International Journal of Trend in Scientific Research and Development (IJTSRD)
Volume 10 Issue 5, Sep-Oct 2026 Available Online: www.ijtsrd.com e-ISSN: 2456 – 6470

Criticality of Energy in National Development

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ABSTRACT

Energy as an enabler of all other sectors is widely recognized as the fundamental driver of national development which serves as the backbone for economic growth, social welfare, and environmental sustainability. The access to affordable, reliable, and sustainable energy is central to achieving the Sustainable Development Goals, particularly SDG 7 and SDG 8. Empirical evidence shows a strong correlation between energy consumption and GDP growth, as a 1% increase in electricity consumption leads to a 0.5-0.9% increase in GDP in developing economies. Energy is known to underpin poverty reduction, food security via agro-processing and cold chains, and job creation, with the renewable sector employing over 13.7 million people globally. More than 86 million people in Nigeria lack access to electricity with the country facing a generation deficit of over 17,000MW, which constraints industrialization, service delivery, and attainment of the 2030 Agenda due to energy gap. The paper therefore examines the critical role of energy in national development with particular emphasis on Nigeria.

KEYWORDS: *Energy, national development, SDG 7, electricity, Nigeria, economic growth, industrialization, global competitiveness, national sovereignty, national security, energy access gap, post-harvest loss.*

How to cite this paper: Paul A. Adekunte | Matthew N. O. Sadiku | Janet O. Sadiku "Criticality of Energy in National Development" Published in International Journal of Trend in Scientific Research and Development (ijtsrd), ISSN: 2456-6470, Volume-10 | Issue-5, October 2026, pp.1292-1297, URL: www.ijtsrd.com/papers/ijtsrd142199.pdf

IJTSRD142199

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INTRODUCTION

According to the International Energy Agency (IEA), energy is the capacity to do work and is regarded as the lifeblood of any modern economy. Energy is used to power industries, drives transportation, enables communication, and sustains social services like health, education, and water supply. In the absence of reliable and affordable energy, no nation can achieve meaningful economic growth, poverty reduction, or sustainable development. It is recognized globally that energy is a prerequisite for development – as reflected in the Sustainable Development Goal 7 (SDG 7) which calls for "affordable, reliable, sustainable and modern energy for all by 2030, as shown in Figure 1. The United Nations also noted that "energy is the golden thread that connects economic growth, social equity, and environmental sustainability". In developing countries, the link between energy and development is well pronounced, as a 1% increase in electricity consumption leads to a 0.5% to 0.9% increase in GDP.

Energy is known to account for 30-50% of industrial production costs, and its availability determines the competitiveness of manufacturing firms, while in the social sector, energy is critical for the powering of hospitals, schools, ICT facilities, and agro-processing industries. Post-harvest losses of about 40% in agriculture occur due to lack of cold storage powered by energy. Nigeria, despite being Africa's largest producer of crude oil and gas is faced by a severe energy deficit, as shown in Figure 2. In Nigeria about 86 million people lack access to electricity, representing the largest energy access gap in the world. The present installed generation capacity of 13,000MW is grossly inadequate to meet an estimated demand of over 30,000MW, leading to households and businesses spending billions of naira annually on diesel and petrol generators. The Manufacturers Association of Nigeria (MAN) reports that manufacturers spend up to 40% of their operating costs on self-generation, which increases the cost of goods and reduces competitiveness.

Energy is described as an enabler of all SDGs, without which Nigeria and any other nation cannot industrialize, create jobs, or even achieve SDG 1-9. As the UN states, "Energy is central to nearly every major challenge and opportunity the world faces" [1-13]. Closing the energy gap remains the single major important step to be taken by Nigeria toward national development and global competitiveness, as shown in Figure 3.

HISTORICAL BACKGROUND

There is a close relationship between energy and national development. From history, the dominant energy source of any era has determined the level of productivity, wealth, and power of nations. The shifting from human/animal power 'n wood/coal 'n oil/gas 'n electricity/renewables has directly tracked with economic transformation [1].

"Energy transitions have always been transitions in the structure of human societies" [14], as shown in Figure 4.

Phases of Energy and Development

Phase 1: Pre-Industrial Era – Biomass & Human Power (Before 1700s)

Energy Source: The energy sources were from wood, charcoal, human and animal muscle

Criticality: Energy was limited to basic cooking, heating, and manual farming. There was slow national development since productivity depended on human labor.

Impact: Societies were agrarian, with GDP growth less than 0.1% per year [14].

