Energy Consumption, Carbon Emission and Economic Growth in Nigeria: Implications for Energy Policy and Climate Protection in Nigeria

[1]Saibu, Muibi Olufemi and [2]Jaiyeola Afeez Olalekan

***Abstract*—**The paper analyses causal effect of oil production and carbon emission from gas flaring on the growth rate in Nigeria between 1970 and 2011. The result revealed that economic growth rate, change in crude oil production growth rate, crude oil production growth rate, crude oil consumption growth rate, consumption growth rate, change in growth rate of carbon monoxide emission from gas flaring, growth rate of carbon monoxide emission from gas flaring and change in investment growth rate, investment growth rate are significant factors influencing economic growth in Nigeria. Therefore, this study concludes that there is causal relationship between oil production, carbon emission from gas flaring and economic growth in Nigeria. More importantly carbon emission constitutes an impediment to sustainable economic growth in Nigeria.

***Keywords*—** Carbon Emission, Environmental Quality and economic Growth.

I. Introduction

OVER the past century, every economy has seen economic growth as one of the principle objectives to be achieved in the macroeconomic stabilization policy area. Kuznets (1973) defined economic growth as a long-term rise in capacity to supply increasingly diverse economic goods to its population, this growing capacity based on advancing technology and the institutional and ideological adjustments that it demands. Also, economic growth as the steady process by which the productive capacity of the economy is increased over time to bring about rising levels of national output and income (Todaro, 2005). Moreover, it has been the only medium anticipated against poverty eradication, more often than not facing the developing countries. For instance, an economy agitating to achieve a desired growth rate over a particular period, such economy must have the basic resources like energy and other natural resources. In order to make economic development sustainable, resources such as energy supply must be available and utilized in such a way that there is enough for the present generation as well as the upcoming generation. Energy consumption is the total amount of energy that is spent by industries (plants and machineries, office equipments) and households (appliances) in an economy. The amount of energy used per industry depend on machineries, climate etc. while household depends on the standard of living, climate, age and type of residence etc(Mahesi, 2012) and this energy consumption is driven by such important factors as industrialization, extensive urbanization, population growth, rising standard of living and even the modernization of the agricultural sector.. In order to reduce energy consumption, many developed countries have embrace different energy conservation strategies to curtail their energy usage which are still absent in most developing countries.

Today, energy has been the heart of most critical economic, environmental and developmental issues in the global world which has also contributed significantly to climate degradation through carbon emission- a gas in the atmosphere causing radiation within the environment. The issue of whether energy consumption has positive, negative or neutral impact on economic activities has interest among different economists, scholars and policy analysts. Consequently, there is need to find out the impact and direction of causality between energy consumption and economic growth (Eddine, 2009). Olatinwo and Adewunmi (2012) advocated that clean, efficient, affordable, sustainable and reliable energy services are indispensable for global prosperity. In Nigeria, Nnaji (2008) also opined that energy efficiency and energy conservation are two important things that must be tackled if ever the country is going to solve energy consumption problems. Energy efficiency can be defined as a way of using less energy supply to provide the same service needs or required while energy conservation is a mean of reducing or going without a service in order to save energy like turn in off a bulb

Almost all electrical and electronic appliances manufactured today have an energy efficient alternative based on greater efficiencies in the power conversion. In particular, greater use of information and communication technologies (ICTs) marks a worldwide transition toward a digital society that may profoundly affect energy consumption. For instance, the cathode ray tube type of a computer system usually takes at least 250 wolts of electricity every hour, alternative, an

[1] Senior Lecture in Department of Economics, University of Lagos, and Postdoctoral Fellow in University of Johannesburg, omosaibu@yahoo.com, fsaibu@uj.ac.za, +27847592847(corresponding Author)
[2] Postgraduate Student, Department of Economics, Faculty of Social Sciences, University of Lagos, Akoka-Yaba, Lagos, Nigeria adesanya56@yahoo.com, +234 (0) 703 449 2687.

Liquid crystal display type takes as low as 36 wolts of electricity per hour to perform the same function. Also, the recent energy saving bulb 10 of 10W energy saving bulbs will require just 100W compared to 10 of 60W bulbs requiring at least 600W per hour to perform the same function even more efficient. Thus, it is therefore paramount to ensure the environment conservation from carbon emission that holds these vital natural (energy) resources.

