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NIGERIAN ASSOCIATION FOR ENERGY ECONOMICS
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NAEE Energy Forum

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Message from the President

It is with great honor and enthusiasm that I welcome you to the 17th Annual Conference of the Nigerian Association for Energy Economics (NAEE). Each year, this forum serves as a cornerstone for advancing energy discourse in Nigeria, fostering collaboration, and promoting innovation in energy economics, and 2024 is no exception. I am particularly excited about this year's theme, *"The Energy Economy and Environment Nexus: Imperative for Good Governance and Sustainable Development in Africa"*, which comes at a critical juncture for our nation and the broader African continent.

In recent years, the world has undergone profound shifts in energy dynamics, economic structures, and environmental challenges. These changes demand not only a reevaluation of traditional approaches but also a concerted effort to forge new pathways toward sustainable development. Our chosen theme addresses the intersection of these three crucial pillars—energy, economy, and environment—highlighting their intertwined roles in shaping the future of governance and prosperity across Africa.

Energy continues to be the backbone of Nigeria's economy, powering industries, driving technological advancements, and sustaining our everyday lives. Despite the sector's vast contributions, we recognize the challenges that have historically hindered our progress, from inefficiencies in energy supply to over-reliance on oil and gas. As the world shifts toward multipolar energy markets, we must seize the opportunity to strengthen our local economy, develop resilient energy infrastructures, and forge strategic partnerships that will safeguard Nigeria's future in this evolving landscape.

From an economic perspective, Nigeria faces multiple crises that compound the complexities of the energy transition. The lingering impacts of the global pandemic, inflationary pressures, and the ever-present threat of climate change all converge to create an environment where the stakes are higher than ever. This is why the *"Energy Economy and Environment Nexus"* is more than a conceptual framework—it is the reality we face and the lens through which we must analyze our path forward. By empowering Nigerian professionals and companies, we can drive economic growth that is not only robust but inclusive. As the energy sector evolves, we must ensure that all Nigerians benefit from the opportunities it presents, particularly as we transition toward a more diversified and competitive energy market.

In our discussions, we must not lose sight of the environment. Nigeria is blessed with rich natural resources, but this wealth brings with it the responsibility of stewardship. The environmental challenges we face—from desertification in the North to flooding in coastal regions—are undeniable. Climate change, while a global issue, has local consequences that directly affect our communities, food security, and livelihoods. Our transition to renewable energy is not just about economic diversification; it is a moral imperative. We must commit to reducing our environmental footprint, ensuring that our energy policies are aligned with global best practices in sustainability. This requires a

(Continued on page 3)

Mission

To train Nigerians to qualify as graduates, professionals, technicians and craftsmen in the field of engineering, geology, science and management in the oil and gas industry in Nigeria or abroad.

Vision

To train Nigerians to qualify as graduates, professionals, technicians and craftsmen in the field of engineering, geology, science and management in the oil and gas industry in Nigeria or abroad.

The Mandate

To develop the capacity, capability and competencies of Nigerians to play effective roles in the operational and management segments of Nigerias oil and gas industry. This is achieved through Human Capital Development (Education and Training Programmes), Institution and Systems Development (PTI, NCPSK, University Upgrade Projects, Skills Development and Training Centre, NTI Bonny, Federal Polytechnic of Oil and Gas Ekowe etc), Promotion of Research and Acquisition of Relevant Technologies (Research Grant Competition, Professional Chair Endowments), Manufacturing and Materials Development.

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ENFORCING COMPLIANCE

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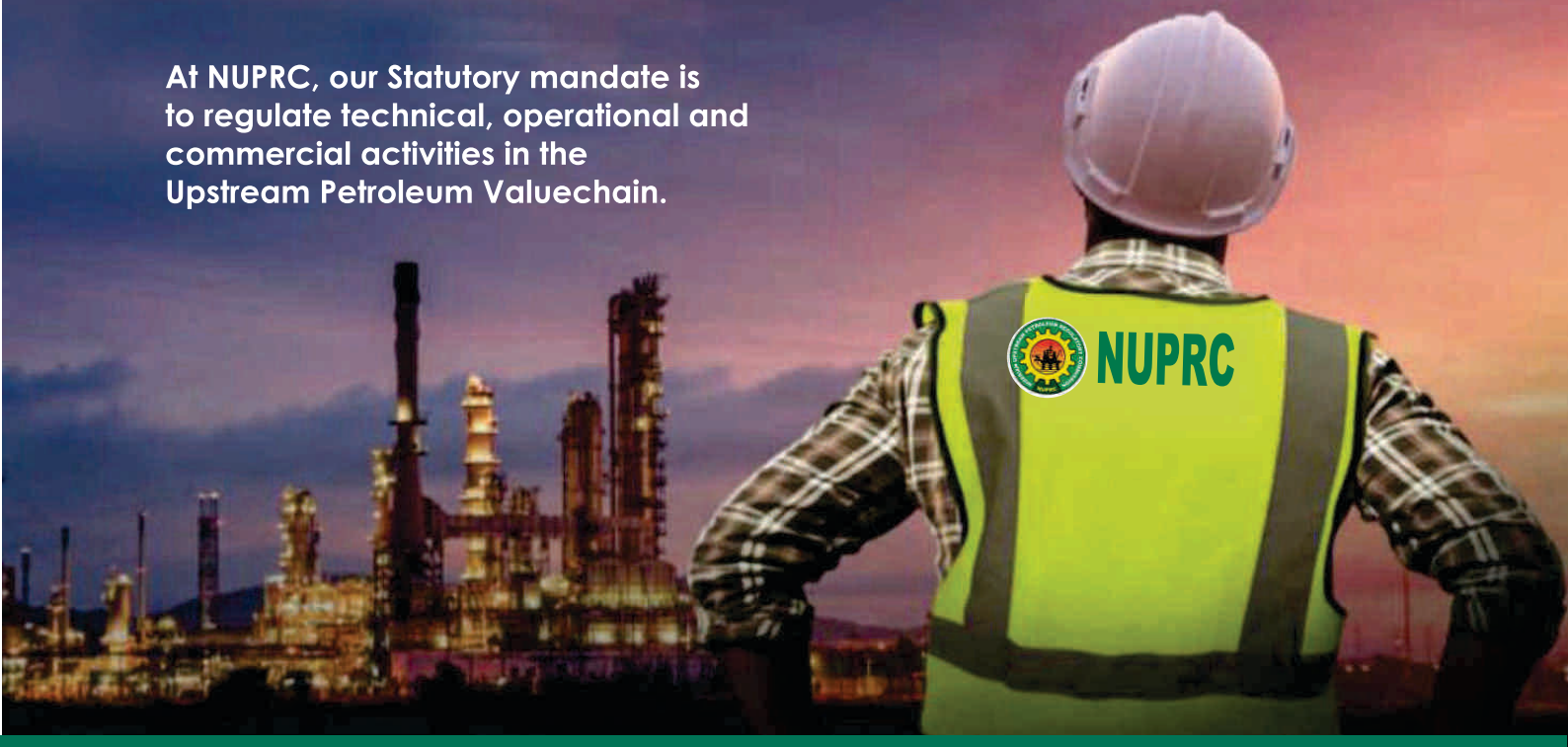
At NUPRC, our Statutory mandate is to regulate technical, operational and commercial activities in the Upstream Petroleum Valuechain.



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October, 2024

concerted effort from both the public and private sectors, as well as support from international organizations and donor agencies. Through strong governance and effective implementation, we can make meaningful strides toward a greener future for Nigeria and the world.

At the heart of the energy-economy-environment nexus lies the concept of good governance. Without transparency, accountability, and effective leadership, even the best-laid plans will falter. Good governance means that our energy policies must be forward-thinking, inclusive, and designed to meet the needs of all Nigerians, especially the most vulnerable. This also includes ensuring that the revenues generated from our energy sector are wisely invested in critical areas such as public infrastructure, education, healthcare, and job creation. In addition to strong institutions, good governance also means empowering the next generation of leaders. Nigeria is home to a vibrant and youthful population, and it is essential that we equip them with the skills and knowledge to drive the energy revolution. The future of our energy sector—and by extension, our economy and environment—depends on the active participation and leadership of our young people.

As we gather for this 17th Annual Conference, I want to remind us all that our theme—*"The Energy Economy and Environment Nexus: Imperative for Good Governance and Sustainable Development"*—is not merely a slogan. It is a call to action. The decisions we make today will shape the future of our nation and our continent. We must act with urgency, foresight, and a deep sense of responsibility to ensure that our energy sector leads Nigeria towards a more sustainable and prosperous future. I would like to express my deepest gratitude to the distinguished speakers, panelists, and participants who have taken time out of their schedules to contribute to this year's conference. I am particularly inspired by the participation of our student members, whose energy and innovative ideas are vital to the future of our association. You represent the next generation of leaders, and your involvement is a testament to the NAEE's commitment to nurturing talent and fostering growth.

