

Harnessing the Impact of Energy Conservation in Rescuing Nigeria from Economic Crisis

¹Sunday Adeniyi Adeyemo, **Abstract**

²Veronica Folasade Titilayo

Babajide, & ³Eniola

Habeebat Adetela

^{1,2&3}Department of Science

Education,

Faculty of Education, University of

Lagos

Article DOI:

10.48028/iiprds/esjprcd.v12.i1.05

Keywords:

Energy,

Conservation, Crisis,

Economy, Nigeria

Corresponding Author:

Sunday Adeniyi Adeyemo

In the context of Nigeria's economic crisis, characterized by inflation, unemployment, and environmental degradation, particularly worsened by climate change. This study explores the potential of harnessing the laws of conservative energy to address these complex challenges. The intertwining gaps of waste generation, unsustainable environmental policies, and limited scientific research exacerbate Nigeria's economic challenges and environmental degradation. The principles of conservation of energy and mass provided a conceptual framework, which recognizes that energy cannot be created nor destroyed but can be transformed from one form to another; therefore, developing effective waste management strategies and promoting sustainable development practices. 56 science and 44 non-science students were randomly selected to participate in a mixed research approach that included semi-structured interviews, questionnaires, and case studies as instruments. The data collected for the econometric modelling were analysed using T-test. Results showed that male students had more awareness of the concept of energy conservation than their female counterparts, however, the difference in their levels of awareness is found to be statistically insignificant. Insufficient financing and lack of willingness as major obstacle to energy conservation implementation. This study proposes policy reforms, diversification of energy sources, increased investment, and collaboration in eco-friendly innovations to promote Nigeria's comprehensive approach to economic sustainability and environmental stewardship.

Background to the Study

Since its emergence in the United States in the years 2008-2009, the economic crisis has been a recurrent phenomenon for research and discussion due to its multifaceted effects globally and locally (Ngwube & Ogbuagu, 2014, p.2). The phenomenon spans different nations manifesting in diverse progressive forms, depending on the individual country's cyclicality, economic growth and declines (Slusarczyk & Sowa, 2017, p.42) and impinging upon socio-economic proclivity and evaluation of prevailing economic paradigms (Slusarczyk & Sowa, 2017, p.42). Within the Nigerian economic context, it has demonstrated much vulnerability impeding sustainable development trajectory and goals based on a nexus of determinants. Nigeria's over-dependency on crude oil, adopted by its flourishing population dynamics, unemployment, governance maladies, inflation, climate change and environmental degradation constitutes pivotal determinants underpinning its economic crisis. These underpinnings pose a great challenge in achieving 13 of 17 sustainable development goals in Nigeria including no poverty (1), no hunger (2), good health and well-being (3), clean water and sanitation (6), affordable and clean energy (7), decent work and economic growth (8), industry, innovation and infrastructure (9), sustainable cities and communities (11), responsible consumption and production (12), climate action (14), life below water (14), and life on land (15). To begin with, the ratio of the country's population to its employment opportunities and standard of living is severely imbalanced leading to poverty and unsustainable development goals. Similarly, the petroleum sector in Nigeria accounts for 80% of the national revenue and foreign exchange earnings, alienating any possibility of exploiting other resources for revenue generation and limiting the establishment of other industries in the Nigerian economic system (Ngwube & Ogbuagu, 2014, p.2).

Adebite (2014) contends that achieving a positive climate change is indispensable for fostering sustainable development. However, despite this imperative, Nigeria grapples with entrenched behavioural patterns and ecological impacts stemming from poverty-driven activities. These activities, including crude oil theft, illegal pipeline breakage, deforestation, oil spillage, illegal oil bunkering, and environmental degradation, collectively contribute to the deterioration of the planet's health and ecosystem. Consequently, these detrimental practices perpetuate a cycle of regressive development leading to unsustainable goals within the Nigerian context. Ihimodu (1986) presents solutions to the crisis stemming from Nigeria's over-reliance on crude oil and gas, acknowledging the persistence of the crisis despite previous attempts to address it. He divides the solutions into short-term and long-term measures, aiming to prevent future recurrences and address immediate challenges. Similarly, Omotor (2011) advocates for diversifying the Nigerian economy away from oil and gas dependence, boosting sectors like agriculture, minimizing inflationary fiscal and monetary policies, and resolving power supply failures. On the other hand, Emovon et al. (2018) identify low power generation, caused by inadequate plant maintenance, outdated equipment, and gas pipeline vandalism, as a key factor in Nigeria's economic stagnation. They propose a structured maintenance methodology and increased funding as solutions. Despite the relevance of these solutions, they have failed to adequately mitigate the crisis. Therefore, this research aims to build upon previous studies, identifying their gaps and offering new insights into addressing the issue from a physicist's perspective. This perspective emphasizes

