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Energy Consumption, Energy Price, Energy Intensity Environmental Degradation, and Economic Growth Nexus in African OPEC Countries: Evidence from Simultaneous Equations Models

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Abstract

This paper investigated the causal relationships among environmental degradation, energy consumption, energy price, energy intensity, and economic growth using simultaneous-equations models with panel data of OPEC African countries from 1970 through 2018. The study used second-generation techniques to analyse the stationarity and co-integration relationship among the variables. The empirical results of the research showed that there exists a bidirectional causal relationship between energy consumption and economic growth; and energy prices and economic growth; and environmental degradation and economic growth. Moreover, the result revealed a unidirectional causal relationship running from economic growth to energy intensity. Nevertheless, the findings show a unidirectional causality from energy consumption to energy intensity with no effect of feedback, and there exists a bidirectional causal relationship between energy prices and energy intensity; between environmental degradation and energy intensity; and between environmental degradation and energy prices for all OPEC African countries. The study recommended that energy policies should identify the dissimilarities in the causal linkages between economic growth and energy consumption to retain sustainable energy consumption in OPEC African countries.

Keywords: Energy Consumption, Economic Growth, Energy Intensity, Energy Price, Simultaneous-Equations Models

1 Introduction

For a decade, Africa had undergone a steady growth with at an average 5 percent annual increase in GDP following many global crises. There are seven out of the world's ten fastest-growing economies in Africa. This fast growth results in higher interest accrued to Africa and turns its image from a region of civil wars, chaos, and poverty into a region of optimism and trade and prosperity. In this study, we believe that one major issue associated with this explosive growth involves energy and contributes to the research by exploring the significance of energy concerning Africa's economic growth. In reality, energy usage promotes economic chances, lowers travel costs, and upgrades the industrial sector contributing to urban transformation (21). Energy has indeed been strongly linked to economic growth because energy is an essential input in the cumulative output process. Therefore, the relationship between economic growth and energy policy is generally considered to be close. The scope for reform in the energy growth axis, however, will influence a country's optimal energy policy. Energy saving in the manufacturing, farming, retail, and housing industries may be a priority if it helps to reduce energy bills, products and services costs, and greenhouse gas emissions. Energy-Saving strategies will lead to a better allocation of resources by moving labour and capital from the sector of energy to a more productive sector.

Nonetheless, if a country's output is heavily dependent on oil, energy conservation policies will restrict economic growth. Policymakers, therefore, need to learn the causal relationship between energy consumption economic growth. Four theories have embodied the causal relationship between energy consumption and economic growth (7), (3). The demand theory suggests that energy usage explicitly and as a supplement to labour and capital has an essential impact on the cycle of economic growth (2). If one-way causality is identified between energy usage and economic growth, the theory of growth is

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supported. In this case, the energy dependency on the economic performance of the relevant country is so strong that fluctuations in the supply of energy would adversely affect economic growth. Throughout the context of the growth hypothesis, the policies of energy-saving can adversely affect economic growth. Well into the situation of the growth model, so as a universality relationship between power and capital has been believed, the impact of technological innovations on energy efficiency can be so strong in the long run that it leads to a decline in the energy reliance of the productive process as capital usage increases.

2 Literature Review

The 1971 fall of the Bretton Woods system and the 1973 first oil shocks threatened some of the conventional macroeconomic structures, such as the distribution process. Nonetheless, a global recession preceded the sudden increase in oil prices due to the oil embargo concerning the Organization of Petroleum Exporting Countries (OPEC). Several ground-breaking studies were conducted during this period (5, 6, 9, 16 and 22) to investigate the correlation between oil price shocks and economic activity to test whether the reported depression (the 1970s) was due to the 1973 oil shock. (18) is the most influential paper in this field; he argued that oil price increases were at least partially responsible for every post-second world war US recession except the one in 1960.

The above-mentioned ground-breaking experiments were linked to the US economy in contrast to (18). These studies have identified a relationship between US economic growth and oil price movement. After these studies, a large number of studies were conducted in various areas. Therefore, this study examined the causal relationships among energy price, energy intensity, energy consumption, and economic growth using simultaneous-equations models with panel data of OPEC African countries.