A special thanks goes to our partners, especially the Petroleum Technology Development Fund (PTDF), for their unwavering support. Your contributions have been instrumental in the continued success of the NAEE, and we are deeply grateful for your commitment to our shared goals. In closing, I look forward to the rich discussions and exchanges that will take place over the next few days. I am confident that the insights gained from this conference will help us navigate the challenges ahead and capitalize on the opportunities that lie in the energy economy-environment nexus.

Thank you all for being part of this important gathering, and I wish you a productive and transformative conference.

Dr. Hassan Mahmud, FCIBN, FNSA, CBE
President, Nigerian Association for Energy Economics

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NAEE Mission Statement

About NAEE

The Nigerian Association for Energy Economics (NAEE) is the Nigerian affiliate of the International Association for Energy Economics (IAEE) with a presence in over 120 Countries all over the World. The NAEE is however the first and currently the only affiliate of the International Association for Energy Economics in Africa. The NAEE was formally inaugurated in Nigeria in December 2006 at the Nigerian National Petroleum Corporation (NNPC) Towers, Abuja, and one of the fastest growing affiliate in the IAEE.

Mission Statement

The Association is a nationwide nonprofit organization of business, government, academic and other professionals that advances the understanding and application of economics across all facets of energy development and use, including theory, business, public policy and environmental considerations.

Nigeria Natural Gas Outlook

Domestic Consumption
29% of NG Production used Domestically

80% of LPG Production Consumed Domestically

Estimated Production
8Billion SCF/Day Production

Africa and Global Ranking
1st in Africa and 9th in the world with potential reserves

Highest Domestic Sector Usage
70% of Domestic Production is used for Power Generation

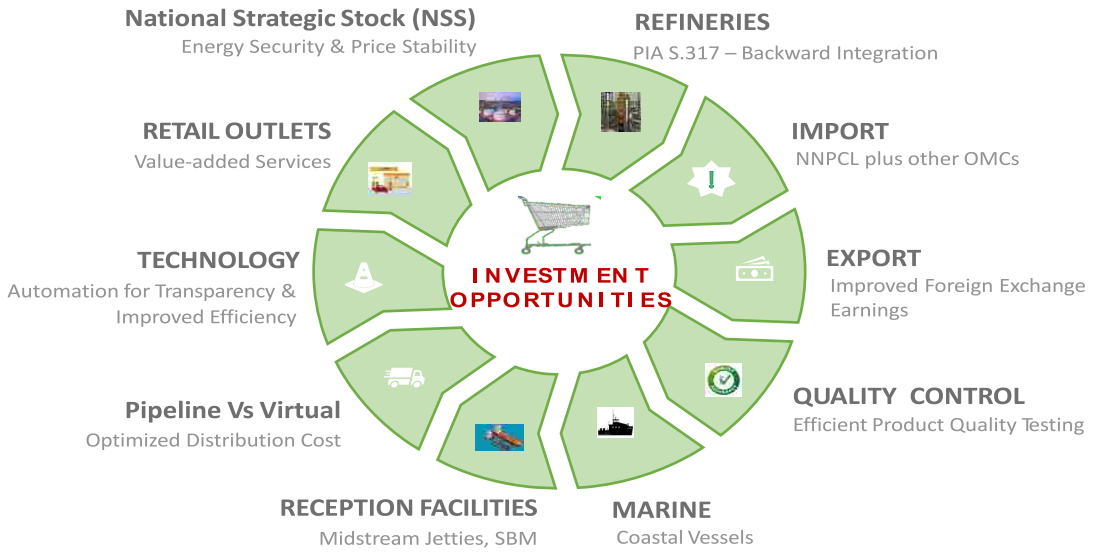
Export
70% of Production Exported

Nigeria has 600TCF Potential Reserves with 209TCF Proven Gas Reserves

Potential Investment for the next 5 years

50%	**Gas Production** Increase Production by 50% to about 15BSCFD in the medium term to support domestic and export demand
11300%	**CNG Usage** Increase usage of LPG and CNG from 0.03mmscfd to 3.42mmscfd in 5 years
500%	**LPG Usage** Increase usage of LPG from about 1.4 Million MT to 8 Million MT in 5 years
400%	**Power Generation** Increase domestic power generation using gas from about 3mW to 12mW in 5 years.
200%	**Physical and Virtual Pipelines** Construct about 1,400Km pipelines and transportation of CNG using virtual pipelines to stranded power and commercial customers
900mmscfd	**Flare Gas Commercialization** ~ 900mmscfd of Flared gas for commercialization

Downstream Investment Opportunities



Stranded Gas Fields
Gas Gathering and Processing Plants
Gas Transportation and Compression
Gas Trunklines to deliver gas to major cities, power plant petrochemical plants and other industrial areas
Gas Parks (City Gates)
Pressure Reduction Systems
Metering Systems
Gas Storage
Offtake to distribution systems (Pipeline + trucks)
Gas Distribution
Auto Gas Facilities
LPG Storage and Distribution Facilities
Marine
Refineries
Retail
Reception Facilities
Import & Export Activities
Quality Control
Pipeline Network
Technology
National Strategic Stock

Join us as we maximise the potential of the Nigerian Midstream & Downstream Petroleum Industry

For more information contact us on
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Petroleum Midstream and Downstream Investment Enabler Survey

A Note from the Editor

I am delighted to welcome you to the tenth edition of the Nigerian Association for Energy Economics (NAEE) Energy Forum – the official Newsletter of the NAEE. This Newsletter offers NAEE members the unique opportunity to share insightful and multidisciplinary perspectives on issues within energy economics. In the past editions of the NAEE Energy Forum, readers have been treated to interesting articles on issues that are germane importance in our profession, national energy reforms and global energy transition.

This is edition is the first after the removal of petroleum subsidy in Nigeria and it captures the current realities in the energy industry amidst challenging economic realities and mounting debt burdens. Furthermore, the Petroleum industry Act, contrary to expectations, has not addressed transparency issues in the oil and gas sector, and has not delivered optimal utilization of resources. As such, there has been unprecedented hikes in the price of petroleum products, electricity tariff increase, unprecedented reforms and incessant collapse of the national grid.

Omowumi Iledare, Professor Emeritus leads the discourse in this edition with an exposition on why the speed to decarbonize through energy transition from fossil fuels is conjectural and argues that it is disruptive for a fossil-dependent country, like Nigeria. He asserts that the quest to either stop or drastically reduce the use of fossil fuels as the primary energy source qualifies as a disruption in the evolving global energy landscape. He sets the political-economic context of global energy dynamics as they relate to Nigeria's development, and he emphasizes the need for government to intentionally balance security, equity and sustainability.

Uche extends the discourse by detailing other specific disruptions that affect energy security from the perspectives of sovereignty, robustness and resilience. He further identifies some technical, natural and socio-political threats to energy security and then reviews the performance of energy security through the Trilemma Index of Africa. Finally, his article proposes a framework for assessing energy security which is applied to the Nigerian situation.

In his paper, Jean Balouga contributes to this Newsletter from the perspective of natural resource wealth management by focusing on the Nigeria Sovereign Investment Authority (NSIA). He opines that, if well managed, this savings and investment platform could propel Nigeria to great heights in her drive for sustainable economic development – amidst the energy transition. Given the high level of corruption and habitual mismanagement of the national wealth over the years, he further argues for transparency and sound corporate governance in the management of the NSIA – benchmarking it with Sovereign Wealth Funds in developed countries. He concludes with a strategic proposition - as Iledare proferred - that Nigeria needs a SWF that will use its offshore investments to drive in critical

foreign direct investment (FDI) and infrastructural investments.

In the last article, Theophilus Tubi tends to proffer solutions to the energy landscaper disruption discourse we started with. He identifies geographical locations with the required (solar and wind) conditions for the establishment of a series of 3-In-1 Hybrid Energy Farms throughout Nigeria. The paper highlights unique ways of electricity generation with a convergence of existing and emerging technologies yielding between 3.5GW and 7GW of Renewable Electricity by a combination of Wind and Solar Technology. The paper uniquely incorporates the retooling of both technologies to achieve economies of scale by introducing Greenhouse Fruit, Spices and Vegetables all under one Solar Panelled Roof. The article is novel in its interplay of blended sustainable technology accretion and environmental sensitivity in identifying and harnessing ingenious solutions aimed at solving some of Nigeria's socioeconomic issues. It brings together Solar, Wind and Greenhouse Technologies to address recurring problems like insufficient power generation, food/dietary issues, unemployment and successful resettlement of internally displaced persons (IDPs).

The Nigeria Association for Energy Economics appreciates all the contributors to the past and current editions of the Forum. We value your support and look forward to more engaging policy relevant contributions. Views, comments and submissions on all aspects NAEE focus areas are welcomed and will be considered for publication. Articles should be type-written in English using MS Word format, Times New Roman font style (size 12), with simple text layout, regular headings, and paragraphs. Contributions should be about 700 to 1500 words and including the author's details – full name, email address, affiliation and mobile number – with a photograph in JPEG format (as a separate file). Contributions should be submitted by email to our email address admin@naee.org.ng

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Obindah **Gershon**, Ph.D
October, 2024

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A FRAMEWORK FOR ASSESSING ENERGY SECURITY IN NIGERIA AMIDST THREATS AND DISRUPTIONS

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ANALYSING THE PROSPECTS OF DEVELOPING MODEL 3-IN-1 HYBRID ENERGY FARMS IN NIGERIA.