the adoption of the Law of Conservation of Energy to manage the crisis effectively, mitigate climate change, and achieve sustainable development goals.

Various researchers have delved into the causes and consequences of the economic and energy crises in Nigeria. Kennedy-Darling et al. (2008) outlines the complexity of Nigeria's energy crisis, suggesting strategies to mitigate its effects. Olatunji et al. (2018) emphasise the hindrance posed by power sector challenges to Nigeria's development and economic prosperity, advocating for renewable energy sources as a solution. Oyedepo (2012) explores efficient energy utilization for sustainable economic development, while Oyedepo (2013) discusses energy consumption patterns and ways to enhance efficiency across industries. Umbu and Agada (2022) propose legal reforms for a democratized energy system, while Somoye (2023) presents possible factors responsible for the energy crisis in Nigeria recommending renewable energy sources and policy improvements. However, despite these insights, none of the studies anchored solutions using the Laws of Energy Conservation or provided actionable strategies and policies to address the economic crisis effectively.

Statement of Problem

Given Nigeria's abundant resources, burgeoning population, and diverse energy options, the pressing challenges posed by the economic crisis demand urgent attention. Despite the plethora of proposed solutions by various researchers, these challenges persist unabated. Therefore, this study seeks to address these persistent gaps by proposing an integrative solution that amalgamates principles from physics and economic strategies to effectively mitigate the crisis.

Purpose of Study

The purpose of this study is to harness the laws of conservation of energy to address the economic crisis in Nigeria. Specifically, the research aims to satisfy the following;

- i. To determine student's level of energy conservation awareness.
- ii. To unravel the barriers to energy conservation in Nigeria.
- iii. To harness the probable impact of these energy sources to Nigerian economy

Research Questions

- i. What are the viable sources of energy in Nigeria?
- ii. What factors impede the advancement of Nigeria's economic system, especially renewable energy?
- iii. How can these resources be conserved through the application of the Law of Conservation of Energy and actionable economic strategies to foster sustainable development?

Expected Outcome

Based on the data analysis using Multiple Correlation table, we expect to find a significant relationship between Using the Law of Conservation of Energy and the economic crisis in Nigeria. We anticipate that certain energy conservation strategies will positively impact economic indicators, thereby providing a potential solution to the economic crisis in the country.

Theoretical Framework

The law of conservation of energy, a principle from physics, posits that energy can neither be created nor destroyed but can be transformed from one form to another (Albert Einstein 1905). This theoretical framework leverages this concept symbolically to understand and address and proffer solutions to economic crisis in Nigeria. Applying the law of conservation of energy as a theoretical framework for addressing economic crises in Nigeria emphasizes efficient resource use, sustainability, economic transformation, human capital development, strong institutions, and resilience. By drawing these parallels, policymakers can create holistic strategies that drive long-term economic growth and stability. This framework highlights the relationship between economic factors and the need for sustainable, effective and all-inclusive approaches to address economic challenges. The application of the Law of Conservation of Energy in this research helps to identify viable energy in Nigeria, and how these sources of energy can be conserved or converted from one form to another through recycling. Such sources of energy can be converted in various forms, for instance, electrical to mechanical to product; steam to mechanical to electrical to product; wind to turbine to mechanical to electrical energy; or water/oil hydraulic to conserve steam to produce tyres and plastic. To highlight and discuss the factors that impede the conservation of these sources of energy to foster sustainable development and economic growth, this research employed the Energy-Economy-Environment model (E3). This model helps to identify the aggregate and disaggregated variables to be considered in this paper. The aggregate variables consider the analysis of macroeconomic indicators like inflation rate, Gross Domestic Product, Unemployment rate, Government Budget, and so on using econometric techniques to examine the impact of energy consumption on economic growth. These variables determine the demand for energies across different sectors such as transportation, electricity, residential, commercial industrial and so on; as well as the energy supplies including petroleum, gas, coal, hydro, nuclear, renewables, or geothermal (Nakata, 2004). Disaggregated variables, on the other hand, consider technological options or climate change mitigation policies (Nakata,2004). These variables help to determine the conversion efficiency, operating load factors, plant running time, and capital/ operating cost (Nakata, 2004). Possible constraints that might impede energy conservation will be determined from the analysis of these variables considering the ecological footprints.