However, (17) investigated the causality relationship between trade openness, economic growth, and energy consumption. A panel data analysis of Asian countries was used, with the application of panel VECM, FMOLS, and DOLS. The inference was drawn about the co-integration between economic growth, trade openness, and energy consumption. While the FMOLS and DOLS estimation analysis reveal a positive relationship between energy consumption and income growth, energy consumption and trade openness, whereas an inverse relationship between energy consumption and energy prices is observed. Similarly, to examine the effects of Trade Openness, Energy Consumption and Economic Growth Relationship in Iran. (14) applied Bayer and Hanck co-integration test, Vector Error Correction Model. The findings of this study show the presence of co-integration amongst the variables. The causality result showed a unidirectional relationship in the short run from energy consumption to trade openness. Meanwhile, the long-run relationship test showed the bidirectional causality between economic growth and energy consumption, and between openness and energy usage, also a unidirectional causality from openness to economic growth was recorded.

Seeing as how the developed countries have experienced rapid industrialization, economic development, and growth as a result of heavy energy use for industrial and other economic activities, it all seems and indicates that developing countries will employ the same development models. As per the United Nations (3). Oil, coal, and gas has driven the industrialization of the country but have also made a tremendous contribution to economic development and social well-fare. As such, power-related emissions of carbon dioxide lead to about 2 over 3 of global emissions CO_2. The overall amount of carbon emission due to the energy sector keeps rising as the global economy grows. Nevertheless, it challenges the quest for environmental protection and viable economic growth, which is given as crucial to the globe's long-term ambitions for economic and social development as a whole. Such developments eventually lead to different arguments about the importance of the rise in energy consumption, especially from non-renewable origins to developing nations ' growth. When part of climate change mitigation and environmental pollution strategies, initiatives also call for the replacement of non-renewable energy sources with renewable energy. Empirical research of the interaction among environmental degradation and economic growth in developing economies is therefore crucial to their short and long-run energy policies.

Likewise, (6) relate energy consumption, carbon dioxide emissions, and economic growth using the South African economy. The study of (5) combined co-integration approach, (20) bounds test and Kripfganz and Schneider causality test. The result indicated that a one-way causality existed from energy use to economic growth, which validates the energy-led growth hypothesis. Consequently, (23) found the relationship between electricity use, real gross domestic product per capita, and carbon emission in Zimbabwe. The study applied Zivot-Andrews, Maki co-integration, DOLS, and Toda-Yamamoto causality test. There exists a long-run positive relationship between electricity consumption and real growth domestic product per capita, also a one-way causality existed and running from electricity consumption to the growth.

3 Acknowledgment Econometric Methodology and Results

3.1 Data and Descriptive Statistics

The study used yearly that covers the period of 1970–2018. Gross Domestic Product growth as a proxy for Economic growth, Energy Prices were calculated as a ration of Energy Consumption (kg of oil equivalent per capita), Energy Intensity (MJ/$2011 PPP GDP), and environmental degredation (CO_2 emission per capita metric ton) were collected from World Bank (2019) world development indicators and Average annual West Texas Intermediate (WTI) crude oil price (in U.S. dollars per barrel) and Consumer Price Index (1) was collected from OECD (2019) database. The trade openness, hibernation, foreign direct investment, and financial development are the control variables in this study and were sourced from World Bank (2019) world development indicators. This study used the Solow development model, which was first demonstrated by Mankiw, (17) on the eve of Islam's (1995) in the panel data study. Consider the Cobb-Douglas growth model as follow:

Where, is the output, is the capital is the labour force; meanwhile, are (7), (14), (16), and (17), Hence, the current study extends the equation (1) above by including energy consumption, energy prices, and energy intensity, the following functional form:

$$Y_{it} = W_{it}^{\varphi}(K_{it}L_{it})^{1-b} \tag{1}$$

Where, Y_{it} is the output, K_t is the capital L_t is the labour force; meanwhile, W_t Are (17), (19), (24), and (4). Hence, the current study extends the equation (1) above by including energy consumption, energy prices, and energy intensity, the following functional form:

$$LNRGDP_{it} = f(LNEC_{it}, LNEP_{it}, LNEI_{it}, LNCO2_{it}) \quad (2)$$

This study will transform all the variables into natural logarithms to capture their elasticity value and set them free from the problem of heteroscedasticity. The functional relationship between energy consumption, energy prices, energy intensity, and economic growth can be represented as follows:

$$LNRGDP_{it} = \theta_0 + \vartheta_1\, LNEC_{it} + \vartheta_2\, LNEP_{it} + \vartheta_3\, LNEI_{it} + \vartheta_3\, LNCO2_{it} + \varepsilon_{it} \quad (3)$$