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SUSTAINABLE DEVELOPMENT IN NIGERIA: DOES THE NIGERIA SOVEREIGN INVESTMENT AUTHORITY MATTER?

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DISRUPTING THE ENERGY LANDSCAPE IN NIGERIA: INTENTIONAL BALANCING OF ENERGY SECURITY, EQUITY AND SUSTAINBILITY.

Professor Emeritus Omowumi Iledare

Introduction

The global energy system is more likely than not to undergo a fundamental restructuring through decarbonization. The rapidity of the decarbonization process will create challenges as well as opportunities worldwide, including Nigeria. Unfortunately, there exists presumptive empirical evidence to suggest that key and most dependable global primary energy sources, fossil fuels are the primary source of greenhouse gas emissions. Consequently, fossil fuels consumption is the major cause of the global warming phenomenon. It is natural, therefore, to assume that the fight against climate change must begin with the drive to end or reduce as much as possible, the use of fossil fuels, which is a call to disrupt the energy landscape in a typical petroleum dependent economy, like Nigeria. So, the quest to either stop or drastically reduce the use of fossil fuels as the primary energy source qualifies as a disruption in the dynamics of the evolving global energy landscape and outlook. Nigeria has emphatically set 2060 to attain the net-zero target, but time will tell.

Indeed, the global urgency and determination to shift global energy supply mix towards renewable energy system because it has a unique attribute to produce energy with no associated emission of greenhouse is glaring. That renewable energy offers a clear path to net-zero emissions is not conjectural but the transition speed to zero carbon emissions is conjectural and cannot be homogeneous. A historical review of renewable energy contribution to primary energy mix shows the extent of the daunting task ahead and why proffering uniform approach to effectively mitigate global warming by mandate is less likely to succeed. Nigeria must learn lessons from the global dissimilarity in the journey to net-zero. The forces shaping the global energy transition trend to 2050 and the key parameters surrounding the transition are not deterministic. Key players in the global energy supply dynamics have diverse interests. Attaining the global transition goals requires a heterogeneous approach rather than a homogenous strategy. The one thing held in common among all energy stakeholders, worldwide, is enhancing the quality of life of human beings, which petroleum has sustained over, at least, my lifetime. Nigeria may not farewell disrupting its energy landscape for environmental sustainability at the expense of energy equity and security to drive its economy with energy affordability, accessibility, assurance, and applicability.

Professor Emeritus Omowumi Iledare

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Interestingly, tackling the global warming phenomenon requires strategic thinking to find the best transition pathway from fossil fuels to non-fossil fuels keeping in perspective the energy trilemma dimensions—energy security, energy equity, and environmental sustainability on one hand. On the other hand, Nigeria must keep in perspective the energy-economy-and-environment nexus. This implies finding the best pathway to disrupt the energy landscape that safeguards energy affordability, availability, acceptability, and accessibility, eventually, is critical. Disrupting the energy landscape in Nigeria, rapidly, without strategic thinking, may more likely than not lead to high energy poverty index, a diminished economy, and a defaced environment. It is not conjectural that a disruption in the global energy landscape, apart from being a threat to balancing the energy trilemma dimensions may upset the global energy dynamics, the economy, and the environment for best sustainable development.

In fact, disrupting the energy landscape in a petroleum dependent economy like Nigeria, implies a rapid increase in the use of renewable energy, all things being equal, translating to a decrease in the use and production of fossil fuels in Nigeria. This decrease will be a loss to agents in this petroleum-dependent economy and with a high incidence of economic vulnerability. Also, rapid energy transition, which really is a form of energy landscape disruption may also increase the volatility of petroleum prices and therefore increases the vulnerability to either energy equity, economic security and or environment, respectively in Nigeria. Technology adoption offers a pathway to perfect energy supply mix and natural gas eases the desired reduction of carbon emissions with less unintended consequences in the journey to net-zero carbons emissions target in 2060 for Nigeria.

As mentioned earlier, carbon dioxide emissions are the primary driver of global climate change and to avoid the worst impacts of climate change, the world needs to urgently reduce emissions. But reducing emissions does not necessarily imply reducing oil and gas extraction to quite a lot of regions worldwide. Sharing equitably the responsibility between regions, countries, and individuals has been an endless point of contention in international discussions. The reasons for the contention are obvious and they anchor mostly on energy security, energy sustainability and energy equity aptly described as energy trilemma. Some regions are more energy secured than others, while energy equity in terms of affordability and accessibility leaves much to desire in some regions. Yet the need for environmental sustainability cuts across the globe even though contributions to carbon emissions differ significantly, across the regions. Africa, for example, contributes cumulatively to date, less than 3%, of the aggregate CO2 emissions.

Nigeria, which is energy poor has anxiety, and rightly so, that abandoning its fossil fuels for renewables, will more likely than not, reduce the ability to supply reliable and affordable energy to households and commercial users. This makes Nigeria very vulnerable in in terms of energy equity. Nigeria is among nations with the lowest average consumption (15 GJ/head) and its people still use some form of wood fuel as their primary source of domestic energy. Physical and economic access to modern energy sources, despite oil and gas production over the years, remain elusive, buttressing home the fact that having

resources without being resourceful can be detrimental to energy equity and security eventually. Adopting energy transition, requires a lot more strategic thinking and apolitical planning than sentiments or mantra, like the decade of gas mantra, in Nigeria.

Invariably, then, energy landscape disruption demands strategic thinking and planning keeping in perspective the economy, environment, and energy sustainability, each of which cannot exist in isolation. Nigeria cannot because of environmental sustainability abandon cheaper power sources to keep energy affordability. Neither can it adopt more expensive renewable energy, which promotes environmental sustainability. Such choices seem like classical energy sustainability and equity quandary. Additionally, Nigeria with a poor energy infrastructure and low technology, can it afford to import expensive sources of energy and compromise energy affordability? This allows importation of more affordable sources, which compete with ambitions for more sustainable energy. This is also a classic rapidity versus adaptability quandary in this energy landscape disruption discourse. Nigeria must not take the baits of aids and grants to abandon its abundant resources in the race to reach environmental sustainability at the expense of energy security and equity.

Thus, an energy mixed roadmap with natural gas as the fuel of the future in Nigeria seems to be worthy of exploration. Gas-to-power strategy along with hydroelectricity expansion, and renewable energy policy is a good step that Nigeria has taken. In fact, the design of the Nigeria fiscal framework in the Petroleum Industry Act 2021 lends credence to the decade of gas mantra of the Federal Government in Nigeria. The three classical instruments, taxation, the royalty scheme, and incentives are highly favorable to natural gas development for domestic consumption. The infrastructure fund for midstream natural gas investments supports the shift. Of course, government in Nigeria still struggles with petroleum subsidy removal, which is antithetical to a smooth energy transition because subsidies crowds out private investment significantly and makes ineffectual Forex management and the aggregate money supply. Of course, removing oil subsidies qualifies as a good disruption in the energy landscape in Nigeria.

To balance energy security in terms of current and the future at a reliably affordable price and energy sustainability in terms of high environmental quality in production and use of energy is a laudable strategy. Additionally, energy mix enhances best resource depletion path limiting high price volatility and shocks to the global economies. For Nigeria with a cumulatively low emissions so far estimated at less than 1.2 percent of global emissions in a cumulative sense and abundant natural gas resources, disrupting the energy landscape toward gas is not complicated though it requires a transformational leadership mindset.

Further, energy mix strategy offers Nigeria the opportunity to improve the growing energy poverty even as technological advancements help to mitigate carbon emission from oil and gas production. This is ongoing right away with the emerging carbon capture and use technology. Adding renewables to energy resources at a pace not detrimental to energy equity is good; the comparative advantage of natural gas offers a complementary option. The unsustainable foreign aid or grants mentioned earlier must not limit natural gas

development. Additionally, energy mix protects countries from energy supply vulnerability and strengthens energy security. It also protects us from market risks such as fluctuations in supply or pricing. Energy mix reduces the risks posed by political unrest or natural disasters and the development of renewable resources such as solar and wind power diminishes the threat of energy scarcity.

Disrupting the energy landscape towards renewable in Nigeria rests on government because it is policy issue. Government must set the best speed for transition agenda and cooperates with regional allies. Energy institutions with frameworks to attract investment by rewarding entrepreneurship and innovation and constraining inefficiency and waste can help. Public-private partnership adoption in finding and developing energy sources based on comparative advantage is desirable. The type of investment fund required for the energy mix strategy that includes petroleum must come from within. The proposed Africa Energy Bank with headquarters in Nigeria is a noble idea.

Finally, transformational leadership in the energy sector in Nigeria is essential to play in the evolving global energy landscape. Meaning transactional leadership with Esau's syndrome must not hinder finding appropriate solution to energy landscape challenges. The management team must have operational control skillsets and own the capability to be an effective manager of the energy workforce. Professional promotion must be apolitical among the cadre. Energy global landscape calls for a rekindling of the engineering education in Nigeria. Further, it is important to rekindle technical education. The relevance of technical education for sustainable national and economic development is not conjectural. Energy is life, its consumption drives prosperity and sustainability. Nigeria must go after a robust energy mix driven purely by economics, technology, public policy, and good governance. The evolving through Strategic thinking, which disavows political expediency, Nigeria needs energy transition framework that balances energy security, equity, and sustainability with a transparent and accountable mindset.

