assumption in economics, the *a-priori* expectation is that CEC > 0, PEC > 0 and GEC > 0 respectively. This implies that all things being equal, the coefficient of hydro-electricity energy, petroleum energy, and gas energy consumption are expected to be positive. In order words, the expectation is that CEC, PEC and GEC are expected to have significant positive effect on textile and clothing output as a sub-sector of the manufacturing sector in Nigeria

$Yt = \beta 0 + \beta 1Y\, t - 1 + \beta 2X\, t - 1 + \beta 3Zt - 1 + \sum_{i=1}^{p} \lambda i\, \Delta Yt - 1 + \sum_{i=1}^{p} \psi j\, \Delta\, X\, t - 1 + \sum_{i=1}^{p} \phi j\, \Delta Zt - 1) + \varepsilon t \ldots\ldots\ldots\ldots\ldots\ldots\ldots (3)$ Therefore, from the explicit form of the ARDL model in equation (2), the variables X and Z are the independent variables, while Y is the dependent variable. The model shows that the lag value of the X and Z in both long-run and Short-run period can have effect on the current value of Y variable. The model also indicated that apart from these two variables, the lag value (previous value) of Y can exerts effect on the current value of Y as a variable. Deducing from the above mode, Z and X denote the components of explanatory variables of non-renewable energy, while Y represents textile and clothing manufacturing output in Nigeria in the current period. Consequently, the implicit form of the functional relationship between the disaggregated components of non-renewable energy or its explanatory variables and textile and clothing manufacturing output (TCO) is expressed as follows:

Therefore, based on the rule of thumb, the explicit specification of the ARDL model that captures the ARDL Error Correction Mechanism (ECM) takes the form:

$$ln(TCO)t = \beta 0 + \beta 1\, ln(TCO\, t-1) + \beta 2\, ln(\, CEC\, t-1) + \beta 3\, ln(\, PECt-1) + \beta 4\, ln(\, GECt-1)$$

$$+ \sum_{i=1}^{p} \lambda i\, \Delta\, ln(TCO\, t-1) + \sum_{i=1}^{p} \psi j\, \Delta\, ln(\, CEC\, t-1) + \sum_{i=1}^{p} \phi j\, \Delta\, ln(\, PEC\, t-1) + \sum_{i=1}^{p} \theta j\, \Delta\, ln(\, GEC\, t-1) +$$

$$\delta iECMt - i + \varepsilon t \ldots\ldots\ldots$$

Hence, from model (4) above, TCO denotes textile and clothing manufacturing output, CEC is coal energy consumption, PEC is petroleum energy consumption and GEC is gas energy consumption. Similarly, β_0 is the intercept parameter that shows the meeting point between non-renewable energy and textile and clothing manufacturing output if plotted graphically. More so, $\beta_1 - \beta_4$ are the long-run slope parameters, while, λ, ψ, ϕ and θ are Short-run slope parameters , ECM_{t-i} is the Error Correction Mechanism and δ is the parameter that measuring the speed of adjustment process in the system from a long-run disequilibrium after a shock to a state.

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3. Results and Discussion

3.1 Diagnostic Test and Analysis/Interpretation

Table 1: Results of Descriptive Analysis

Statistics	TCO	CEC	PEC	GEC
Mean	701.0997	7.275000	1163.637	13.93472
Median	472.5400	7.595000	1155.041	13.18000
Maximum	1443.030	9.960000	1419.975	24.52000
Minimum	344.0600	4.480000	772.0540	4.790000
Std. Dev.	417.8506	1.436357	158.9969	6.744427
Skewness	0.941745	-0.040151	-0.576087	0.308125
Kurtosis	2.911683	2.854526	3.316058	2.667118
Jarque-Bera	3.301365	2.977840	2.141097	3.234507
Probability	0.042823	0.371978	0.342820	0.198443
Sum	25239.59	261.9000	41890.93	501.6500
Sum Sq. Dev.	6110970.	72.20930	884800.4	1592.055
Observations	36	36	36	36