Research Methodology

Data Source and Data Sampling Method

The data for the study were sourced from the University of Lagos, Yaba. With special consideration to the population of students in the institution, the samples were randomly selected and limited to 100 students. These data were collected through meticulous observation of the ecological footprints of Nigerians, and how their environmental habits and practices can help or hinder conservation of energy.

Justification for Data Sampling Method

These data were collected through meticulous observation of the ecological footprints of Nigerians, and how their environmental habits and practices can help or hinder conservation of energy.

Data Collection and Analysis

The present study employed a quantitative and qualitative approach through the collection of data from the respondents. The quantitative analysis involved data collection and econometric modelling to assess the economic impact of energy conservation measures and renewable energy deployment. To achieve this, a set of well-structured questionnaires were used as the research instrument. Descriptive statistics, T-test were used to provide answers to the research questions. Lastly, Qualitative research methods, such as case studies and interviews, were utilized to gather insights from stakeholders and experts in the field. Reliability coefficient of the instrument used is 0.84.

Presentation of Results

Research Questions

What is the student's level of energy conservation awareness?

Table 1: Mean of Students' Level of Energy Conservation Awareness

	Item 1	Item 2	Item 3	Item 4	Item 5
Mean	3.7000	2.5800	2.5300	3.3100	3.8500
N	100	100	100	100	100
Std. Deviation	.88192	1.34975	1.38866	1.07021	1.02863

Table 1 above shows the general awareness level of students on energy conservation. As indicated above, the mean of their awareness level is slightly below average (mean score = 3.19). This means that in spite of the low implementation status of energy conservation in the Nigerian state, considerable percentage of the Nigerian Senior Secondary School students are aware of the concept.

Table 2: Mean of Awareness Level between Science and Non-Science Students

COHORT		Item 1	Item 2	Item 3	Item 4	Item 5
Science	Mean	3.8929	2.5714	2.3571	3.3750	3.8393
	N	56	56	56	56	56
	Std. Deviation	.86715	1.46296	1.57744	1.08816	1.15643
Non-Science	Mean	3.4545	2.5909	2.7500	3.2273	3.8636
	N	44	44	44	44	44
	Std. Deviation	.84783	1.20692	1.08102	1.05354	.85156
Total	Mean	3.7000	2.5800	2.5300	3.3100	3.8500
	N	100	100	100	100	100
	Std. Deviation	.88192	1.34975	1.38866	1.07021	1.02863

As indicated in table 2 above, the mean of Science Students' Awareness is found to be slightly higher (mean = 3.2) than that of their counterparts who are non-science students (mean = 3.18). Flowing from the above, it is evident that the issue bordering around energy conservation has gone beyond mere science to becoming a general as far as the Nigerian context is concerned. This is because, even those who are non-science by profession seem to have almost similar level of awareness / interest in energy conservation as Nigerian scientists, owing to the urgent relevance and daily need of energy conservation by every Nigerian.

What are the barriers to energy conservation in Nigeria?