A FRAMEWORK FOR ASSESSING ENERGY SECURITY IN NIGERIA AMIDST THREATS AND DISRUPTIONS

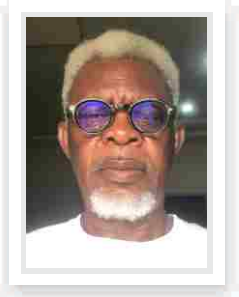
Uche Collins NWOGWUGWU *PhD. MNES, MNAEE, FISDS, PHF*

1. Overview

Energy security is the assurance that when the switch is turned on, the light will always come on. Developed economies are built with a secure energy supply. Nigeria has the lowest access to electricity globally, with about 92 million persons out of the country's 200 million population lacking access to power, the Energy Progress Report 2022 released by Tracking SDG 7 has revealed. (https://punchng.com, 5th June 2022). India, for instance, has declared that access to electricity is a legal right. Access to electricity has been identified as the biggest obstacle facing businesses.

Low-income countries are weighing any effect of access to finance, corruption, and other political instability issues, albeit access to power overrides all these other concerns. Over half of the people in least-developed countries lack access to electricity. UNCTAD calculations show that in 2019, more than half of the people living in LDCs lacked access to electricity. This is equivalent to some 570 million people, or about two-thirds of the world's population, without electricity. UNCTAD calculation is based on data from the International Energy Agency and UNCTAD stat (July 2021). Around 93% of the people from the developing world saw electricity for the first time through coal; there are more than one billion people who still do not have access to grid power the world over, depending on self-generating sets or other non-modern means. These peoples' lives, education, health, and welfare will improve as they move on to the grid, and sustainable development goal 7 encourages nations to ensure that they do so whilst at the same time ensuring that this new power demand is met sustainably.

There are many non-renewable sources of energy driving the global economy. In the meantime, most renewable sources of energy, such as wind and solar energy, are either not consistent, are not predictable, or are not dispatchable. That means that we cannot assume that they are going to be there when we need them most, and they cannot be relied upon to form the basis of a secure energy system. Hospitals, schools, industries, and so on need reliable power at all times, and so until significant amounts are made in batteries to enhance energy storage, renewable energies simply cannot supply the base load needed for a fully modern economy. It can be part of the mix, but it cannot be the whole mix. This is why, despite the reduction in coal and gas in many regions, coal and gas have



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4. : United Nations Office for Disaster Risk Reduction. Visited

not been removed completely. They will remain until another feasible base-load alternative is found. So, energy security, as well as reliable and consistent delivery of energy to a population, is by far the strongest pull in any corner of the energy trilemma. Until the intermittency and dispatch ability of the renewables can be addressed, grids have to cope with far more variables and inputs and have to deal with greater fluctuations.

Wind and solar are critical pillars of the World's efforts to tackle climate change, reduce air pollution, and provide energy access to all. Their declining costs are a huge opportunity. But power systems need to become more flexible, and market designs must be adapted to avoid unintended impacts on energy (electricity) security. Fatih Berol, the Executive Director of the IEA, stated that renewable energy systems are causing a static change in the energy market, and this will need to be facilitated carefully to ensure the security of the energy supply. Much renewable energy is needed to get onto the grid, albeit, at the moment, the grid is not ready for intermittency and availability of renewables, unlike the base-load energy mix of coal, oil, gas, and nuclear. (Onyedikachi et al 2022)

2. Conceptual Review

Three perspectives of energy security: the three perspectives on energy security have their roots in separate disciplines: political science (the sovereign perspective), natural sciences and engineering (the robustness perspective) and economics (the resilience perspective). They differ with respect to their focus on different energy security threats and response strategies.

Table 1: Summary of thethree perspectives on energy security

	Sovereignty	**Robustness**	**Resilience**
Historic roots	War-time oil supplies and the 1070s oil crisis	Large technological accidents, electricity blackouts, concerns about scarcity	Liberalization of energy systems
Key risks for energy systems	Intentional actions by malevolent agents	Predictable natural and technical factors	Diverse and partially unpredictable factors
Primary protection mechanism	Control over energy systems, Institutional arrangements preventing disruptive actions	Upgrading infrastructure and switching to more abundant resources	Increasing the ability to withstand and recover from various disruptions

Source: Cherp and Jewell, 2011

Energy security is a multifaceted concept, and it has four particular relevant dimensions in the current environment viz:

i. Physical disruption of supplies resulting from infrastructure breakdown, natural disasters, social unrest, political action or acts of terrorism;

ii. Long-term physical availability of energy supplies to meet growing demand in the future;

iii. Deleterious effects on economic activity and people due to energy shortages, widely fluctuating prices or price shocks, and

iv. Collateral damage from acts of terrorism resulting in human casualties, serious health consequences or extensive property damage.

on 31/8/22 by George Kowalski & SeadVilogorac

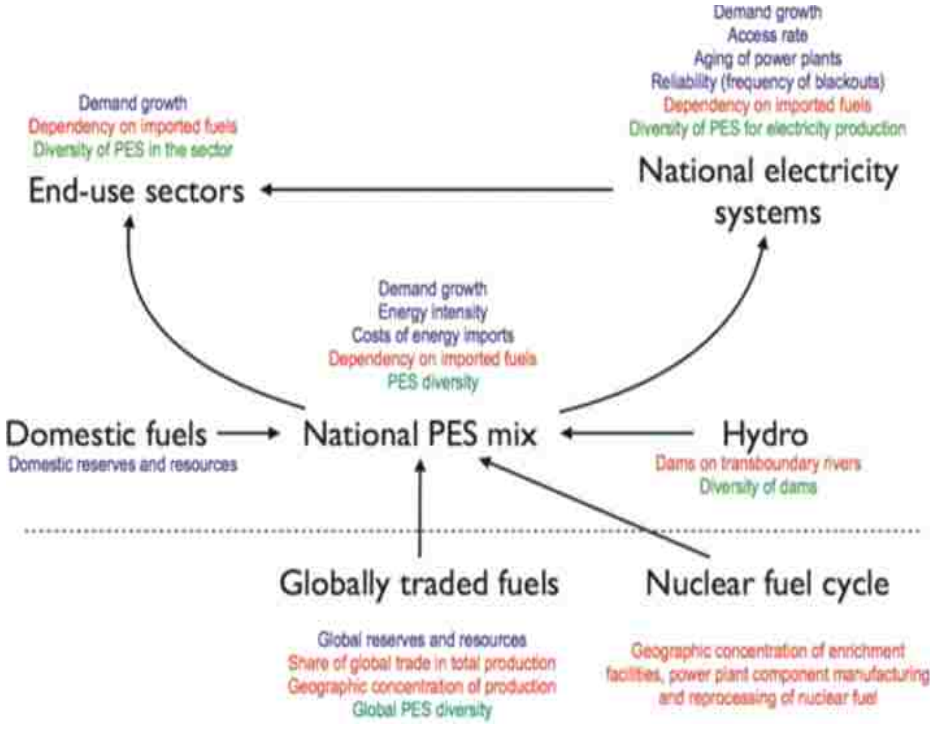
5. World Energy Council, World Energy Trilemma; Trilemma Index, African Regional Profile, 2021 in partnership with Oliver Wyman
6. https://whateverworks.oil
7. Cherp, A. & Jewell, J. (2011). The three perspectives on energy security: intellectual history, disciplinary roots, and the potential for integration. *Current Opinion in*

Against the above background, energy security may thus be defined as "the availability of usable energy supplies, at the point of final consumption, at economic price levels and in sufficient quantities and timeliness so that, given due regard to encouraging energy efficiency, the economic and social development of a country is not materially constrained".

Particular points that emerge from the definitions are:
· The long-term physical availability of energy supply to meet the growing future demand for energy;
·The future availability of energy resources;
·The reliability of energy supplies,
·The deliverability through infrastructure development and
·The affordability of energy by consumers (https://www.unisdr.org

3.Energy Security Assessment Framework

Presented here is a framework that addresses the security of national energy systems with a focus on energy sources, carriers, and strategic energy services. The figure shows the elements of energy systems and their interconnections accounted for in the framework. The blue, red, and green text indicate concerns related to the three perspectives on energy security (see Fig 2) – robustness, sovereignty, and resilience, respectively. The dotted line separates external and domestic factors.
(Cherp, 2015)



Source: Cherp, 2015

4. Assessing the Performance of Energy Security through the Trilemma Index of African Regional Profile

The Energy Trilemma index, a construct of the World Energy Council, considers the soundness or otherwise of a country's economic and social development from how it interacts with the energy system. This is considered by weighing and examining the availability and exploitation of three things: energy security, Energy affordability, and environmental sustainability. The best performers in the index include Sweden, Norway, the UK, USA, amongst others. From the Energy Security dimension, the top five African performers are Angola, Kenya, Gabon, Cote d'Ivoire, and Egypt, with Nigeria dropping out of the list of top performers this year. Angola has been amongst the top ten global performers for the past three years and is continuing on its positive trajectory. Angola is a major oil-producing and oil-exporting country, and a member of OPEC, and oil revenues continue to dominate the economy. The country is exploiting its oil reserves while maintaining a low-carbon generation mix that includes 58% hydro and has developed an integrated transmission network to improve electricity supply across the country. All top five performing countries have developed their energy resources to meet their domestic energy demands while also establishing energy efficiency programs and increasing the deployment of renewable energies that have improved the reliability of their energy systems.