Policy and research interests have grown on the link between energy consumption, economic and carbon emission and there is general contention on causal relationship among energy consumption, carbon emission and a country's output growth. However, energy-growth-environmental pollution nexus has continued to receive greater attention in the contemporary energy economics research and literature. The first impetus of this study was the concern over energy price rises, the finite nature of key energy resources and the presumed importance of providing energy to facilitate the development process. The second momentum considers the environmental consequences of energy use testing the causality between energy use and income making references to the widespread concern about climate change i.e. the relationship between carbon emission and income is now seemingly of greater important (Jumbe, 2004; Oderinde & Oladele, 2011; Mahedi, 2012 and Olatinwo & Adewunmi, 2012). The aim of this paper is to examine in addition to the casual relationship between energy consumption, economic growth and carbon emission, the impact of energy consumption and carbon emission on the growth rate in the Nigerian economy. Examining such relationship and impact is germane to designing appropriate energy policy and development sustainable green economy for the the country.

Apart from this introduction, the remaining part of the paper is organized as follows: Section 2 review some salient studies in the literature and identified a empirical gap this paper attempts to fill. Section 3 provides the methodological approach adopted and the definition of variables used. It also attempt to provide an explanation of analytical approach adopted and sources of data used for the analysis. Section 4 discusses the empirical results and section 5 concludes with policy implications.

II. Environmental Quality/Economic Growth Nexus: Empirical review

The pioneering studies examining the nexus between carbon emission or environmental quality and economic growth studies have focused on environmental pollutants and economic growth nexus, which are closely related to testing the validity of the so called Environmental Kuznets Curve (EKC) hypothesis, which postulates an inverted U-shaped relationship between per capita income and environmental degradation in the long run (Akbostanci, Turut-Asik & Tunc, 2009; Diao,Zeng, Taim & Tam, 2009 and He and Richard, 2010). The second strand is related to energy consumption and economic growth nexus (Mehrara, 2007; Olusegun, 2008; Akinlo, 2009 and Esso, 2010). Akpan et al (2012) opined that a marriage of the different thoughts of study (Environmental Kuznet Curve hypothesis and Energy-growth nexus) in which the relationship among oil production, economic growth and carbon emissions from gas flaring are examined under a multivariate framework has formed a relatively new area of research. Nearly every studies that have focused on these two thoughts for both the developed countries (Ang, 2007; Apergis and Payne, 2009; Ozturk and Acaravci, 2010, etc) and developing countries (e.g. Jumbe, 2004; Menyah and Wolde-Rufael, 2010) have returned conflicting and mixed results. Empirical evidence from similar studies in Nigeria are at best scanty. Akpan et al (2012) opined that Akinlo (2009)'s study suffered from short span of data set (1980-2006) which was based on a bi-variate analysis between electricity consumption and economic growth rather than on an integrated framework within the energy-growth-emission framework. He associated the likely problem from the study as the loss in power associated with the small sample size and the issue of omitted variable bias.

Other studies similar studies on Nigeria l(ike Olusegun, 2008 and Odularo and Okwonkwo, 2009). The weaknesses identified with these studies reiterate the need for further research in this area. For instance, one of the pioneering studies in this area, Ebohon (1996) investigated the causal relationship between energy consumption and economic growth nexus which is not country specific cited by Akpan etal (2012). Therefore, the problem of false generalization cannot be ruled out. The study by Odularu and Okonkwo (2009) is limited to the long run relationship between the energy consumption and economic growth. Furthermore, studies by Omotor (2008) and Olusegun (2008) investigated the causality and long run relationship between energy consumption and economic growth, the work of Olusegun (2008) is particularly noteworthy as it is one of the first to apply the ARDL bounds test approach to cointegration cited by Akpan etal (2012). However, Apan et al (2012) contemplated on the authors' omission of coal consumption as one of his respective independent variables. Oderinde and Ishola (2011) did a modern-day work to cover this deficiency by taking into consideration labour, capital, primary exports (oil and agricultural products) to complement the energy-growth model . This study therefore intends to fill this space in the literature. Pesaran, Shin & Smith (2001), Olusegun (2008), Akinlo (2009), Bekhet & Yusop (2009), Odularo & Okwonkwo (2009), Esso (2010), Pradhan (2010) and Oderinde & Ishola (2011) adopted dynamic version of the energy-growth model for empirical analysis such as Auto-regressive Distributed Lag (ARDL) bounds testing, cointegration and Error Correction Model (ECM), vector error correction (VECM) while Akpan et al (2012) adopted Granger causality test. This study made a narrative attempt to adopt a dynamic methodology of the form of Granger causality and dynamic regression model to examine the dynamic effect of oil production, and carbon emission from gas flaring on economic growth in Nigeria and further employ the inter-dependence variance auto regression (VAR) framework to establish the economic growth response of external and internal carbon emission which serves as the methodological rationale for the study. Therefore this paper contributes to this growing empirical studies on Nigeria.