Table 3: Barriers to Energy Conservation in Nigeria

	Item 1	Item 2	Item 3	Item 4	Item 5
Mean	3.7300	3.4400	3.8100	3.7700	3.8000
N	100	100	100	100	100
Std. Deviation	1.07172	1.13991	1.07021	.94125	.89893

Table 3 shows the barriers to energy conservation in Nigeria. As found in the table, students agreed that nearly all the items listed on the questionnaire are huge barriers militating against energy conservation in Nigeria, however, items 3, unavailability of resources and 5, lack of willingness (mean = 3.81 and 3.80 respectively) seem to constitute the largest barriers to energy conservation in Nigeria, according to the respondents.

What are the probable impacts of energy conservation to Nigerian economy?

Table 4: Independent Samples Test on Impacts of Energy Conservation to Nigerian Economy

		Levene's Test for Equality of Variances		t-test for Equality of Means			95% Confidence Interval of the Difference			
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
Item 1	Equal variances assumed	2.952	.089	-1.125	98	.263	-.22000	.19556	-.60809	.16809
	Equal variances not assumed			-1.125	90.823	.264	-.22000	.19556	-.60847	.16847
Item 2	Equal variances assumed	.046	.831	.343	98	.732	.06000	.17485	-.28698	.40698
	Equal variances not assumed			.343	97.985	.732	.06000	.17485	-.28698	.40698
Item 3	Equal variances assumed	2.525	.115	-.692	98	.490	-.12000	.17332	-.46395	.22395
	Equal variances not assumed			-.692	94.690	.490	-.12000	.17332	-.46410	.22410
Item 4	Equal variances assumed	.703	.404	-.250	98	.803	-.04000	.15974	-.35701	.27701
	Equal variances not assumed			-.250	97.942	.803	-.04000	.15974	-.35701	.27701
Item 5	Equal variances assumed	.002	.960	2.817	98	.007	.28000	.15413	1.02586	1.58586
	Equal variances not assumed			2.817	97.023	.012	.28000	.15413	1.02590	1.58590

Table 5: Mean of Energy Conservation Awareness Based on Gender

GENDER		Item 1	Item 2	Item 3	Item 4	Item 5
M	Mean	3.9600	2.3600	2.5200	3.4000	4.0400
	N	50	50	50	50	50
	Std. Deviation	.78142	1.52208	1.43200	1.17803	.87970
F	Mean	3.4400	2.8000	2.5400	3.2200	3.6600
	N	50	50	50	50	50
	Std. Deviation	.90711	1.12486	1.35842	.95383	1.13587
Total	Mean	3.7000	2.5800	2.5300	3.3100	3.8500
	N	100	100	100	100	100
	Std. Deviation	.88192	1.34975	1.38866	1.07021	1.02863

Table 6: Potential Impacts of Energy Conservation on Nigerian Economy

	Item 1	Item 2	Item 3	Item 4	Item 5
Mean	3.9700	4.0100	3.9800	4.2640	4.3040
N	100	100	100	100	100
Std. Deviation	.97913	.87033	.86433	.72416	.78361

As seen in table 4 above, items 1 to 4 are found to be insignificant to energy conservation in Nigeria. However, item 5 ($t = 2.817 >$ critical table value 1.984 for $df = 98$ at .05 level of significance). In the same vein, the p-value of item 5 ($.007 <$.05 level of significance) shows that the item “lack of willingness” is the greatest barrier to energy conservation in Nigeria. The willingness can be political, educational, or any other. However, the interval between the lower and upper 95% confidence interval of respondents' agreement also corroborated this as its interval is seen to cross zero on the Levene's test for equality of variances *table 3.1*

Table 5 shows the mean of energy conservation awareness of respondents based on gender. As indicated in the table, the male (mean = 3.26) level of awareness is found to be slightly higher than that of their female counterpart (mean = 3.13). Succinctly put, the results show that the male students in the Senior Secondary schools have more awareness of the concept of energy conservation than their female counterparts, however, the difference in their levels of awareness is found to be statistically insignificant.

Table 6 shows the potential impacts that energy conservation is capable of contributing to Nigerian economy. As indicated on the table, students strongly agreed that if ventured into, energy conservation is capable of boosting the Nigerian economy by 81% (mean = 4.11). The above general mean is found to be the largest among all other computed means from the analysis of respondents' results. This means that in spite of students' relative fair level of general awareness of the concept of energy conservation, they can easily relate the potential benefits inherent in energy conservation based on their average daily sense of relevance of energy conservation to their lives.