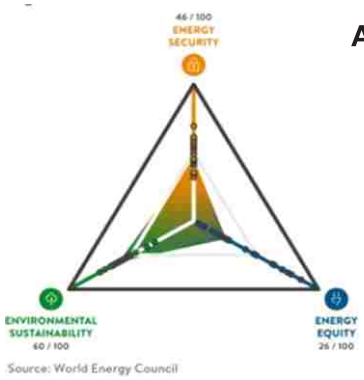
Several countries in the region have shown substantial progress in their energy security scores since 2000, including Kenya (+59%), Tanzania (+51%), Ghana (+40), Senegal (37%), Eswatini (+37%), Cameroon (+35%). However, three countries fell back over the same period: Egypt (-5%), Algeria (-4%), and Mauritius (-2%).

Many African countries scored C or D for Energy Security in 2021. This low performance is generally caused by a lack of capacity to develop a reliable and secure energy supply, but it also relates to some cumulative factors depending on the countries' specific circumstances. The most relevant factors contributing to a low energy security score include lack of adequate investment, significant energy infrastructure gap, shortage of energy supply and energy services, insufficient power generation capacities, inadequate T&D networks, non-reliability of the power supply with increased power shortages; substantial technical and commercial electricity loses; terror attacks and sabotages of pipelines, political and social instability.

The implementation of centralized and decentralized grids offers a promising opportunity to provide sustainable access to electricity in rural areas. Accordingly, many countries in the region need to promote these technologies (including micro-grids for off-grid and grid-connected), an innovative and disruptive distributed generation adoption (pay-as-you-go solar power systems and product bundles) (WEC, 2021).

Environmental Sustainability, 3(4), 202-212. https://doi.org/10.1016/j.consust.2011.07.001

8. Presentation at NAEE Conference Abuja. July 2022 Onyedikachi Nwogwugwu et al.
9. Cherp, A., Adenikinju, A., Goldthau, A., Hernandez, F., Hughes, L., Jewell, J., Olshankaya, M., Jansen, J. Soares, R., & Vakulenko, S. (2012). Energy and Security. In T.B. Johansson, N. Nakicenovic & A. Patwardhan. (Eds.) \ *Global Energy Assessment: Towards a Sustainable Future (pp. 325-383).* Cambridge University Press. http://www.globalenergyassessment.org/
http://www.wtrg-com/oil_graph/oil/price197a.gif



African Trilemma Balance

5. Framework for Analysis of Energy Security

The framework for the analysis of energy security within Nigeria is based on her characteristics, vulnerabilities, selection, and interpretations of relevant indicators. Critical concerns are (i) *threats to energy security and (ii) disruptions*.

i. Threats to energy security. Threat to energy security can mean any potential hazard that exists or does emerge within or outside an energy system that can result in some form of disruption of the energy system. This may comprise *technical, natural, socio-political, economic, or environmental.* In the present globalized world, the monopoly that oil has on the transport and electricity sectors represents a massive economic risk that is extremely expensive and time-consuming to reduce. The greater the dependence a country has on oil, the greater the consequences would be when the flow falters. Thus, energy security boils down to adequate, affordable, and reliable supply.

The reliable supply was traditionally linked to the geopolitics between exporters and importers and the long-term supply contract they shared. Today's oil is largely traded on world markets and involves numerous middlemen therefore, geopolitics has become far less of a factor. Like most commonly traded items, oil is something called a fungible commodity. This means that oil can be easily interchanged or exchanged and allows shortages or restrictions in one part of the world to be quickly overcome through multiple trades so the oil gets where it needs to go. Effectively, all of the world's oil producers pour oil into one central repository, and all consumers pay for the privilege of sucking it out. In a classic supply and demand situation, the reliability of supply is determined by there being enough space capacity in the system to cover this demand and not by which particular country you live in. Like many systems, it does not run 100 percent of the time; there is always some space capacity in the system. The oil industry tries to stay ahead of the game by investing in a new supply. However, this can be eroded at any time by unpredictable events, including accidents, armed conflicts, and fickle Mother Nature.

Nigeria is one of the largest and oldest oil producers in Africa and the world's fourth-leading exporter of liquefied natural gas (LNG), despite continuing instability and corruption that frequently disrupt at least some of Nigeria's energy industry activities. The country possesses an estimated 32.7 billion barrels of proven oil reserves, making it the largest producer in Africa. In addition to these 32.7 billion barrels, Nigeria also possesses 165 trillion cubic feet of natural gas, which includes 75.4 trillion cubic feet of non-associated

10. http://www.wtrg.com/prices.htm
11. http://www.macrotrends.net/1369/crude-oil-prices-history.chert>crude
12. crude oil history chart GEA 2012
13. World Data Atlas Nigeria Topics World Rankings World Rankings
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15. Nkwoh, Benedicta (2022). Electricity and Power Systems in Nigeria. Commercial Service, U.S. Consulate General, Lagos Nigeria
16. Extractive360.com (visited 1.51am 9/23/2022) *Nigeria To Account for 35% of Africa's New Oil Pipelines by 2023*
17. Gboyega, A., Søreide, T., Minh Le, T., Shukla, G. P., (2011) Political Economy of the Petroleum Sector in Nigeria. *The World Bank Africa Region Public Sector Reform and Capacity Building Unit*
18. Ariweriokuma, Soala. 2009. The Political Economy of Oil and Gas in Africa. London and New York: Routledge

gas, and according to Mele Kyari (2019), 70% of Western African energy supply originates from Nigeria. The oil and gas sector is one of the most important sectors in the country and accounts for more than 90% of the country's exports and 80% of the federal government's revenue. The country is the ninth-largest in terms of global gas reserves, with over 193.3 Tcf. Nigeria continues to struggle to provide energy resources to the global market due to a lack of supply and security demands within the country. In 1956, Nigeria began its production of oil with 5,100 bpd; moreover, with the continual expansion of energy infrastructure after joining OPEC in 1971, Nigerian capabilities of oil production steadily increased toward 2.32 million bpd of crude and condensate oil at $60 a barrel in 2019.

Technical Threats

Approximately 70 percent of Nigeria's oil production is accomplished by joint ventures (JVs) and another 25 percent by production-sharing contracts (PSCs). Five major international oil companies (IOCs)—Shell, Exxon-Mobil, Chevron-Texaco, Total, and Agip—currently are engaged in JV operations with the Nigerian government. In these JVs, the Nigerian government (via NNPC) holds 60 percent of the equity. The government has made many efforts to bring indigenous companies into oil production via marginal fields and other schemes, but so far, they are not major players in the industry. The lack of vital infrastructure is contributing to other security threats on the supply and demand sides of the Nigerian energy sector. In addition to the illicit trading of hydrocarbons, Nigeria's ageing infrastructure frustrates potential supply expansions meant to meet domestic demand. Approximately 55% of the population, around 95 million Nigerians, lacks access to adequate electricity, while those who do have access experience constant power disruptions. As a short-term remedy, Nigerians have relied on self-power generation through solid biomass (wood, garbage, and waste).

Regarding Nigeria's electricity grid, Nigeria's electrification rate is 'reported to be at 45%, which is far lower than Ghana (72%) and South Africa (85%). The problem for Nigeria is the lack of maintenance and repair, direct investments, and obsolete equipment, as energy distribution companies are not able to 'accumulate the necessary revenue to pay full market costs, which in turn further hobbles energy suppliers. One of the main failures of Nigerian electricity generation stems from transmission losses during distribution. The main challenges here are chronic vandalism and targeting of electrical infrastructure by militias and insurgents, high commercial losses, and, again, the lack of investment in maintaining the overall infrastructure.

Natural Threats

Oil and gas production is concentrated in 9 out of 36 states in Nigeria—Abia, Akwa Ibom, Bayelsa, Cross River, Delta, Edo, Imo, Ondo, and Rivers, with the five core states accounting for more than two-thirds of production. The Niger Delta basin is the largest along the West African coast; it has 246 production fields and 3,446 active wells.

According to the estimates by BP (2010), Nigeria has proven reserves of over 37 billion petroleum barrels and more than 5 trillion cubic meters of natural gas in 2008. Nonetheless, while proven reserves of petroleum have risen steadily, petroleum production fluctuated during 1996-2008 and notably took a dip from 900 million barrels in 2004 to below 800 million barrels in 2008. For natural gas, proven reserves increased substantially from 1.2 trillion cubic meters in 1980 to 5.2 trillion cubic meters in 2008, which is in sharp contrast with the modest increase in other Africa's proven reserves during the same period.