Phase 2: First Industrial Revolution – Coal (1760-1900)

Energy source: Coal + Steam engine

Criticality: Coal powered factories, railways, and steel. It marked the first time nations could mass-produce goods. Britain became the first industrial power because of coal reserves [1].

Impact: GDP per capita in industrial nations grew 10x. Urbanization and rail networks expanded [8].

Lesson: Nations with coal industrialized, while those without it lagged behind.

Phase 3: Second Industrial Revolution – Oil, Gas & Electricity (1900-1970)

Energy Source: From petroleum, natural gas, hydro and centralized grid

Criticality: Electricity enabled 24/7 factories, lighting, and communication. Oil powered cars, ships, and planes, enabling globalization.

Impact:

1. **USA:** Rural Electricity Act 1936 brought power to farms 'n increased agricultural output by 300% [15].
2. **Post-WWll Europe/Japan:** Marshall Plan invested in power plants 'n drove the "economic miracle" [6, 16].

Phase 4: Oil Crises & Energy Security Era (1970s-2000)

Event: 1973 & 1979 Oil Shocks

Criticality: The world realized that the dependence on imported oil = economic vulnerability. Oil price increase 4x caused recession in non-oil countries [1].

Response:

1. Creation of IEA in 1974 for energy security
2. Nations invested in nuclear, coal, and efficiency [8].

Lesson: That energy is a matter of national sovereignty and security and not just economies [17].

Phase 5: Sustainable Energy & SDG Era (2000-Present)

Energy Source: Renewables + Gas + Digital Grids + Efficiency

Criticality: Two new factors emerged which were:

1. **Climate Change:** Fossil fuels linked to global warming 'n push for clean energy [18].
2. **Energy Access & SDGs:** In 2015, UN made energy central to development via SDG 7: "Energy for All by 2030" [6].

Impact:

1. Renewable energy jobs reached 13.7M globally by 2022 [3], as shown in Figure 5.
2. Solar + battery costs fell 85% since 2010, making decentralized power possible for rural areas [1].

Lesson: Development now = Clean + Affordable + Reliable energy [6].

THE HISTORY OF ENERGY CRITICALITY IN NIGERIA

1950s-1960s:

Key Event: Discovery of oil + Kainji Dam in 1968.

Impact on Development: Oil became main forex earner and while Kainji Dam provided first major hydro power [13].

1970s-1980s:

Key Event: Oil boom.

Impact on Development: Funded infrastructure, schools, and hospitals. Energy became a revenue source for development [8].

1990s-2000s:
Key Event: NEPA Crisis.

Impact on Development: Frequent blackouts stalled industries, while manufacturers relocated [4].

2005-2013:
Key Event: Power Sector Privatization.

Impact on Development: Unbundled NEPA into 11 Discos + 6 Gencos. Coal: improve efficiency [5].

2013-Present:
Key Event: Energy Access Gap.

Impact on Development: 86 million people are without electricity. Government launched Solar Home Systems + Mini-grids [8].

2023:
Key Event: Electricity Act 2023.

Impact on Development: Allowed states to generate, transmit, and distribute power. Decentralization begins [11].

The key lesson for Nigeria is that from 1960-2023, the country's development was tied to oil revenue and grid electricity. The country's failure to diversify and expand access has greatly limited industrialization, coupled with the fact that the inability to provide adequate energy will threaten its ability to achieve SDG 1 – No poverty, SDG 3 – Good health, SDG 4 – Quality education, and SDG 8 – Decent work and Economic growth [6, 19, 21].

Global Evidence: Energy and Development

1. South Korea 1960s: The country heavily invested in power plants. Electricity access went from 20% to 100% in 20 years. Its GDP grew from $1,000 to $34,000 [8].
2. China 1980-2010: The country built 1000GW of power. This powered its manufacturing boom and lifted 800m people out of poverty [1].
3. Common Thread: There is no country that has achieved middle-income status without first achieving greater than 80% electricity access [8, 12]

WHY ENERGY IS CRITICAL: THE 7 KEY DIMENSIONS

Energy is critical for the following key areas:

1. Economic Growth and Industrialization

A. Input to production: There can be no factory, mining, or ICT that can run without reliable energy/power. Energy accounts for 30-50% of industrial cost.
B. GDP link: 1% increase in electricity consumption = 0.5-0.9% increase in the GDP in developing countries.
C. Nigeria case: In Nigeria, manufacturers spend 40% of operating cost on diesel as a result of grid failure – raising the cost of goods [1, 4, 8].