Where $LNRGDP_{it}$ indicated the natural logarithms of real gross domestic product, $LNEC_{it}$ indicated the natural logarithms of Energy Consumption, $LNEP_{it}$ indicated the natural logarithms of Energy Prices, $LNEI_{it}$ indicated the natural logarithms of Energy Intensity, $LNCO2_{it}$ indicated the natural logarithms of envronmental degradation, and is the error term with the presumption that it has a normal distribution with zero mean and predictable variance. The following tables, 1, represented the descriptive and correlation analysis of the variables. The results showed that the values of Kurtosis and Skewness show a lack of symmetric in the distribution. In general, if the values of Kurtosis and Skewness are 0 and three, respectively, the observed distribution is assumed to be normally distributed. Also, if the Skewness Coefficient is in a surfeit of unity, it is measured relatively excessive, and a low (high) Kurtosis value reveals excessive platykurtic (extreme leptokurtic). This showed that the frequency distributions are not normal. The results of the correlation matrix show that economic growth decrease along with the energy prices and energy intensity, while energy consumption, however, increases economic growth in the African OPEC economies.

3.2 Testing slope homogeneity Testing the cross-sectional dependency/ Second Generation Panel Unit Root Test

The second issue in data analysis for the panel is determining whether the slope parameters are heterogeneous or not. A robust null hypothesis is a causality from one variable to another by imposing the joint restriction on the whole panel (Granger, 2003). Besides, the parameter homogeneity assumption is not capable of capturing heterogeneity due to specific characteristics of the region (Breitung, 2005). Also, after the slope of homogeneity is the relationship dependency test. Cross-section dependency must be tested once proceeding for further steps. Otherwise, outcomes may be bias and contradictory (Breusch and Pagan, 1980; Pesaran, 2004). Therefore, the presence of cross-section dependence in the series and the equation of co-integration should be checked before further studies.

Table 1: Descriptive and Correlation Analysis

	LNGDP	LNEU	LNEP	LNEI	LNCO2	LNFD	LNPOP	LNTOP	LNFDI
Mean	1.425	6.766	1.733	1.465	19.07	2.525	0.986	3.733	4.342
Std. Dev.	1.056	0.682	1.628	0.444	2.260	0.728	0.365	0.585	0.481
Skewness	-0.220	0.242	4.741	0.293	-0.913	-0.093	-0.992	-0.421	-0.321
Kurtosis	5.356	2.161	25.46	2.527	3.709	2.810	5.534	4.158	2.658
LNGDP	1.000								
LNEU	0.045 (0.398)	1.000							
LNEP	-0.171* (0.001)	-0.177* (0.001)	1.000						
LNEI	-0.101 (0.061)	0.078 (0.146)	0.018 (0.729)	1.000					
LNCO2	0.045 (0.403)	0.109** (0.044)	-0.140* (0.009)	0.078 (0.148)	1.000				
LNFD	-0.143* (0.008)	0.135** (0.012)	-0.082 (0.128)	-0.001 (0.982)	-0.413* (0.000)	1.000			
LNPOP	-0.145* (0.007)	-0.258* (0.000)	0.164* (0.002)	-0.036 (0.503)	-0.159** (0.003)	-0.128** (0.018)	1.000		
LNTOP	0.230* (0.000)	(0.145*) (0.007)	-0.308* (0.000)	-0.223* (0.000)	0.172* (0.001)	0.007 (0.892)	-0.063 (0.243)	1.000	
LNFDI	0.445* (0.000)	0.144630 0.0073	-0.219* (0.000)	-0.332* (0.000)	0.218* (0.000)	0.388* (0.000)	-0.346* (0.000)	-0.222* (0.000)	1.000

The presence of cross-sectional dependence between countries is tested through the (6) LM test when the time dimension exceeds the cross-sectional dimension. (24) has improved this test if the time dimension is smaller than the cross-section dimension, and the time dimension is larger than the cross-section continuum. If the average group is zero, this test is biased, but the average individual is distinct from zero. In the last step to know the stationarities' property of the variables, the panel unit root test must be taken.