Source: Eviews,10

The results of descriptive analysis of the estimated variables in Table 1 revealed that textile and clothing output (TCO) had a mean of 701.0997, coal consumption (CEC) had a mean of 7.275000, petroleum energy consumption had a mean of 1163.637 and gas energy consumption had a mean of 13.93473 respectively. This implies that petroleum energy as a form of non-renewable energy contributed more to textile and clothing output than coal and gas energy consumption by the sub-sector of the manufacturing sector of the Nigerian economy. The estimated coefficient of the kurtosis that measures the peak of the normal distribution curve and skewness that shows the symmetrical nature of the curve were found to be within the 3 and -+0 bench mark. This implies that the distribution was found to be normal. The results also revealed that the analysis covered a period of 36 years, which is adequate enough to explain the trend of the relationship between the variables.

3.2. Trend Analyses of the Study Variables

This section focuses on the trend analyses of the study variables.

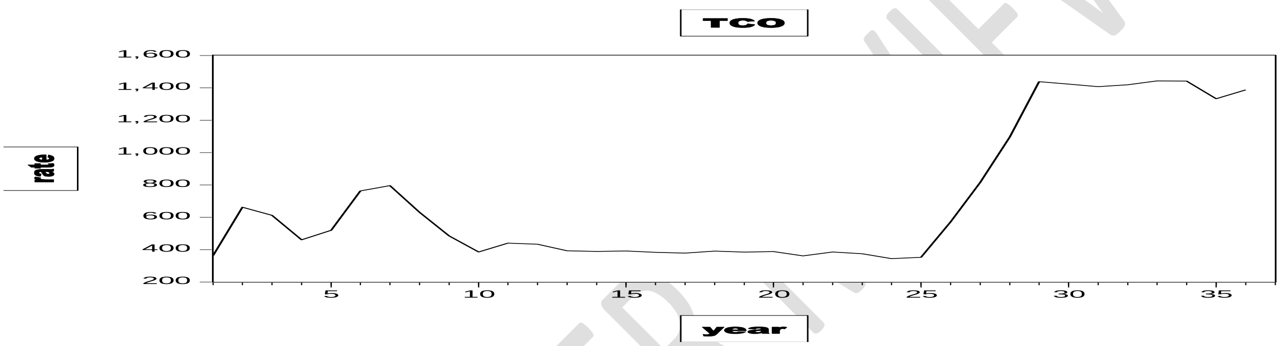

Figure 1: Trend of Textile and Clothing Manufacturing Output in Nigeria
Source:*Extract from Results of E-views 10.*

The result of textile and clothing manufacturing output presented in Figure I shows that TCO trended with a mild swing between 1986 and 1990 during the implementation of Structural Adjustment Programme (SAP) in Nigeria before it descended to a low output between 1991 and 2005 when the Sani Abacha's regime grappled with rolling plans. There was an upward jerk from 2006 t0 2010 in response to the Small Scale Enterprises Development Programme championed by Small Scale Enterprises Development Agency of Nigeria (SMEDAN) and the consolidation exercise of 2004. This trend that has stabilized since then, suggesting signs of significant textile and clothing manufacturing output in Nigeria within the review period.