Awareness Level

- i. I know the concept of renewable energy very well.
- ii. Nigeria has quite a number of renewable energy sources.
- iii. We always use renewable energy in our home or work.
- iv. There is adequate awareness of energy conservation in Nigeria.
- v. Businesses and industries have a significant responsibility in promoting energy conservation.

Barriers to Energy Conservation

- i. There is inadequate energy conservation information in Nigeria.
- ii. Insufficient funding constitutes a major obstacle to implementation of energy conservation in Nigeria.
- iii. Unavailability of resources is a barrier to energy conservation in Nigeria.
- iv. Absence of substantial demand for energy conservation in Nigeria is a major setback to energy conservation exploration in the country.
- v. Lack of willingness is a barrier to energy conservation in Nigeria.

Impacts of Energy Conservation

- i. Energy conservation is very important to Nigerian economic recovery.
- ii. Energy conservation can help to reduce fuel consumption in Nigeria.
- iii. Energy conservation can lead to employment generation.
- iv. Energy conservation can promote national security.
- v. Energy conservation can help to reduce carbon emission in Nigeria.

Insufficient funding constitutes a major obstacle to implementation of energy conservation in Nigeria. Businesses and industries have a significant responsibility in promoting energy conservation. Absence of substantial demand for energy conservation in Nigeria is a major setback to energy conservation exploration in the country

Table 7: Reliability Statistics

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
.860	.844	15

A_5, B_7, B_8, B_9 and I_11 was expunged to obtained the above reliability. By harnessing the laws of energy conservation, Nigeria can potentially address its economic crisis and achieve sustainable economic growth. Efficient use of the Law of Conservation of Energy could bring about a total turnaround to the economic woes Nigeria is facing (Tajudeen, 2015). This data analysis will lay the foundation for further research and policy recommendations in this area.

Recommendations

Based on the thorough analysis and insights presented in the paper, several recommendations has been made to address the economic crisis in Nigeria by harnessing the laws of energy conservation:

- i. Diversification of Energy Sources:** Nigeria should focus on diversifying its energy sources away from heavy reliance on crude oil. This can be achieved by investing in renewable energy sources such as solar, hydroelectric, biomass, and wind energy. By tapping into these abundant resources, Nigeria can reduce its vulnerability to fluctuations in oil prices and enhance energy security.
- ii. Promotion of Energy Efficiency:** Implementing energy efficiency measures across various sectors, including transportation, residential, commercial, and industrial, can significantly reduce energy consumption and costs. This can be achieved through public awareness campaigns, incentives for energy-efficient technologies, and stringent energy efficiency standards for buildings and appliances.
- iii. Enhanced Waste Management:** Improving waste management practices, particularly in the recycling and conversion of waste to energy, can contribute to both environmental sustainability and energy conservation. By implementing effective waste management strategies, Nigeria can mitigate environmental degradation while harnessing the energy potential of organic waste materials.
- iv. Policy Reforms:** Nigeria should enact and enforce policies that support sustainable energy development and conservation efforts. This includes establishing renewable energy targets, providing incentives for investment in renewable energy projects, and phasing out subsidies for fossil fuels. Additionally, regulatory frameworks should be put in place to promote energy efficiency and incentivize businesses and industries to adopt sustainable practices.
- v. Investment in Research and Development:** There should be increased investment in research and development to innovate new technologies and solutions for energy conservation and sustainable development. Collaborations between academia, government, and the private sector can drive technological advancements and facilitate the adoption of renewable energy technologies in Nigeria.
- vi. Education and Awareness:** Public education and awareness campaigns should be conducted to promote the importance of energy conservation and sustainable practices. This includes educating individuals, businesses, and policymakers about the benefits of renewable energy, energy efficiency, and waste management strategies. By fostering a culture of sustainability, Nigeria can mobilize collective action towards addressing the economic crisis and achieving long-term environmental stability.
- vii. Stakeholder Engagement:** Collaboration and partnership between government, industry, civil society, and international organizations are essential for driving sustainable development initiatives. Engaging stakeholders in dialogue and decision-

making processes can ensure that policies and interventions are inclusive, effective, and sustainable in the long run.