There are two groups of panel unit root tests developed in the literature. The first group includes first-generation unit root tests that ignore cross-sectional dependence, while the second group contains second-generation unit root tests that allow for cross-sectional dependence (8) and (18). There are various methods for the panel unit root test. This study chooses two-second generation panel unit root tests such as CIPS test, and CADF test. The table below showed the results of each test. As can be seen from Table 2 below, since the probability values of series and co-integration equations are smaller than 0.05, H0 hypotheses are firmly rejected, and it has been decided that there is cross-sectional dependency among these countries. This revealed a significant change in the series in one of the countries also affects the others.

Therefore, while the decision-makers in these countries set their policies, they should take into consideration to policies of the other countries and the other external factors. Furthermore, since cross-section dependency determined, while choosing the unit root and co-integration tests method, this situation should be taken into account. Therefore, panel unit root tests and co-integration analysis considering the cross-section dependency have also been used. Results in Table 2 showed that series are non-stationary at levels but become stationary at first differences; they are said to the of the first order, *I(1)*. In this case, it has been concluded that the existence of a co-integration relationship between these series can be tested since series under consideration are integrated of the same order.

3.3 Larsson et al. (2001) Cointegration Test

This method employs this study to estimate the cointegration between the variables. The (14) method is equivalents Johansen's (1988) methodology within a panel error correction model (VECM) framework. It has some advantages over the residual-based test cointegration, such as(6) (9). The (14) procedure allows for more than one cointegration vector, but (10) assumes only one cointegrating vector. (14) consider testing for cointegration under the assumption that: for …., N the null hypothesis is for …N against the alternative hypothesis that for a non-vanishing fraction of cross-section members. This test statistic is parallel to that of (20) and is known by a cantered and scaled version of the cross-sectional average of the individual trace statistics. Denotes the trace statistic for the null hypothesis of a k-dimensional cointegrating space for the unit where the superscript s indicates the specification of the deterministic components. Using the central limit theorem in the cross-sectional dimension and the appropriate mean and variance correction factors imply that under the null hypothesis:

$$LLL^S\left({}^k/_x\right) = \frac{\sqrt{N^2 \sum_{i=1}^{N}\left(LR_i^v\left({}^k/_x\right) - E(LR_i^v\left({}^k/_x\right)\right)}}{\sqrt{Var\left(LR_i^v\left({}^k/_x\right)\right)}} \to N(0,1) \qquad (4)$$

In the serial limit $Q \to \infty$ tailed by $N \to \infty$. $E(LR_i{}^v\left(\frac{K}{x}\right))$ and $Var(LR_i{}^v(\frac{K}{x})\,))$ denote mean and variance of the asymptotic trace statistics respectively found from a stochastic simulation (Johansen, 1995). For $Q \to \infty$ the expressions $E(LR_i{}^v\left(\frac{K}{x}\right))$ and $Var(LR_i{}^v(\frac{K}{x})\,))$ converge to the limit of the expected value and variance of the trace statistic, respectively, equivalent to the case v deliberated. For each country in the panel, the null hypothesis, $r = 0$, is tested using the observed trace statistic. If the null hypothesis experienced, then the null hypothesis, $r = 1$, is tested. This serial testing technique ends when the null hypothesis, $r = r_i$is not rejected, which determines the rank evaluation of r. For determining the panel trace test, the statistic $LR_i{}^v\left(\frac{K}{x}\right)$, as noted in Eq. (4), is obtained by standardising the average of the N countries' trace statistics. If cointegration is present, the procedure allows one to test whether the cointegrating vector is homogeneous across countries.

Table 2: Cross-sectional Dependency Test, Testing of Slope Homogeneity and Second Generation Panel Unit Root Test

Variables	CD	CIPS Level	CIPS First Difference	CADF Level	CADF First Difference
LNGDP	11.1*	-1.710	-6.183*	-2.035	-5.816*
LNEC	5.91*	-2.156	-6.183*	-1.874	-5.100*
LNEP	-2.93*	-0,460	-3.887*	-1.985	-8.343*
LNEI	7.19*	-1.046	-5.685*	-1.459	-4.174*
LNCO2	8.10*	-0.013	-5.333*	-2.131	-6.211*
Test of Homogeneity					
LM	39.51*				
LM adj*	9.546*				
LM CD*	6.876*				