III. Empirical Methodology

Two different but not mutual exclusive approaches have been adopted in the literature in tracing the nexus between energy consumption and economic growth. First, regression approach (Pachauri, 1977), where there is little attention to direction of causality and second, causality approach (Odhiambo, 2009; Bowden and Payne, 2009; Yuan et al. 2008), where there is high stress on the direction of causality. This paper attempt to combine the two approaches they can be netted within the Autoregressive Distributed Lag (ARDL) bounds testing framework and Granger causality test adopted in this paper. The central issue in the causal relationship between economic growth and energy consumption has been whether economic growth stimulates energy consumption or is energy consumption itself a stimulus for economic growth via indirect channels of effective aggregate demand, improved overall efficiency and technological progress (Ghosh and Basu, 2006).

There are two related hypotheses on the nexus between energy consumption and economic growth: energy - led-growth hypothesis and growth- led- energy hypothesis. The investigation of these two hypotheses is well established in the development literature, yet the outcomes remain inconsistent and controversial. Pradhan had attributed the controversy over the results from the existing studies to various structural frameworks and policies followed by different countries under different conditions and time periods. Apergis and Payne (2009), Balat (2008), Chiou-Wei et al., (2008), Lee and Chang (2007,2008), Mahadevan and Asafu- Adjaye, (2007); Hatemi-J and Irandoust, (2005) attributed the controversy to differences in methodology, various proxies for energy consumption and growth, presence of omitted variables, varying energy consumption patterns, etc. Of all these shortcoming, the omitted variable is the most critical error among all others as it impedes the ability to determine the indirect channels through which the either energy consumption or economic growth impacted on each other when causality was not established between them. In order to capture the causality relationship between oil price, energy consumption, investment and real economic growth and to account for possible feedback effects from the short run fluctuations to the long run steady state of the relationship between the key variables, the model is expressed in the form that allows for the testing of both unit root and cointegration. Therefore, the granger causality test is done using the models below;

$$RGDP = f(OLP, CEGF, OLC, INVEST) \tag{1}$$

Mathematically, it can be logarithmical expressed in three models in order to follow the hypothesis formulated above as thus:

$$InRGDP_t = \alpha_0 + \beta_4 OLP_t + \mu_t \tag{2}$$

$$InRGDP_t = \alpha_0 + \beta_1 InCEGF_t + \mu_t \tag{3}$$

$$InRGDP_t = \alpha_0 + \beta_1 InOLP_t + \beta_2 InCEGF_t + \beta_3 InOLC_t + \beta_4 InINVEST_t + \mu_t \tag{4}$$

Where; RGDP = Real gross domestic product;*OLP* = Oil production; *CEGF* = Carbon emission from gas flaring; *OLC* = Oil consumption; *INVEST* = Investment; $\alpha_0 =$ Intercept; $\beta_{1-4} =$ Slope or regression parameters; and$\mu =$ Stochastic term.

The model revealed that first and second lag of RGDP growth rate [DRG(-1) & DRG(-2)]; change in crude oil production growth rate (DOLPG), first and second lag of crude oil production growth rate [DOLPG(-1) & DOLPG(-2)]; change in crude oil consumption growth rate (DOLCG), first lag of crude oil consumption growth rate DOLCG(-1), change in growth rate of carbon monoxide emission from gas flaring (DCO2G), first and second lag of growth rate of carbon monoxide emission from gas flaring [DCO2G(-1) & DCO2(-2)] and change in investment growth rate (DINVTG), first and second lag of investment growth rate [DINVTG(-1) & DINVTG(-2)] are the only significant factors influencing economic growth proxied by change in RGDP growth rate (DRG). Therefore, this study rejects the null hypotheses and concludes that there is causal relationship between oil production, carbon emission from gas flaring and economic growth in Nigeria between the period of a decade after independence from colonial rule and 2011 fiscal year.