In conclusion, by adopting a holistic approach that integrates principles of energy conservation with strategic economic policies, Nigeria can overcome its economic challenges, promote sustainable development, and build resilience against future crises. The recommendations outlined above provide a roadmap for policymakers and stakeholders to chart a sustainable path towards economic recovery and environmental stewardship.

Reference

- Douglason G Omotor, (2011). Nigeria and the global economic crisis, economic thought and practice, Department of Economics and Business, *University of Dubrovnik*, 20(1), 59-80
- Emovon, I., Samuel, O. D., Mgbemena, C. O., & Adeyeri, M. K. (2018). Electric Power generation crisis in Nigeria: A Review of causes and solutions. *International Journal of Integrated Engineering*, 10(1). Retrieved from open access <https://penerbit.uthm.edu.my/ojs/index.php/ijie/article/view/1840>
- Ihimodu, I. I. (1986). Nigeria's economic crisis: Some attempted solutions. *The African Review: A Journal of African Politics, Development and International Affairs*, 77-88. Retrieved from open access <http://www.journals.udsm.ac.tz/index.php/ar/article/viewFile/395/368>
- Kennedy-Darling, J., Hoyt, N., Murao, K., & Ross, A. (2008). *The energy crisis of Nigeria: An overview and implications for the future*, The University of Chicago, Chicago, 775-784. Retrieved from open access <http://large.stanford.edu/courses/2015/ph240/shittu1/docs/kennedy-darling.pdf>
- Nakata, T. (2004). Energy-economic models and the environment, *Progress in energy and combustion science*, 30(4), 417-475.
- Ngwube, A. & Ogbuagu, M. (2014). Global financial crisis and Nigeria economy, *Global Journals Inc.*
- Olatunji, O., Akinlabi, S., Oluseyi, A., Abioye, A., Ishola, F., Peter, M., & Madushele, N. (2018). Electric power crisis in Nigeria: A strategic call for change of focus to renewable sources. In *IOP Conference Series: Materials Science and Engineering* (413, 012053). IOP Publishing. <https://iopscience.iop.org/article/10.1088/1757-899X/413/1/012053/meta>

- Oyedepo, S. O. (2012). Energy efficiency and conservation measures: tools for sustainable energy development in Nigeria. *International Journal of Energy Engineering*, 2(3), 86-98. Retrieved from https://www.researchgate.net/profile/Sunday-Oyedepo/publication/285023183_Energy_efficiency_and_conservation_measures_Tools_for_sustainable_energy_development_in_Nigeria/links/5661b93608ae418a7867ad7d/Energy-efficiency-and-conservation-measures-Tools-for-sustainable-energy-development-in-Nigeria.pdf
- Oyedepo, S. O. (2013). Energy in perspective of sustainable development in Nigeria, *Sustainable Energy*, 1(2), 14 Retrieved from <https://www.academia.edu/download/71611233/rse-1-2-2.pdf>
- Slusarczyk, B. & Sowa, B. (2017). The economic crisis – its causes and results and the limiting ventures (selected aspects), *Central European Review of Economics & Finance*, 22(6), 41–55.
- Somoye, O. A. (2023). Energy crisis and renewable energy potentials in Nigeria: A review, *Renewable and Sustainable Energy Reviews*, 188, 113794. Retrieved from <https://www.sciencedirect.com/science/article/abs/pii/S1364032123006512>
- Tajudeen, I. A. (2015). Examining the role of energy efficiency and non-economic factors in energy demand and CO2 emissions in Nigeria: Policy implications, *Energy Policy*, 86, 338-350.
- Umbu, E. I., & Agada, J. (2022). *Energy crisis in Nigeria: A call for a democratized energy sector*, Emmanuel Umbu, Joseph Agada 'Energy Crisis in Nigeria: A call for a democratized energy sector' (2022) 11. Retrieved from https://papers.ssrn.com/sol3/papers.cfm?abstract_id=4560140