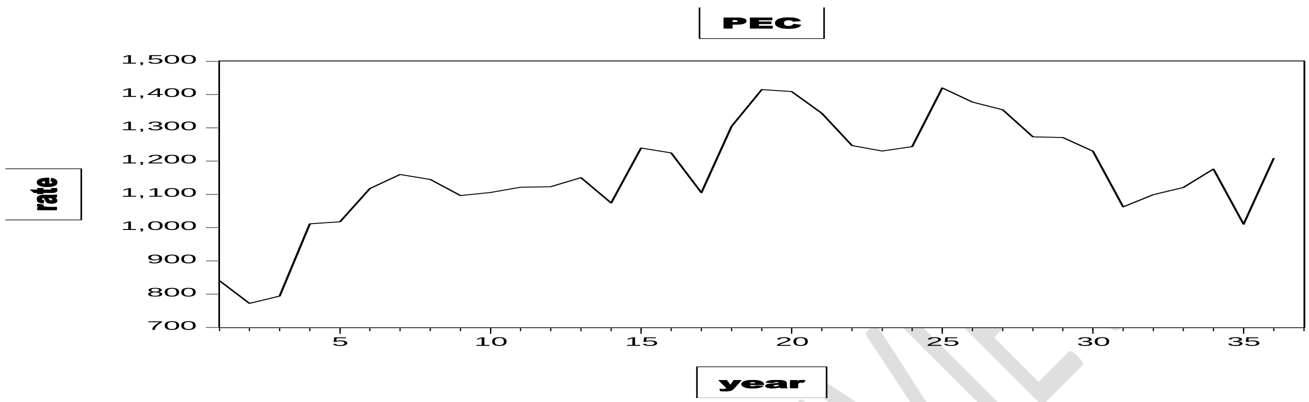

Figure 2: Trend of Petroleum Energy Consumption in Nigeria
Source:*Extract from Results of E-views 10.*

The trend of petroleum energy consumption shown in Figure 2 reveals that the petroleum energy consumption indicated an unsteady growth throughout the study period. However, there were peaks in the periods of 2010 and 2015. However, the trend has shown some signs of decline in the current period, probably due to increased availability of alternative energy use in the country.

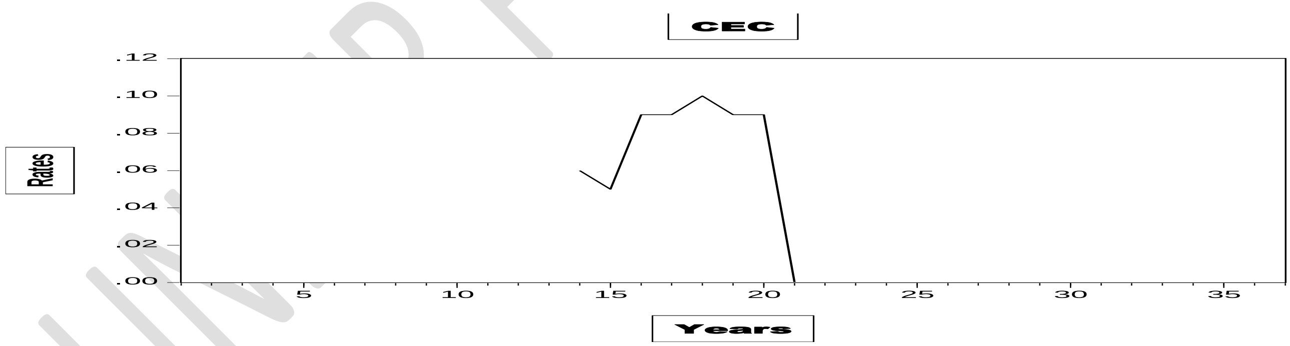

Figure 3: Trend of Coal Energy Consumption in Nigeria
Source:*Extract from Results of E-views 10.*

As shown in Figure 3, the trend of coal energy consumption in Nigeria revealed that coal energy consumption trailed at low ebb in the 1980s, with higher consumption rate oscillating around the period of 1995 and 2000. The trend has returned to near-zero since then.