Socio-Political Threats - Corruption

From its inception, oil production in Nigeria has been associated with a widening of the income gap as well as increasing poverty and corruption of state institutions. Weak control of petroleum governance made corruption possible.

Small-Scale Petroleum Theft versus Organized Crime

Losses occur in different ways and volumes. Small-time operators who tap into oil pipelines are not confined to the Niger Delta. They are spread all over the country where the pipelines pass. Criminals trying to steal refined petroleum products for distribution through informal retail outlets have caused periodic pipeline accidents in Lagos and other areas outside the Niger Delta. Numerous small-scale crude oil thieves also steal the oil for refining in illegal local refineries. Between June and July of 2008, the military Joint Task Force (JTF) destroyed 111 illegal refineries that were located —in almost every village in Bomadi and Burutu Local Government areas (This Day 2008, 1). Although bunkering is a large problem for the government, those involved seem to defend the crime by reference to low political accountability.

Those engaged in large-scale oil theft break into pipelines in the Delta mangrove swamps and load stolen oil into smaller barges and ships that then go on the high seas to load huge ocean tankers. Another form of large-scale bunkering is the loading of crude over approved or rightful quotas by licensed operators (Azaiki 2006, 268). Given the highly visible nature of oil theft, it would appear that there must be either payoffs or the participation of security forces. As the bunkering gets large and organized, it has a clear demand side. Large-scale stealing of oil by large ocean tankers involves international organized crime groups, which buy the oil and take it to refineries abroad for refining. The payoff from this type of bunkering must be exceedingly profitable to keep people investing in such a risky venture. For instance, in September 2007, the Navy announced that it had seized 260 vessels used for illegal bunkering (Leadership (Abuja) 2007). On July 11, 2008, the JTF arrested a tanker (MT Lina Panama) owned by a Greek company called Corinthians laden with 150 metric tons of Nigerian crude oil suspected to be stolen from a Nigerian Agip Oil Company's facility. The federal government has blamed the noncooperation of the international community and the lack of capability of Nigeria security operatives for the persistence of large-scale bunkering.

Indeed, as bunkering has persisted and grown profusely over the years, many Nigerians believe that the security agencies, especially the Navy, may be aiding and abetting illegal bunkering (Gillies 2009; Huillery 2007); it was told on July 26, 2009, that satellite images prove collusion of

an international criminal cartel and that Nigerian security ought to be able to stop the small barges that feed the ocean tankers on the high sea (This Day 2009, 10). In 2003, the issue of informal excess lifting of crude oil at export terminals was brought before the National Assembly when the chair of the House Committee on Petroleum claimed that the country was losing about N100 billion annually from such activities by the international oil companies (IOCs) (Azaiki op. cit, 267). These losses pose a significant risk, particularly given weaknesses in the system of checks and balances in the various institutions monitoring the oil industry, including security.

Government Response: From Tolerance to Incapacity?

The government falters to deal decisively with the extensive bunkering probably due to the payoffs from the bunkering, which are spread quite broadly among entrenched interests in the oil communities (see Onuoha 2008; Watts 2008). The prevailing violence in the region also constrains military action. The violence is perpetrated in small communities where people are forced to join criminal gangs for sheer survival, acquiesce to illegal bunkering for self-protection, or flee the communities for safety. Security operatives explain that the government is restrained from acting against the different forms of illegal bunkering because of the potentially high secondary damages, especially loss of innocent lives. Not even those in positions of authority at the local level can escape the intimidation and violence used by those engaged in illegal bunkering. Traditional rulers and even local government chairs are pressured to succumb to the prevailing order. If these officials fail to acquiesce, bunkers can incite rebellion in the community or attempt to assassinate them. —the soldiers and the community leaders are involved; in fact, it is they who are the masterminds of these things (The Nation 2008, A13).

As corruption, poverty, and unemployment remain high for young Nigerians, Nigerian energy security incorporates illicit hydrocarbon trading as employment opportunities for Nigerian villages, which provides the oil needed for daily life. Direct targeting of Nigerian oil pipelines by militias, frequent electrical blackouts from faulty electrical grids, and ageing oil refineries contribute to the country's struggle with energy stability and productivity. For Nigeria to successfully utilize its energy resources and develop its economy, the government must address social, political, security, and financial choke points that are hindering Nigerian production and development.

Hydrocarbon theft continues to deprive the Nigerian government of vital revenue and energy sources, therefore diminishing investor confidence. The actions of illicit hydrocarbon theft proliferated when oil prices rose above $100, and the Nigerian energy market became profitable and has expanded into five main categories of operations: small-scale theft and illegal local refining; large-scale illegal bunkering in the field; theft at export terminals; theft from fuel trucks; and oil tanker hijackings. Due to the Gulf of Guinea being relatively shallow, Nigerian offshore drilling locations, oil tankers, and terminals are subjected to piracy due to the lack of physical security. It is estimated that approximately 400,000 bpd are stolen from Nigerian energy terminals, refined in bush regions of the Niger River Delta. At the height of militia operations in 2016, the Niger Delta Avengers targeted Nigerian oil pipelines to force the government to distribute higher percentages of energy revenue to communities. These concentrated attacks on

Nigerian oil and gas pipelines accumulated a loss of 1.5 trillion naira or $3.8 billion in current inflation rates. The diminishing of the Nigerian energy supply due to violent militias, political corruption, and hydrocarbon theft deter foreign and domestic investors from participating in the energy industry, thus leading to a dearth of necessary investments for modernizing energy output and expanding current infrastructure networks to provide for growing domestic demand.

Environmental Threats

Among the environmental threats to livelihood and economic activities, including oil exploration and exploitation in the region, is water flood, the worst of which was witnessed in the year 2022. Environmental issues also hamper the success of Nigeria's energy sector. Between 1970 and 2000, the Nigerian government recorded 7,000 oil spills; another 1,693 spills have occurred since 2007. 14,000 tons of crude oil spilled into the Niger River in 2009; there were 62 oil spills in 2017 and another 111 oil spills in 2018. The Nigerian environmental disaster is closely connected to delayed government action intended to keep multinational energy companies and Nigerian corporations accountable to environmental standards and protections because Nigeria is heavily dependent on revenue from the supplying of Nigerian crude oil and liquefied natural gas. As environmental depletion continues in the Niger Delta, poverty levels increase in tow, and so too do attacks on Nigerian pipelines.

Illicit hydrocarbon trading also increases as local militias and warlords compete over those finite natural resources that have yet to be impacted by worsening environmental conditions. In addition to continual oil spills and a lack of environmental protection initiatives from the Nigerian government, the usage of solid biomass fuels exacerbates pollution. According to International Energy Agency projections for 2018-2030, in 2018, 67% of Nigerians (131,320,000 people) used a solid biomass fuel (wood, garbage, and waste) other than charcoal, LPG (Liquefied Petroleum Gas), electricity, gas, biogas, or biofuels as a means to cook food. By 2030, when Nigeria is projected to have a population of 263 million people, only 15% of the population will utilize electricity, gas, biogas, and biofuels as a means to cook food, while 51% of the population will continue to use solid biomass fuel; 5% will use charcoal, and 8% will use LPG.

ii. Energy System Disruption

Seba (2014) argues that the Stone Age did not end because humankind ran out of stones. It ended because rocks were disrupted by a superior technology: bronze. Stones didn't just disappear. They just became obsolete for tool-making purposes in the Bronze Age. The horse and carriage era did not end because we ran out of horses. It ended because horse transportation was disrupted by superior technology, the internal combustion engine, and a new, disruptive 20th-century business model. Horses didn't just disappear. They became obsolete for mass transportation.

The age of centralized, command-and-control, extraction-resource-based energy sources (oil, gas, coal, and nuclear) will not end because we run out of petroleum, natural gas, coal, or uranium. It will end because these energy sources, the business models they employ, and the products that sustain them will be disrupted by superior technologies, product architectures, and business models. Compelling new technologies such as solar, wind, electric vehicles, and

autonomous (self-driving) cars will disrupt and sweep away the energy industry as we know it. Seba (2014) submits that "The same Silicon Valley ecosystem that created bit-based technologies that have disrupted atom-based industries is now creating bit- and electron-based technologies that will disrupt atom-based energy industries".

i. *Clean Disruption of Energy and Transportation*
The industrial era of energy and transportation is giving way to an information technology and knowledge-based energy and transportation era. The combination of bit-based and electron-based technologies will put an end to conventional atom-based energy and transportation industries. The disruption will be a clean one and have the following characteristics:

ii. *Technology-based disruption*.
The clean disruption is about digital (bit) and clean energy (electron) technologies disrupting resource-based (atom-based) industries. Clean energy (solar and wind) is free. Clean transportation is electric and uses clean energy derived from the sun and wind. The key to the disruption of energy lies in the exponential cost and performance improvement of technologies that convert, manage, store, and share clean energy.

iii. *Flipping the architecture of energy.*
Just as the Internet and the cell phone turned the architecture of information upside-down, the clean disruption will create an energy architecture that is different from the one we know today. The new energy architecture will be distributed, mobile, intelligent, and participatory. It will overturn the existing energy architecture, which is centralized, command-and-control oriented, secretive, and extractive.