A. Data Description and Analytical Technique

Data and methodological description for the econometric analysis of the relationship among energy consumption, carbon emission and growth rate in Nigeria between 1970 and 2011 are adopted. The time frame for the analysis is chosen based on availability of data from various sources. The data sourced for the analysis of this study are presented and employed to estimate the multiple regression model specified in the previous section. To examine the empirical relationship between carbon emission, energy consumption and economic growth in nigeria. The model designed for this research or study is the multiple regression equation. The model predicts the relationship between the dependent variable (RGDP) and independent variables ("OLP", "CEGF", "OLC" and "INVEST"). This study made a narrative attempt to adopt a dynamic methodology of the form of Granger causality and dynamic regression model to examine the dynamic effect of oil production, and carbon emission from gas flaring on economic growth in Nigeria and further employ the two step granger cointegration test framework to establish the economic growth response of external and internal carbon emission which serves as the methodological rationale for the study

The model is estimated using the Central Bank of Nigeria Statistical Bulletin, Volume 22, 2011; World Development Index, 2012 and International Energy Agency (IEA) publications for the period of 42 years (1970 – 2011).

IV. Empirical Results and Discussion

A. Unit Root Tests

The first and prime step of the nexus between energy consumption, carbon emission and economic growth requires that all the variables should be integrated of same order, specifically, I(I). The ADF unit-root test is deployed for investigating the same since it was observed that the variables were not stationary at level, the log difference of the variables were then examined and the estimated results of these variables are reported in Table I. The test result indicated that the time series variables, change of real gross domestic product growth rate (Δrg), change of crude oil production growth rate ($\Delta olpg$), change of crude oil consumption ($\Delta olcg$), change in growth rate of Carbon Monoxide Emission from Gas Flaring ($\Delta C02g$), and change in investment growth rate ($\Delta invtg$) were found to be stationary after the first difference and hence there are series of order one (I(I).

TABLE I
ADF Unit Root Test Results

Variable	ADF Tau Statistics		Order of Integration
	Intercept	**Linear Trend**	
Δrg	-7.7438*(1) [-3.6156]	-7.6760*(1) [-4.2191]	1
$\Delta olpg$	-5.7002*(3) [-3.6268]	-5.6156*(3) [-4.2350]	1
$\Delta olcg$	-5.1342*(4) [-5.1342]	-4.9951*(4) [-4.2436]	1
$\Delta C02g$	-8.6359*(0) [-3.6105]	-8.5399*(0) [-4.2119]	1
$\Delta invtg$	-9.7901*(0) [-3.6145]	-9.6422*(0) [-4.2119]	1

Note: * significant at 1%; Mackinnon critical values and are shown in parenthesis. The lagged numbers shown in brackets are selected using the minimum Schwarz and Akaike Information criteria

B. Cointegration Test

In carry out the cointegration test, equation 3 was estimated using ordinary least square techniques and the residual from this equation was tested for unit roots. And the results of the both long run OLS model and the unit root tests on the residual are presented in table II and IV respectively. The estimated error term ($ect_t = \hat{u}_t$) extracted from the estimated long run model reject the null hypothesis "no stationary", which implies the null hypothesis "no cointegration" is rejected for intercept and linear deterministic models at 1% McKinnon critical value as shown in Table III. This implies that there is long-run relationship among change of real gross domestic product growth rate (Δrg), change of crude oil production growth rate ($\Delta olpg$), change of crude oil consumption ($\Delta olcg$), change in growth rate of Carbon Monoxide Emission from Gas Flaring ($\Delta C02g$), and change in investment growth rate ($\Delta invtg$) in Nigeria between 1970 and 2011.

C. Granger-Causality Test Results

The third step involves the estimation of the Granger-Causality test. The causality between economic growth and crude oil production proxies from a decade after independence and 2011 are shown in Table IV. The results indicated that the null hypotheses "change in investment growth rate ($\Delta invtg$) does not granger cause change of real gross domestic product growth rate (Δrg)"; and "change in investment growth rate ($\Delta invtg$) does not granger cause change of crude oil consumption ($\Delta olcg$)" at 10% significant level. This indicates that change in investment growth rate ($\Delta invtg$) granger cause changes in real GDP growth rate (Δrg) and investment growth rate($\Delta invtg$).

Also, the null hypotheses "change in growth rate of Carbon Monoxide Emission from Gas Flaring ($\Delta C02g$) does not granger cause change of crude oil production growth rate ($\Delta olpg$)"; and "change of crude oil production growth rate ($\Delta olpg$) does not granger cause change in growth rate of Carbon Monoxide Emission from Gas Flaring ($\Delta C02g$)" at 10% and 5% significant level respectively. This indicated that there is bi-causal relationship between change in growth rate of Carbon Monoxide Emission from Gas Flaring ($\Delta C02g$) and change of crude oil production growth rate ($\Delta olpg$).