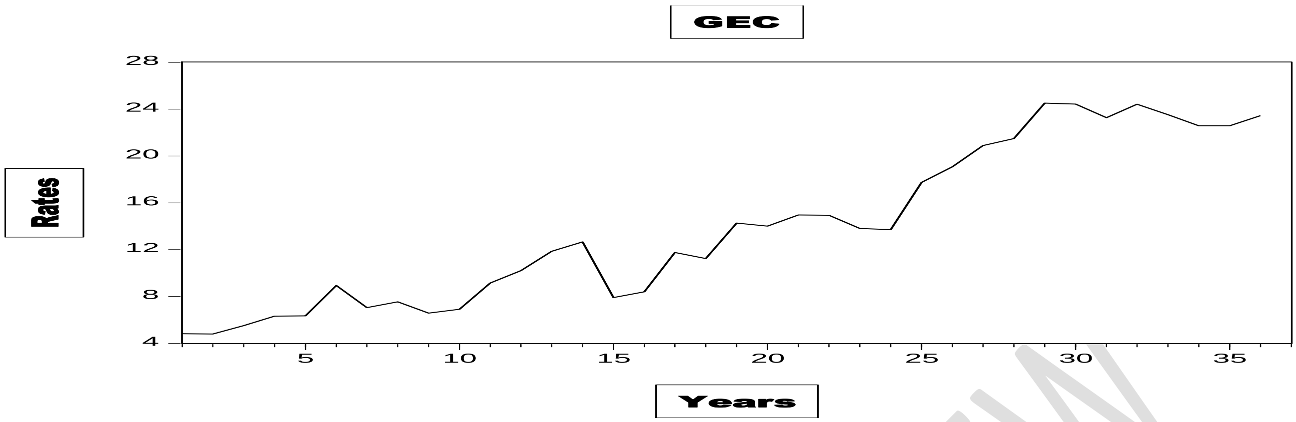

Figure 4: Trend of Gas Energy Consumption in Nigeria
Source:*Extract from Results of E-views 10.*

The result of gas energy consumption trend analyzed in Figure 4 shows that the gas energy consumption trend was low until the year 2000 when the Nigerian government returned to democratic rule from successive military regimes. The liquefied natural gas supply policies implemented by the democratic dispensation could be responsible for the rise in gas energy consumption rate.

Table 2: Summary of Phillips-Peron Unit Root Test

Variable	PP-Statistics Coefficient	Critical Value (5% or 0.05)	Order of Integration
TCO	-4.014878	-2.951125* (0.0038)	1(1)
CEC	-6.740150	-2.951125* (0.0000)	1(1)
PEC	-2.411601	-2.948404** (0.0160)	1(0)
GEC	-6.453213	-2.951125* (0.0000)	1(1)

Source: E-Views (10.0), Test with intercept and trend, ** significance at 1%, ** significance at 5%*

The findings from the Phillips-Perron unit root test in Table 2 indicated that Textile and clothing output (TCO), coal energy consumption (CEC) and gas energy consumption (PEC) were integrated at first difference,1(1) and significant at 0.05 level. The findings established that petroleum energy consumption (PEC) was found to be integrated at level,1(0). Interestingly however, the results show a mixture of 1(0) and 1(1) order of integration which implies that that the ARDL is the most appropriate technique for estimating the model.

Table 3: Summary of Bounds Cointegration Test

Test Statistic	Value	Signif.	I(0)	I(1)
F-statistic	2.905321	10%	2.37	3.2
K	3	5%	2.79	3.67
		2.5%	3.15	4.08
		1%	3.65	4.66

Source: E-Views (10.0)

The coefficients of the Bounds cointegration in Table 3 indicated that at K(3=2.905321), which means that the coefficient falls in-between the lower bound,1(0) and upper bound 1(1). Thus, based on the decision, the results are inconclusive. This necessitated the estimation of the short-run model.

Table 4: Summary of ARDL (2,0,3,0) Error Correction Regression

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(TCO(-1))	0.522729	0.122820	4.256042	0.0003
D(CEC)	-0.090996	0.159238	-0.571447	0.5730
D(PEC(-1))	0.210047	0.166738	1.259743	0.2199
D(PEC(-2))	0.365807	0.167616	2.182407	0.0391
CointEq(-1)*	-0.268239	0.065158	-4.116759	0.0004
R-squared	0.571100	Mean dependent var		23.47758
Adjusted R-squared	0.509829	S.D. dependent var		119.0826
S.E. of regression	83.37238	Akaike info criterion		11.82324
Sum squared resid	194626.7	Schwarz criterion		12.04998
Log likelihood	-190.0834	Hannan-Quinn criter.		11.89953
Durbin-Watson stat	1.929610			

Source: Eviews,(10.0)

The findings from the ARDL Error Correction Model in Table 4 indicated that contEq (-1) had an estimated coefficient of -0.268239 and p-value of 0.0004 which means p<0.05. This implies that whenever there is a disequilibrium in the model, the speed of adjustment from the disequilibrium due a shock back to a state of equilibrium is 27.83 percent. In order words, the model will adjust slowly back to its equilibrium position even if a disequilibrium occurs.