iv. *Abundant, cheap, and participatory energy.*
The clean disruption will be about abundant, cheap, and participatory energy.
The existing energy business model is based on scarcity, depletion, and command-and-control monopolies. The clean disruption is similar to the information technology revolution that overturned the old publishing and information model and made information abundant, participatory, and essentially free.

v. *Clean disruption is inevitable.*
The clean disruption of energy and transportation is inevitable when you consider the exponential cost improvement of disrupting technologies, the creation of new business models, the democratization of generation, finance, and access, and the exponential market growth

vi. *Clean disruption will be swift.*
Energy disruption is happening now. It may be over by 2030 or perhaps before. Oil, natural gas (methane), coal, and uranium will simply become obsolete to generate significant amounts of electricity and power the automobile. These energy sources will still have uses. For example, uranium will be used to make nuclear weapons, and natural gas will be used for cooking and producing fertilizer. Obsolescence and clean disruption will not put an end to incumbent industries. We still have vinyl records, sailboats, and jukeboxes. These niche market products will survive, but energy and

19. Azaiki, S. 2006. Oil, Politics and Blood: The Niger Delta Story. Ibadan: Y-Books.
20. Azaiki, S. 2007. Oil, Gas and Life in Nigeria. Ibadan: Y-Books.
21. UNCTAD (2021) Over half of the people on LDC lack access to electricity, *United Nations Conference on Trade and Development* Geneva 10, Switzerland
22. Elendu, Chidi (2022) Energy Systems Evolution:

transportation will not be the multi-trillion dollar energy heavyweights that they are today.

The disruption of energy and transportation as we know it today is being led by three main sets of technology-based products:

1. Solar: Solar is on its way to disrupting all forms of conventional energy. Solar is already cheaper than nuclear. It's already cheaper than retail electricity in hundreds of markets around the world, from Berlin to Seville to Palo Alto. In some markets, solar has already pushed wholesale electricity prices down by as much as 40 percent. Solar photovoltaic (PV) companies have decreased their costs by a factor of 154, a classic technology cost curve. Technology companies have an unparalleled record of lowering costs exponentially while increasing quality exponentially. The same economics that governed digital cameras, disk drives, microprocessors, routers, and mobile phones now govern solar PV technology development.

2. Electric vehicles: The electric vehicle is already better, faster, and safer than the internal combustion engine (gasoline) vehicle. Electric vehicles (EVs) are also cheaper to operate and maintain. An electric vehicle is still more expensive to purchase upfront, mainly due to battery costs.

However, like other technology products, the technology cost curve of EVs points to a disruption soon; innovative business models will only accelerate the transition from gasoline vehicles to electric vehicles. Internal combustion engine car companies will have their Kodak moment sooner than they think. By 2025, gasoline-engine cars will be unable to compete with electric vehicles.

3. Autonomous (self-driving) cars: Autonomous (self-driving) vehicles will soon be better, faster, cheaper, and safer than vehicles driven by human drivers. The disruptive wave brought about by self-driving cars will wipe the last vestiges of the gasoline car and oil industries. Elendu (2022) sees energy systems evolution as a disruption of the status quo ante. With the upsurge of renewable energy technologies, which have been described as infinite, inexhaustible, and replenishable at a reasonable rate, the disruption has set in biomass. Bio-gas/biodiesel and biogas belong to this categorization called clean energy, which is preferred by many.

A Disruption of the Status quo. Thisdaylive.com visited 15th October 2022 at 20.43pm

23. Seba, Tony (2014) Clean Disruption of Energy and Transportation: How Silicon Valley is Making Oil, Nuclear, Natural Gas, and Coal Obsolete by 2030. *Clean Planet Ventures,* Silicon Valley California USA www.tonyseba.com
24. Backgrounder: Nigeria's Energy Security Dilemma. 'Backgrounders - July 14, 2020 by 'Semaj N. McDowell https://onepetro.org/IPTCONF/proceedings
25. http://www.bp.com>out-look...

ANALYSING THE PROSPECTS OF DEVELOPING MODEL 3-IN-1 HYBRID ENERGY FARMS IN NIGERIA.

Tubi, O. Theophilus

Introduction

Nigeria, with its' weak human capital development, is ranked 152 of 157 countries on the Human Capital Index, with 2019 national inequality index (Gini-Coefficient) recorded at 35.1%, while GDP growth rate was 1.9% in 2018 and 2% in the first half of 2019, leading to a high incidence of unemployment and underemployment measured at 43% in 2018 and a poverty rate of 40.1% of total population, in 2019, indicating 83m Nigerians are living below the national poverty line, earning below N11,452.50k monthly, N382 ($1.1) a day (NBS, 2020).

Energy Poverty is a leading cause of individual poverty and worsening socioeconomic indices in Nigeria and most of Sub-Saharan Africa. It is a phenomenon that is progressively worsening due to the geometric increase in population and less than arithmetic increase in investment in energy resource development and energy-related infrastructure. Lack or limited access to energy by individuals and firms stifles growth and development. As Rockefeller Foundation president Dr. Rajiv J. Shah noted, "We cannot end poverty without ending energy poverty. Despite recent progress, the world is not on track to solve this problem by 2030. Now is the time to unleash the full potential of distributed energy by integrating the strengths of Grid and off-grid systems…"

There is a growing awareness of Nigeria's electricity generation and consumption constraints as a hurdle to more economic prosperity and development. The per capita electricity consumption in 2015 was only 0.15 MWh/capita (or 0.69 toe/capita), compared to South Africa with 4.0 MWh/capita and Ghana with 0.3 MWh/capita. (Siemens AG, 2019). To satisfy the evident and urgent need to close the electricity consumption gap with peer countries in Africa to meet local demand, the power generation consumption per capita needs to increase at least 8-fold in the first instance to meet GDP projections. As the largest economy in Africa (NBS, 2016) and one with a desire to rival the 20 best economies in the world (Vision 20:2020), there is a clear requirement to equal and surpass countries such as Ghana and South Africa the very least in terms of electricity generation and consumption. There are, therefore, compelling reasons for the country to generate sufficient power to meet both present and future demand. Additional investments in the overall energy supply chain are necessary to drive the ambitious GDP growth expectations. This is what we set out to confront in this paper and proffer possible solutions for adoption and immediate implementation.

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Nigeria generates grossly insufficient power, with a potential to generate (13 GW) 13,000 megawatts (MW) of electricity from existing plants, but most days only able to generate (4 GW) 4,000 MW with a transmission wheeling capacity of (7.5 GW) 7,500 MW and network operational capacity of (5.5 GW) 5,500 MW, with highest peak generation ever attained being (5.2 GW) 5,222.3 MW. (TCN, 2020). Joy Ogaji, Executive Secretary of the Association of Power Generation Association Companies (APGC), stated that peak generation has also been reported at (8.5GW) 8,500 MW by the end of April 2020. Bello, (2020). There are plans underway, in partnership with Siemens AG, to modernise the existing network and gradually enlarge it to produce and distribute (25 GW) 25,000 MW. Bloomberg (2020). Four years down the line, we still eagerly await the first and second phases of the SIEMENS deal to be completed.

With an electricity access rate of 45%, 36% rural and 55% urban, there are 20 million households without power even as the country targets universal electricity access by 2030. Nigeria recorded a total consumption of 24.72 billion kWh of electric energy for the year 2015, which is a per capita average of 126 kWh, compared to 5,518.12 kWh for Europe (USAID, 2020). There is very little that can be achieved in relation to the inherent economic potential realisation. *{Note that The Gigawatt (GW) = 1billion Watts or 1,000 Megawatts (MW).}* So, one of the critical challenges for Nigeria and, indeed, Africa is the generation of power. Power consumption per capita in Africa is the lowest of all continents, currently estimated at 613 kWh per annum, compared to 6,500 kWh in Europe and 13,000 kWh in the United States. Adesina, (2017).
We know power is the capacity of energy that is being used. In essence, power, is units of energy divided by time. Georgiou *et al.* (2020). In other words, energy is the sum total of power used at a given time period. “Economies cannot develop in the dark, said Adesina, President of the African Development Bank. Close to 600 million people still don't have access to electricity in Africa, and the majority live in rural areas. Grid expansion alone will not be enough to electrify these populations, but with a combination of distributed energy solutions and smart grid expansion, we can achieve universal, economically impactful electrification”. (*Ibid*)
The following point buttresses the need for a structural shift in energy consumption cost reduction to reduce the incidence of poverty.