TABLE II
ESTIMATED REGRESSION RESULTS

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-0.036	0.046	-0.789	0.439
DRG(-1)	-0.691	0.164	-4.216**	0.000
DRG(-2)	-0.436	0.179	-2.431*	0.024
DRG(-3)	-0.252	0.165	-1.524	0.143
DOLPG	-0.160	0.077	-2.086*	0.034
DOLPG(-1)	-0.617	0.297	-2.077*	0.040
DOLPG(-2)	-0.628	0.080	-7.801**	0.000
DOLCG	-0.114	0.053	-2.151	0.033
DOLCG(-1)	0.076	0.027	2.822*	0.016
DOLCG(-2)	0.326	0.680	-0.480	0.636
DCO2G	0.750	0.313	2.400*	0.025
DCO2G(-1)	0.443	0.157	2.822*	0.016
DCO2G(-2)	0.251	0.116	2.168*	0.031
DINVTG	-0.006	0.003	-1.963*	0.050
DINVTG(-1)	-0.121	0.036	-3.332*	0.004
DINVTG(-2)	0.189	0.031	6.034**	0.000
R-squared	0.86251	S.D. dependent var		0.278124
Adjusted R-squared	0.818589	F-statistic		22.1221
Durbin-Watson stat	1.824953	Prob(F-statistic)		0.005569

***Source**: Extracted from the result appendix*

TABLE III
ARDL COINTEGRATION TEST RESULTS (INTERCEPT MODEL)

Null Hypothesis: No Cointegration (Intercept Model)

Exogenous: Constant and Lag Length: 0 (Automatic - based on SIC, maxlag=9)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-5.802866	0.0000
Test critical values:	1% level	-3.626784	
	5% level	-2.945842	
	10% level	-2.611531	

*MacKinnon (1996) one-sided p-values.

TABLE IV
GRANGER-CAUSALITY TEST RESULTS

Pairwise Granger Causality Tests

Null Hypothesis:	Obs	F-Statistic	Prob.
DOLPG does not Granger Cause DRG	39	0.58844	0.4480
DRG does not Granger Cause DOLPG		0.03927	0.8440
DOLCG does not Granger Cause DRG	39	0.75605	0.3903
DRG does not Granger Cause DOLCG		0.21198	0.6480
DCO2G does not Granger Cause DRG	39	0.03897	0.8446
DRG does not Granger Cause DCO2G		0.24377	0.6245

DINVTG does not Granger Cause DRG	39	3.55365	0.0675
DRG does not Granger Cause DINVTG		1.76833	0.1920
DOLCG does not Granger Cause DOLPG	39	2.57916	0.1170
DOLPG does not Granger Cause DOLCG		0.06500	0.8002
DCO2G does not Granger Cause DOLPG	39	3.11579	0.0860
DOLPG does not Granger Cause DCO2G		6.50360	0.0152
DINVTG does not Granger Cause DOLPG	39	0.20215	0.6557
DOLPG does not Granger Cause DINVTG		0.03696	0.8486
DCO2G does not Granger Cause DOLCG	39	0.91850	0.3443
DOLCG does not Granger Cause DCO2G		0.01032	0.9197
DINVTG does not Granger Cause DOLCG	39	3.29949	0.0776
DOLCG does not Granger Cause DINVTG		0.79254	0.3792
DINVTG does not Granger Cause DCO2G	39	0.75206	0.3916
DCO2G does not Granger Cause DINVTG		1.39954	0.2446

V. Conclusion and Recommendations

The paper analyses causal effect of oil production and carbon emission from gas flaring on the growth rate in Nigeria between 1970 and 2011. The result revealed that economic growth rate, change in crude oil production growth rate, crude oil production growth rate, crude oil consumption growth rate, consumption growth rate, change in growth rate of carbon monoxide emission from gas flaring, growth rate of carbon monoxide emission from gas flaring and change in investment growth rate, investment growth rate are significant factors influencing economic growth in Nigeria. Therefore, this study concludes that there is causal relationship between oil production, carbon emission from gas flaring and economic growth in Nigeria. More importantly carbon emission constitutes an impediment to sustainable economic growth in Nigeria. In addition, the oil production and carbon emission has great effect on the Nigerian economic growth as theoretically pointed by previous studies that physical and chemical work from oil production performed by energy has historically been a very important driver of economic growth (Kummel, Kroeger & Eichhorn, 2001; Ayres, Ayres & Warr, 2002; Ayres, 2004 and Ayres & Warr, 2010). Also, the study found support for the assertion economic growth causes increase in resource use and create more negative externalities than providing solution to environmental problems (Kamande, 2010, Yusuf, Yahya & Nasisu, 2011; Oderinde and Isola, 2011 and Akpan et al, 2012). This influence of oil production is seen but not yet to be felt significantly by many citizens in the case of Nigeria as the results showed mixed impact.