Table 5: Summary of Estimated ARDL (2,0,3,0) Regression Model

Variable	Coefficient	Std. Error	t-Statistic	Prob.*
*ln*TCO(-1)	1.254490	0.158465	7.916529	0.0000
*ln*TCO(-2)	-0.522729	0.163076	-3.205428	0.0038
*Ln*CEC(-1)	-6.665467	18.17424	-0.366754	0.7170
*Ln*CEC(-2)	-0.090996	0.226151	-0.402369	0.6910
*ln*PEC(-1)	-0.187146	0.227412	-0.822936	0.4186
*ln*PEC(-2)	0.155760	0.249206	0.625023	0.5379
*ln*PEC(-3)	-0.365807	0.207139	-1.765996	0.0901
*Ln*GEC	19.80158	6.699389	2.955729	0.0069
C	527.9457	346.9490	1.521681	0.1412
R-squared	0.967458	Mean dependent var		715.2191
Adjusted R-squared	0.956611	S.D. dependent var		432.3206
S.E. of regression	90.05246	Akaike info criterion		12.06566
Sum squared resid	194626.7	Schwarz criterion		12.47380
Log likelihood	-190.0834	Hannan-Quinn criter.		12.20299
F-statistic	89.18934	Durbin-Watson stat		1.929610
Prob(F-statistic)	0.000000			

Source: E-views 10.0

The results of the Estimated ARDL model in Table 5 revealed that the coefficient of textile and clothing and lag one, TCO (-1) had a coefficient of 1.254490 with a probability value of 0. 000. This implies that previous year output of textile and clothing was found to have significant positive effect on is current period output level. Similarly, it was found that TCO (-2) had a coefficient of -0.522729 and a p-value of 0.00038. This also means that two previous years textile and clothing output were found to have significant negative effect on the current output level of the sub-sector of the manufacturing sector in Nigeria. The results also revealed that coal energy consumption (CEC) had a coefficient of -6.665467 and a p-value of 0.7170, while petroleum energy consumption (PEC) had a coefficient of -0.090996 and a p-value of 0. 6910. This implies that CEC and PEC had no significant negative effect on textile and clothing output level. Furthermore, the findings revealed that gas energy consumption (GEC) had a coefficient of 19.80158 and a probability value of 0.0069 or $p<0.05$. This implies that gas energy consumption (GEC) was found to have significant positive effect on textile and clothing output in Nigeria.

The results revealed that adjusted R square had a coefficient of 0.956611, which means that that about 95.66 percent of the changes in the output of textile and clothing was due to changes in the consumption of hydro-electricity energy, petroleum energy and gas energy as forms of non-renewable energy required by the manufacturing sector of the Nigerian economy. The F-statistic had a coefficient of 89.18934, with a p-value of .000000 or $p<0.05$. The conclusion is that the estimated model was found to be significant at 0.05 level. In order words, the model estimated is reliable and can be use in the formulation and implementation of macroeconomic policy on non-renewable energy and textile and clothing output in Nigeria. The Durbin Watson (DW) coefficient of 1.929610 which is approximately 2 means that there was no evidence of serial correlation in the estimated model. It was also revealed from the analysis that the Akaike info criterion (AIC) is the most appropriate information criterion since it has the lowest coefficient.

Table 6: Model Robust Test

Statistic	Test	Coefficient	p-value	Decision
Breusch-Godfrey Serial Correlation	F-Stat.	0.905913	.4187	NoSerial Correlation
Heteroscedasticity	F-Stat.	1.498188	.2099	No Heteroscedasticity
Ramsey RESET	t-Stat.	1.419954	.1690	Linearity
	F-Stat.	2.016269	.1690	Linearity
Normality	JB	1.065009	.5871	Normal

Source: Eviews 10.0

The findings from the results of residual tests of model robustness revealed that the Breusch-Godfrey serial correlation F-statistic has a probability value of 0.4187 or p>0.05. Thus, the null hypothesis of the existence of serial correlation was rejected and the conclusion is that the model estimated is free from the problem of serial correlation. That is the covariance of the error term was absent and the model is not spurious. The Heteroscedasticity test revealed that the F-statistic has p>0.05(0.2099 which implies that the estimated model was not heteroscedastic. In order words, the homoscedastic principle exists in the estimated model. The conclusion is that the variance was found to be constant. Furthermore, the Ramsey RESET test revealed that both the t-statistic and the F-statistic had p>0.05 which means that the model was correctly specified in line with the linearity principle. The Jacque-Bera test of normality revealed that the null hypothesis of normality was accepted since p>0.05; hence the conclusion that the distribution of the data used was found to be normal.