Table 3: Larsson's Heterogeneous Panel Cointegration

Countries	r=0	P values	r=1	P values	r=2	P values	r=3	P values
ALGERIA	51.57*	0.021	26.03	0.127	10.51	0.243	0.863	0.352
ANGOLA	78.79*	0.000	19.78	0.438	4.99	0.809	0.169	0.681
CONGO	43.05	0.131	24.48	0.180	8.770	0.387	0.061	0.803
GABON	36.21	0.385	16.77	0.656	5.808	0.718	0.458	0.498
GUINEA	54.09**	0.011	20.43	0.393	3.788	0.919	0.650	0.420
LIBYA	95.09*	0.000	44.51*	0.000	20.25*	0.008	1.869	0.171
NIGERIA	52.20**	0.019	18.25	0.547	6.078	0.686	0.193	0.660
LR_NT	58.72*	-	24.32	-	8.601	-	0.609	-
LR_TEST	12.19	-	4.98	-	2.064	-	-0.939	-
E(Z_k)	27.73	-	14.96	-	6.068	-	1.137	-
Var(Z_k)	45.264	-	24.73	-	10.54	-	2.212	-
N	7.000		7.000		7.000		7.000	

The results from the (14) cointegration test for African OPEC countries were reported in Table 3 above. Since the test follows a standard normal distribution, its 1%, 5%, and 10% critical values are 58.72. The results suggested one cointegrating vector between energy consumption, energy prices, energy intensity, and economic growth at the 5% level of significance. Compared with the Pedroni tests, (14) co-integration test provide stronger evidence of cointegration. Therefore, the panel rank (LR) test results reject the null hypothesis of no cointegration among the variables. Given the presence of panel cointegration with one cointegrating vector, the null hypothesis of a similar co-integrating vector is tested. A panel of Table 3 revealed that the null of homogeneous cointegrating vectors is rejected as the test statistic, 58.72, exceeds the critical value of 43.964. Hence, the LLL (2001) panel test for co-integration indicates an average rank, r=0, between energy consumption, energy prices, energy intensity, and economic growth. Therefore, this result is suggesting that the determinants understudy contributed to the development of African OPEC economies. This result is consistent with the previous studies of (16).

3.4 Simultaneous Equations Causality Test

(11) developed the non-causality test in heterogeneous panel data models with fixed coefficients. In the structure of a linear autoregressive data generating procedure, the augmentation of standard causality tests to panel data suggests testing cross-sectional linear restriction on the coefficients of the model. The utilisation of cross-sectional data may broaden the data set on causality from an offered variable to another. The Simultaneous Equation Causality Test Estimates are:

$$LNRGDP_{it} = \theta_0 + \vartheta_1\, LNEC_{it} + \vartheta_2\, LNEP_{it} + \vartheta_3\, LNEI_{it} + \vartheta_4 LNURB_{it} + \vartheta_5 LNCO2_{it} + \varepsilon_{it} \tag{4}$$

$$LNEC_{it} = \theta_0 + \vartheta_1\, LNGDP_{it} + \vartheta_2\, LNEP_{it} + \vartheta_3\, LNEI_{it} + \vartheta_4 LNTOP_{it} + \varepsilon_{it} \tag{5}$$

$$LNEP_{it} = \theta_0 + \vartheta_1\, LNGDP_{it} + \vartheta_2\, LNEC_{it} + \vartheta_3\, LNEI_{it} + \vartheta_3 LNFD_{it} + \varepsilon_{it} \tag{6}$$

$$LNEI_{it} = \theta_0 + \vartheta_1\, LNGDP_{it} + \vartheta_2\, LNEC_{it} + \vartheta_3\, LNEP_{it} + \vartheta_3 LNFDI_{it} + \varepsilon_{it} \tag{7}$$

$$LNCO2_{it} = \theta_0 + \vartheta_1\, LNGDP_{it} + \vartheta_2\, LNEC_{it} + \vartheta_3\, LNEP_{it} + \vartheta_4 LNEI_{it} + \varepsilon_{it} \tag{8}$$

The simultaneous causality results in Table 4 below revealed bidirectional running from energy consumption to economic growth, energy prices to economic growth, from environmental degradation to economic growth,. Also, the result showed a unidirectional causal relationship running from energy intensity to economic growth, and from energy consumption to environmental degradtion. Furthermore, the finding indicated that energy prices and energy intensity, environmental degradtion and energy intensity, environmental degradtion and energy price have a bi-direction causal relationship. However, there is no causal relationship between energy consumption and energy intensity. The findings supported the energy-led growth hypothesis and in line with (5) and (15).