2. Poverty Reduction & SDG 1

A. Access = Opportunity: Less spending on kerosene by households using electricity makes them to have more hours for work/study.
B. Jobs: Globally, the energy sector provides jobs for 65 million people. Renewable energy alone employed 13.7 million in 2022.
C. Nigeria: In Nigeria, about 86 million people lack access to electricity, which limits income generation [3, 8].

3. Health & Human Capital – SDG 3

A. Hospitals: Regular power 24/7 is required for vaccines, surgery, and material care in hospitals. 1 in 4 health facilities in SSA have no electricity.
B. Clean cooking: About 2.3 billion people make use of dirty fuels. This causes about 3.2 million deaths/year from indoor pollution.
C. Nigeria: In Nigeria, the frequent power outages disrupt oxygen supply and cold chains in hospitals [9, 10].

4. Education & SDG 4

A. Digital learning: ICT, e-learning, and laboratories require power to function.
B. Study hours: Solar lamps increase or extend study time for rural children by 2-hours/day.
C. Nigeria: Only 28% of public schools in Nigeria have reliable electricity [7, 12].

5. Infrastructure & SDG 9

Transport, water supply, telecom, and smart cities all depend on energy. The water treatment plants in Lagos is said to require 15MW daily. Water and wastewater utilities according to the World Bank are among the largest electricity consumers in any city, accounting for 2-3% of total national electricity use. Diesel cost makes water expensive [6, 20].

6. Agriculture & Food Security – SDG 2

A. Value addition: Need for cold storage, irrigation pumps, and processing to reduce post-harvest loss from 40% to less than 10% [10].
B. Nigeria: Nigeria losses about 50% of tomatoes harvested due to lack of cold chain powered by energy.

7. Energy Security & National Sovereignty

A. No energy = No independence: Wars, sanctions, and inflation are tied to oil and gas [1].
B. Nigeria paradox: Nigeria as Africa's largest oil producer still imports about 80% of refined fuel. This is known to create Forex pressure [13].

Energy and SDG 7: The Core Goal

SDG 7: This is to ensure access to affordable, reliable, sustainable and modern energy for all by 2030 [21], as shown in Figures 6 and 7.

THE CHALLENGES FACING NIGERIA

Some of the challenges faced by Nigeria in the energy sector include:

1. **Generation gap:** The installed capacity is 13,000MW as opposed to the demand of 30,000MW.
2. **Transmission losses**: Before power reaches the consumers 40% is lost.
3. **Funding**: The required funding of $100b is needed to achieve universal access by 2030.
4. **World Bank**: Inconsistency in policy affects private investment [5, 8].

Ways forward: Strategies for Leveraging Energy for Development

Developing nations including Nigeria, should evolve and adopt strategies in the energy sector for national development, poverty eradication, and much more such as:

1. Diversify energy mix: Gas + solar + hydro to drastically reduce the dependency on diesel.
2. Decentralized renewable: Enhance solar mini-grids for rural areas
3. Industrial clusters: Ensure and enhance 24/7 power for Special Economic Zones (SEZs) to boost manufacturing, e. g., Lekki Free Trade Zone (LFTZ) in Lagos, Calabar Free Trade Zone in Cross River, Onne Oil & Gas Free Zone in Rivers, and Kano Free Trade Zone, all in Nigeria.
4. Energy efficiency: Reduce energy waste and lower cost
5. Policy reform: Urgent need for the full implementation of Electricity Act 2023 [1, 3, 4, 8, 11].

CONCLUSION

Since energy as a critical factor is an enabler of all SDGs and not just another sector, Nigeria as well as other developing economies for that matter cannot industrialize without reliable, affordable energy, create jobs, or even achieve SDG 1-9. History had shown that every major leap in national development has been preceded by a leap in energy use and access. From coal in Britain to oil in the US to electricity in Asia – energy has been an enabler of industry, health, and education. Therefore, Nigeria should replicate this history via decentralized renewables, gas, and grid expansion under SDG 7 to avoid being left behind in the 21st century. Sustainable national development would require governments to treat energy and universal access to modern energy as strategic national priorities. The long-term objective should be an energy system that is reliable, affordable, accessible, secure, environmentally sustainable and capable of supporting inclusive economic growth. More information on the criticality of energy for national development can be obtained in the books in [22-37] and the following related journals:

Annals of the New York Academy of Sciences
Energy Policy
Journal of Economic Studies
Energy Economics
Economic and Political Weekly
Renewable and Sustainable Energy Reviews
The Journal of Energy and Development
The Energy Journal
Energy
Energy for Sustainable Development
Climate Change
Energy, sustainability and Society
World Development
African Development Review
Nigerian Journal of Economic and Social Studies
Journal of Energy in Southern and eastern Africa

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Figure 1. Sustainable Development Goals
Source:
https://en.wikipedia.org/wiki/Sustainable_Development_Goals_and_Nigeria

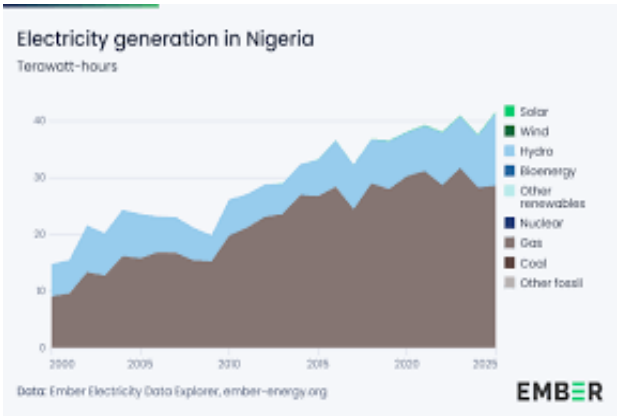


Figure 2. Energy in Nigeria
Source:
https://en.wikipedia.org/wiki/Energy_in_Nigeria



Figure 3. Energy development
Source:
https://en.wikipedia.org/wiki/Energy_development

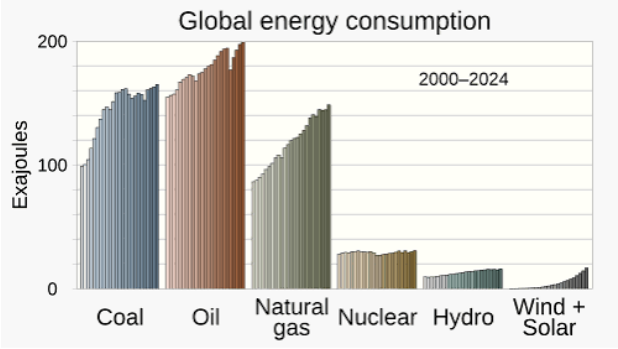


Figure 4. Energy transition
Source:
https://en.wikipedia.org/wiki/Energy_transition

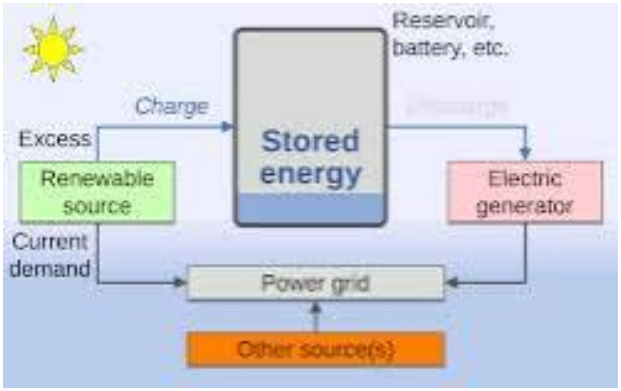


Figure 5. Renewable energy
Source:
https://en.wikipedia.org/wiki/Renewable_energy



Figure 6. Sustainable energy
Source:
https://en.wikipedia.org/wiki/Sustainable_energy

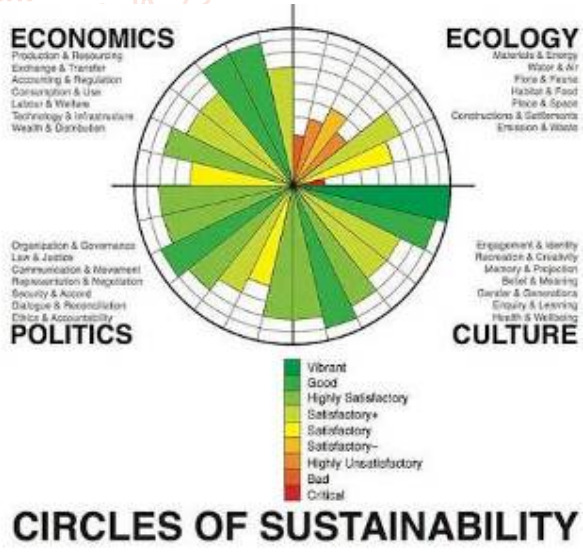


Figure 7. Circles of sustainability.