4. Discussion of Findings

The study found that coal energy has not contributed much to the output level of textile and clothing sub-sector of the manufacturing industry. This suggests that coal is no longer an important energy resource in Nigeria as it has no remarkable contribution of the growth of key sectors like textile and clothing in the coutry. This finding agrees with the view of Nwachukwu, Ezedinma, and Jiburun (2014) that coal supply in the country has been erratic and epileptic, thus resulting in frequent power outages that have impaired economic growth and development. The results ARDL regression model also revealed that coal energy consumption (CEC) had a coefficient of -6.665467 and a p-value of 0.7170. Thus, $p>0.05$; hence the null hypothesis was accepted and the conclusion was that coal energy consumption had significant negative effect on the output level of textile and clothing sub-sector of the economy. Abdulkari and Isik (2020) study also found a negative and insignificant relationship between coal consumption and industrial growth. While, Oyeyemi (2018) that reported that electricity generated and premium motor spirit have a positive impact on industrial output growth in Nigeria but with high cost of production. Also, the result indicated that a unit increase in hydro-electricity energy consumption leads to an insignificant 6.67 unit decrease in the output level of textile and clothing output in Nigeria. Also,Yahaya, Salisu and Uma (2015) in their study on Nigerian firms found that 93.9% of the firms described coal as their major problem while 97.4% of the firms have their private generators. This also means that the effect of coal energy on textile output was found to be insignificant and negative because the estimated t-statistic was found to be insignificant at 0.05 level. Asaleye *et'al*., (2018) opined that Nigerian manufacturing companies spent about 40 per cent of the production overhead on coal leading to increase cost of operation and prices of goods made in Nigeria when compared with prices of similar goods from other countries.

The study found that petroleum energy consumption has not contributed significantly to the output level of textile and clothing sub-sector of the manufacturing industry. This insignificant effect of petroleum on textile output could be linked to the findings of Nwabueze, Joel and Nwaozuzu (2022) who reported that petroleum energy is bedeviled by a lot of challenges, including the recurrent severe shortages in the supply of petroleum products largely due to failing refineries, corruption and geopolitical conflicts in the Niger Delta area. Ogunjobi (2015) pointed out that available statistics indicate that the industrial sector seems to be experiencing slow growth and one of the factors responsible to a considerable extent for this slow growth despite the policies and incentives is poor energy consumption..

Another finding of the study is that gas energy consumption has contributed significantly to the output level of textile and clothing sub-sector of the manufacturing industry. This suggests that gas energy is an important source of energy used to enhance the growth of manufacturing sector output in Nigeria. The findings contradicted those of Dada (2019) who found that energy generation from gas, hydro and oil and coal have negative effect on industrial output in the short run. Based on this, the null hypothesis was rejected and the conclusion drawn is that gas energy consumption had a significant positive effect on textile and clothing output in Nigeria. Oyeyemi (2018) also reported found a unidirectional causality of Granger Causality test runs from gas consumption to industrial output growth suggests that gas consumption has significant effect on manufacturing sector output. Furthermore, it was found that a unit increase in gas energy consumption leads to 19.80 unit increase in the output level of textile and clothing manufacturing sub-sector of the Nigerian economy.