4 Conclusion and Policy Implications

The present study investigates the five-way linkages between energy consumption, energy prices, energy intensity, environmental degradtion, and economic growth using the Cobb–Douglas production function. While the literature on the causality links between emissions-energy-growth has increased over the last few years, no study examines this interrelationship via the simultaneous equation models. The objective of the present study is to fill this research gap by examining the above interaction for 7 African OPEC countries over the period 1970-2018. Our results suggest that energy consumption and energy prices enhance economic growth. This shows a bi-directional effect. Thereby rejecting the neo-classical assumption that energy is neutral for growth. This pattern is similar to the findings of Oh and (19), (7), (17), and (2).

Thus, we conclude that energy is a determinant factor of the GDP growth in these countries, and, therefore, a high level of economic growth leads to a high level of energy demand and vice versa. As such, it is essential to take into account their possible adverse effects on economic growth in establishing energy conservation policies.

Table 4: Simultaneous Equations Causality Results

	LNEC −/→ LNGDP	*LNEC ←/− LNGDP*
Z-Statistics	-3.42*	4.50*
P-value	0.001	0.000
	LNEP −/→ LNGDP	*LNEP ←/− LNGDP*
Z-Statistics	3.81*	-3.91*
P-value	0.000	0.000
	LNEI −/→ LNGDP	*LNEI ←/− LNGDP*
Z-Statistics	1.47	3.19*
P-value	0.142	0.000
	LNEC −/→ LNEP	*LNEC ←/− LNEP*
Z-Statistics	3.45*	3.292*
P-value	0.000	0.000
	LNEC −/→ LNEI	*LNEC ←/− LNEI*
Z-Statistics	0.490	3.88*
P-value	0.624	0.000
	LNEI −/→ LNEP	*LNEI ←/− LNEP*
Z-Statistics	3.59*	2.01**
P-value	0.000	0.044
	$LNCO_2$ −/→ *LNGDP*	$LNCO_2$ ←/− *LNGDP*
Z-Statistics	-6.54*	7.11*
P-value	0.000	0.000
	$LNCO_2$ −/→ *LNEC*	$LNCO_2$ ←/− *LNEC*
Z-Statistics	-0.33*	5.98*
P-value	0.743	0.000
	$LNCO_2$ −/→ *LNEP*	$LNCO_2$ −/→ *LNEP*
Z-Statistics	-7.76*	4.78*
P-value	0.000	0.000
	$LNCO_2$ −/→ *LNEI*	$LNCO_2$ −/→ *LNEI*
Z-Statistics	-5.15*	7.64*
P-value	0.000	0.000

Our empirical results also show that there is a unidirectional causal relationship from energy consumption to energy intensity without feedback. This implies that due to the expansion of production, the countries are consuming more energy, which puts pressure on the environment leading to more emissions. Hence, it is essential to apply some sorts of pollution control actions to the whole panel regarding energy consumption.

It is found that bidirectional causality between economic growth and energy intensity emissions implies that degradation of the environment has a causal impact on economic growth, and a persistent decline in environmental quality may exert a negative externality to the economy through affecting human health, and thereby it may reduce productivity in the long run. The main policy implications emerging from our study are: First, these countries need to embrace more energy conservation policies to reduce energy intensity emissions and consider strict environmental and energy policies. The research and investment in clean energy should be an integral part of the process of controlling carbon dioxide emissions and find sources of energy to oil alternatives. These countries can use solar energy as a substitute for oil. Thus, implementing energy and environmental policies and also reconsidering strict energy policies can control carbon dioxide emissions. As a result, our environment will be free from pollution, and millions of peoples can protect themselves from the effects of natural disasters. Second, high economic growth gives rise to environmental degrading, but the reduction in economic growth will increase unemployment.

The policies with which to tackle environmental pollutants require the identification of some priorities to reduce the initial costs and efficiency of investments. Reducing energy demand, increasing both energy supply investment and energy efficiency can be initiated with no damaging impact on the African OPEC's economic growth and therefore reduce emissions. At the same time, efforts must be made to encourage industries to adopt new technologies to minimise pollution. Finally, given the generous subsidies for energy in the exporting countries, relatively there is more scope for more drastic energy conservation measures with not much effects on economic growth in these countries. Indeed, it is unlikely that the elimination of energy price distortions restrains economic growth in the oil-exporting countries. However, subsidy reform should for in a reform program that engenders broad support and yields widespread benefits.

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