Considering the observed nature of the effect of oil production and carbon emission from gas flaring on the growth rate of the national output in Nigeria during the period under

study the strategic policy options are proffered as follows: there is need to have one or a single energy regulator, hence the need to re-align, harmonise existing structures-organisation, management and policies on Energy. The policy on energy supply and demand planning should be drawn based on a long term view of the direction of a country over a minimum period of 100 years. The ultimate goal is to supply adequate energy to support growth and development of the economy from viable sources and to have a one-stop shop that assesses what infrastructure is necessary for such to happen that can lead to industrial development. Thus, there is a need to have central coordination for planning of sources of energy supply and for managing demand in Nigeria, from the current dispersed supervisory authorities. Furthermore the country do not need to sacrifice economic growth to decrease their emission levels as they may achieve CO2 emissions reduction via energy conservation without negative long-run effects on economic growth; and the government should integrate emissions regulation with economic development policies.

References

[1] Akpan, G. E. and Apkan, U. F. (2012). Electricity Consumption, Carbon Emissions and Economic Growth in Nigeria. International Journal of Energy Economics and Policy, 2(4), pp. 293-308.

[2] Arnulf, G. (1990). The Rise and Fall of Infrastructures. Retrieved from http://www.iiasa.ac.at/Admin/PUB/Documents/XB-90-704.pdf

[3] Ayres, R. U., Ayres, L. W. and Warr, B. (2002). Energy, Power and Work in the U. S. Economy 1900-1998, Insead's Center For the Management of Environmental Resources, 2002/52/EPS/CMER Retrieved from http://flora.insead.edu/fichiersti_wp/inseadwp 2002/2002-52.pdf

[4] Ayres, R. U. and Warr, B. (2004). Accounting for Growth: The Role of Physical Work. Retrieved from http://www.abundancedebunked.com/downloads/Ayres-TheRoleOfPhysicalWork.pdf

[5] Ayres, R. U. and Warr, B. (2006). Economic Growth, Technological Progress and Energy Use in the United State Over the Last Century: Identifying Common Trends and Structural Change in Macroeconomic Time Series, Retrieved from http://www.helsinki.fi/iehc2006/papers2/Warr.pdf

[6] Ayres, R. U. and Warr, B. (2009). The Economic Growth Engine: How Useful Work creates Material Prosperity.

[7] Ayres, R. and Warr, B. (2010). The Economic Growth Engine: How Energy and Work Drive Material Prosperity (The International Institute for Applied Systems Analysis). Edward Elgar Publishing; Reprint Edition.

[8] Beaudreau, B. C. (1996). Mass Production, the Stock Market Crash and the Great Depression. New York, Lincoln, Shanghi: Authors Choice Press.

[9] Dalton, M., O'Neill, B., Prskawetz, A., Jiang, L. and Pitkin, J. (2008). Population Aging and Future Carbon Emissions in the United States. Energy Economics 30, pp. 642-675.

[10] Dantama, Y. U., Abdulahi, Y. Z. and Inuwa, N. (2012). Energy Consumption - Economic Growth Nexus in Nigeria: An Empirical Assessment Based on ARDL Bound Test Approach. European Scientific Journal, 8(12), pp. 141-158.

[11] Environment Protection Agency (2012). Climate Change: Greenhouse Gas Emission. Retrieved from http://www.epa.gov/climatechange/ghgemissions/gases/co2.html

[12] Fischer, R. A., Byerlee, E. and Edmeades, E. O.(2000). "Can Technology Deliver on the Yield Challenge to 2050".

[13] Masuduzzaman (2012). Electricity Consumption and Economic Growth in Bangladesh: Co-Integration and Causality Analysis. Global Journal of Management and Business Research, Vol. 12(11), pp. 47-56.

[14] Pesaran, M. H. And Shin, Y. (1999). "An Autoregressive Distributed Lag Modelling Approach to Cointegration Analysis," In Strom S. (ed.), Econometrics and Economics Theory in the Twentieth Century, the Ragner Frisch Centenial Symposium. Cambridge, Cambridge University Press.. Avoid using *above* ("the above method," "mentioned above," etc.) or *below* (in the figure below). Be specific.