5. Conclusion and Policy Recommendations

The contribution of non-renewable energy on the manufacturing sector in Nigeria has remain a debating issue. The study was therefore, conducted to find out its effect, particularly on including textile and clothing output. The conclusion of the study is that non-renewable energy has effect on textile and clothing output of the manufacturing sector in Nigeria. Based on the findings of the study and the conclusion drawn, the following are the policy recommendations among others that should be implemented:

i. The policy thrust on manufacturing sector output in Nigeria should be anchored on parameters that are different from coal energy. Alternative energy sources, particularly renewable sources should therefore, be explored by the federal ministry of petroleum for enhanced economic growth, particularly of textile and clothing subsector.
ii. Government should partner with Private Sector to invest more resources on the exploration and exploitation of petroleum resources and revamp existing refineries so as to ensure constant supply of petroleum products so that the textile sub-sector of the manufacturing sector will have access to the products for higher output.
iii. Government should Legislate Laws to devolve power to States to ensure that energy generation and distribution is increase through greater investment in form of increasing the availability of modern and functional gas plant in the country since it was found that gas energy consumption has significant positive effect on textile and clothing output in Nigeria.

References

Adamu, A. & Darma, M., (2016). Inland natural gas consumption and real economic growth. *Journal of Economics and Sustainable Development, 7*(8),183-206

Amadi, C., Amadi, N. N., & Anyim, E. (2013). Analysis of energy balance on Nigeria's economic growth: Evidence on electricity sector. *Report and Opinion*, 5(10),8-14 http://www.sciencepub.net/report.

Aremu, I. (2015). *Reflections on industry and economy*. Lagos: Malhouse Press Limited

Asaleye, A.J., Lawal, A.I., Inegbedion, H.I., Oladipo, A.O., Owolabi, A.O., Samuel, O. M., & Igbolekwu, S.O.(2021). Electricity consumption and manufacturing sector performance: Evidence from Nigeria. *International Journal of Energy Economics and Policy, 11*(4), 195-201

Awodumia, O.B., & Adewuyib,A.O.(2019).The role of non-renewable energy consumption in economic growth and carbon emission: Evidence from oil producing economies in Africa. *Energy Strategy Reviews,1*(1),1-20

Bick, R., Halsey, E.,& Ekenga, C. (2018). The global injustice of fast fashion. *Environmental Health, 17*, 1-4. doi: 10.1186/s12940-018-0433-7

Central Bank of Nigeria (2018). *Statistical Bulletin: Annual report and statement of accounts*. *https://www.cbn.gov.ng/documents/statbulletin.asp*

Central Bank of Nigeria (2019). Central bank of Nigeria Annual Statistical Bulletin, 30, 1981-2019.https://www.cbn.gov.ng/Out/2020/STD/2019%20Statistical%20Bulletin_Real%20S ector_Final%20e_Copy.xlsx.

Dada, J.T. (2019). Energy generation and industrial output in Nigeria. *Indian Journal of Economics,396*(C),33-44

Edet., E.E.,Henry,J.T.,Efefiom,E.C.,Nyiputen,I.R., & Bassey,E.B. (2022).Electricity supply and manufacturing sector output in Nigeria . *Energy Economics Letters,9*(10),44-54

Elijah, U., & Nsikak, J. (2013). *Energy requirements and industrial growth in Nigeria: An ARDL approach. Nigeria*. Proceedings of the NAEE/ AEE Conference on energy resource management in a Federal System, challenges, constraint, and strategies.

Eniayo, I. (2018). Solving Nigeria's electricity crisis through alternative energy sources. *Africa in Fact: The Journal of Good Governance Africa,2*(1)13-17

Haseeb, M., Kot, S.,Hussain, H.I., Mihardjo, L.W.W.,& Saługa ,P.(2020).Modelling the Non- linear energy Intensity effect based on a quantile-on-quantile approach: The case of textiles manufacturing in Asian Countries. *Energies, 13,* 1-9. doi:10.3390/en13092229

Henry, J. T., Ndem, B. E., Ujong, O. L., & Ihuoma, C. M. (2021). Electric power deficit and economic growth in Nigeria: A sectoral analysis. *International Journal of Energy Economics and Policy, 11*(6), 508-516.Available at: https://doi.org/10.32479/ijeep.11491

Iwashokun, A. F. (2019). *Energy sector development and manufacturing output in Nigeria from 1981*-2016 (Master's Thesis),Obafemi Awolowo University, Ile-Ife-Nigeria

Johnson, S., Echeverria, D., &Venditti, R. (2020). Supply chain of waste cotton recycling and reuse: A review. *AATCC Journal of Research*, *7,*19-31. doi: 10.14504/ajr.7.S1.3

Kassim, F., & Isik, A.(2020). *Impact of energy consumption on industrial growth in a transition economy: Evidence from Nigeria*. https://mpra.ub.uni-muenchen.de/101757/MPRA Paper No. 101757

Koszewska, M. (2018). Circular economy - challenges for the textile and clothing industry. *AUTEX Research Journal*, *18,* 337-347. doi: 10.1515/aut-2018-0023

KPMG. (2021). *Nigeria's electricity supply industry highlights: Power sector watch*, *edition 2021-Q4.* Retrieved from: https://assets.kpmg/content/dam/kpmg/ng/pdf/power-sector- watch-edition-2021-q4-for- upload.pdf.

Kwode, D. (2015). Taxation rates, revenue and economic growth. *International Journal of Accounting and Taxation*, *6*(3),142-153

Lawal, E., & Owoicho, E. (2021). Impact of electricity consumption on manufacturing output in Nigeria. *Salem Journal of Business and Economy, 7*(7), 11-21. *Journal of Economics and SustainableDevelopment,7*(6),154-163.

Muhammad, M.,Buba,R., Agboola,Y.H.,& Lola,G.K. (2018).Disaggregate energy supply and industrial output in Nigeria. *International Journal of Economics, Business and Management Research,2*(2),154-172

National Bureau of Statistics (2014). *Nigerian manufacturing sector: Summary report for 2010- 2012.* Abuja: NBS

Nwogwugwu,U.C.C.,Metu, A.G., & Ihugba, O.A.(2021).Do disaggregated manufacturing sectors matter in Nigeria's economic growth: VECM approach. *Journal of Economics and International Finance,13*(2),85-99

Ogunjobi, J.O. (2015). The effect of electricity consumption on industrial growth in Nigeria. *Journal of Economics and Sustainable Development, 6(*18), 54-59

Olarinde, M.O., & Omojolaibi,J.A. (2014). Electricity consumption, institutions, and economic growth in Nigeria. *Journal of Economics and Sustainable Development*, *5*(12), 40-55.

Olufemi, O. J. (2015). The effects of electricity consumption on industrial growth in Nigeria. *Journal of Economics and Sustainable Development, 6*(13), 54-59.

Onwe, J. C., & King, O. (2020). Electricity consumption and manufacturing sector output in Nigeria: Evidence from ARDL approach. *Energy Economics Letters, 7*(2), 110- 117.Available at: https://doi.org/10.18488/journal.82.2020.72.110.117

Romer P (1986). Increasing returns and long-run growth. Journal of Political Economy 94(5),1002-1037.

Snoek, S.(2017). *Circular economy in the textile industry: Transition theory in Dutch start-ups towards a circular economy* (Published MSc Thesis), climate studies, environmental policy group.

Wibisono, A.B.B.,(2022).*Energy efficiency analysis of the textile industry in Indonesia* (Unpublished Master Dissertation), Escola Tècnica Superior d'Enginyeria Industrial de Barcelona

World Bank. (2020). *World Bank sustainable energy: World Bank International energy agency and energy sector management assistance* *program.*Washington, D.C.USA: World Bank https://www.data.worldbank.org/indicator/EG.ELC.ACCS.ZS

World Bank. (2021a). *World development indicators-Nigeria*. Retrieved from: http://data.worldbank.org/data-catalog/world-development-indicators.

World Bank. (2021b). Nigeria to improve electricity access and services to citizens. World Bank Press Release, No. 2021/088/AFR (2021).

Yahaya, Y., Salisu, B. M., & Uma, B. (2015). Electricity supply and manufacturing output in Nigeria: Autoregressive distributed lag (ARDL) bound testing approach. *Journal of Economics and Sustainable Development* , *6*(17),30-35

Yakubu, Y., Manu, S. B., & Bala, U. (2015). Electricity supply and manufacturing output in Nigeria: Autoregressive distributed lag (ARDL) bound testing approach. *Journal of Economics and Sustainable Development*,*6*(17),67-73