A look at Wind Turbines, Solar Panels and Hydroponic Greenhouse Farming: Solar photovoltaic (PV) panels and Wind Turbines are by far the biggest drivers of the rapid increase in Renewable Energy electricity generation globally; in 2018 and 2019, 100 gigawatts (GW) and 114.9 gigawatts (GW) of Solar PV were installed, contributing 55% and 60% of new renewable energy capacity, respectively; Wind contributed the second largest share, with 28% in 2018 and 34% in 2019, of new renewable capacity. IEA/IRENA (2020). Power generation costs have significantly dropped by 82% and 39%, respectively, for Solar PV and Wind Technologies between 2010 and 2019. As a matter of fact, while a one million investment in 2010 yielded 213 kW in Solar PV and 514 kW in onshore wind, the same amount invested in 2019 yielded 1,005 kW of Solar PV and 679 kW of onshore Wind power in 2019. IRENA (2020b). In spite of Nigeria's efforts to partner with Germany to install 420 MW of Solar capacity across nine northern states as part of a renewable energy and energy efficiency partnership,

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3. IEA (2019). Nigeria Energy Outlook: Analysis from Africa Energy Outlook 2019. (https://www.iea.org/articles/nigeria-energy-outlook) Retrieved

Meza (2013), Nigeria still has an abysmally low renewable energy ratio to non-renewable energy mix.

Wind Turbines, as explained by the Office of Energy Efficiency and Renewable Energy (EE&RE), work on a simple principle: instead of using electricity to make wind - like a fan - Wind Turbines are propelled wind to make electricity. The wind turns the propeller-like blades of a turbine around a rotor, which spins a generator, creating electricity. Wind is a form of Solar Energy caused by a combination of three concurrent events: (i) the Sun's uneven heating of the atmosphere, (ii) natural irregularities of the Earth's surface and (iii) the constant rotation of the Earth on its axis.

Wind flow patterns and speeds vary significantly across regions and are modified by barriers such as bodies of water, vegetation, and differences in terrain. The terms "Wind Energy" and "Wind Power" both describe the process by which wind is used to generate mechanical power or electricity. This mechanical power can be used for specific tasks like pumping water, or a generator can convert this mechanical power into electricity by using the aerodynamic force from the rotor blades, which work like an aeroplane wing or helicopter rotor blade. When wind flows across the blade, the air pressure on one side of the blade decreases. The difference in air pressure across the two sides of the blade creates both lift and drag. The force of the lift is stronger than the drag, which causes the rotor to spin. The rotor connects to the generator, either directly (if it's a direct drive turbine) or through a shaft and a series of gears (a gearbox) that speed up the rotation and allow for a physically smaller generator. This translation of aerodynamic force to the rotation of a generator creates much-needed electricity.

Modern Wind Turbines fall into two basic groups: Horizontal-Axis Wind Turbines (HAWT) and Vertical-Axis Wind Turbines (VAWT). The former most commonly has three blades and operates "upwind," with the turbine pivoting at the top of the tower so the blades face into the wind; the latter comes in several varieties, including the eggbeater-style Darrieus model, named after its French inventor. These turbines are omnidirectional, meaning they don't need to be adjusted to point into the wind to operate. Their advantages of running at lower wind speeds, ability to work in any direction of wind flow, compact construction and quiet operation make them ideal. The latest VAWT blades that are developed by NACA have the ability to self-start. Jaimon, *et al* (2019).

Wind turbines' sizes also vary, but we limit ourselves to two: utility-scale wind turbines and offshore wind turbines. Utility-scale wind turbines range in size from 100 kilowatts to as large as several megawatts. A commanding model, the Darrieus Wind Turbine, is located in Cap-Chat, Quebec. It is about 60 m wide and approximately 100 m tall, and it has an impressive 3.8 MW rating capacity. Larger wind turbines are more cost-effective and are grouped together into wind plants, which provide bulk power to the electrical Grid. Offshore wind turbines tend to be massive and taller than the Statue of Liberty. These turbines are able to capture powerful ocean winds and generate vast amounts of energy.

Greenhouse food production, often termed controlled environment agriculture (CEA) or hydroponics farming, is high-technology and capital-intensive. Yet, hydroponic culture requires only basic agricultural skills. As further indicated in (Jensen, 2013), the yield per

4:09pm, 3rd June, 2020.
4. IEA (2020), Global Energy Review 2020, IEA, Paris https://www.iea.org/reports/global-energy-review-2020
5. IEA (2020), Energy Prices 2020, IEA, Paris https://www.iea.org/reports/energy-prices-2020
6. Georgiou, S., Aunedi, M., Strbac, G., & Markides, C. N. (2020). On the value of liquid-air and pumped-thermal electricity storage systems in low-carbon

crop is five times higher in greenhouses than in open field agriculture (OFA) because of the optimal growing conditions, balanced plant nutrients and so on, provided in controlled environments. Due to this controlled environment, year-round production is achieved, whereas open-field crop production is only seasonal. Output at hydroponic greenhouses, designed in a tiered system, can be used to increase harvest by another factor of ten further. In essence, where a typical plot may yield 10kg of vegetables, the tiered system will conveniently produce at least 100kg. This paper proposes a simple tech-solution (the 3-in-1-hybrid farm) for all the aforementioned associated issues of Power-Malnutrition-Poverty.

Study Aims and Objectives

We propose a Hybrid Renewable Energy Technology Convergence with an Organic Fruits/Spices/Vegetables Hydroponics Farm Settlement, that is, an energy farm situated on an agricultural (Fruits/Spices/Vegetables) Hydroponics farm settlement. The plan is to assess the technical possibility and economic practicality of setting up Model 3-in-1 Hybrid Farms by conducting a precise study of renewable energy potential at identified locations with ideal natural conditions throughout Nigeria in order to serve as Renewable Energy Stations for the production and supply of both electricity and Farm Produce. These farms will consist of hydroponics greenhouses (producing fruits, spices, and vegetables) and Wind and solar panel farms.

The specific objectives are:

i. Identify and confirm through precise field study, the best possible sites conducive to the establishment of the 3-In-1 Hybridisation Farms

ii. Show the Interconnections, Interdependence, and Linkages through a holistic Integrated framework involving Site Identification and Selection, Robust Energy Demand and Supply Estimation and Detailed Energy System Planning, Design and Configuration

iii. Show the possible technical combination possibilities of establishing the 3-In-1 Hybridisation Farms

iv. Show the economic need inherent in the establishment of the 3-In-1 Hybridisation Farms

v. Demonstrate the imperatives for the siting of the 3-In-1 Hybridisation Farms

vi. Demonstrate the National Strategic Energy Need to improve Energy Efficiency, Energy Intensity and Energy Access.

vii. Establish and Demonstrate ingenuity in harvesting three or more forms of Energy Resources at each site through harmonisation of natural resources and blended technology.

3.0 METHODOLOGY

We employ a conceptual model system analysis using actual location data (Dunnet, 2020) and deploy a blend of assistive technological tools using inputs from geospatial satellites for this study. The large-scale wind climate data is provided by atmospheric re-analysis data in GWA version 3, and the ERA5 dataset from the European Centre for Medium-Range Weather Forecasts (ECMWF) is used for the simulation period 2008-2017. To run the modelling over a very large area, a system of software and

electricity systems. Energy, 193, 116680.

7. NBS (2020) National Household Kerosene Price Watch (April 2020) (https://www.nigerianstat.gov.ng/)
8. NERC (2020) Renewable Energy Sourced Electricity. (https://nerc.gov.ng/index.php/home/operators/renewable-energy) Retrieved, 3:20pm, 25th May, 2020.
9. IRENA (2020b) Online Article: How Falling Costs Make Renewables a Cost-effective Investment. 2nd June, 2020.

Servers called the GWA Frogfoot was developed. This method is very similar to what is used in the WAsP software. Local Wind climate calculations are based on more than a single generalised Wind climate, and terrain data is input as raster maps rather than vector maps. The location-specific information provided by the Atlas involves three main models: Solar radiation model, air temperature model, and PV power simulation model. Solar radiation and air temperature modelling result in a series of pre-calculated data layers that can be retrieved at (almost) any location on the map.

4.0 DATA EXTRAPOLATION & ANALYSIS

Before now, two main barriers to large-scale implementation of wind power were (1) the perceived intermittency of the wind and (2) the difficulty in identifying good wind locations, especially in developing countries. Archer and Jacobson (2005). The first barrier can be ameliorated by linking multiple wind farms together and deploying Dresser Vertical-Axis Wind Turbines, while the second difficulty has been eliminated to a large degree by World Wind Atlas, which we have adopted in this study.

Conversion Metrics

1 MW = 1 Million Watts (≈3,000 Units of 350watts Panels) = 5 Acres
25 MW = 25 Million Watts (≈75,000 Units of 350watts Panels) = 125 Acres
50 MW = 50 Million Watts (≈150,000 Units of 350watts Panels) = 250 Acres
100 MW = 100 Million Watts (≈300,000 Units of 350watts Panels) = 500 Acres

Where 500 Acres = 202.34 Hectares = 1 Square Mile = 2.02 Km^2. Note also that the Cost per Watt is now as low as $0.3 per Watt.

5.0 SUMMARY AND CONCLUSION

The summary of our findings shows clearly that this is not only technically feasible and efficient but also economically cost-effective. With a stated National Policy Performance Target of 20% (unconditional) to 45% (conditional) reduction in GHG emissions by 2030, this study creates a possible path to further achieving this goal. It, therefore, aligns with the federal government industrial development target to dedicate at least 30% of the federal budget to capital expenditure and achieve GDP growth of 7% to create over 15 million jobs by 2020 and double manufacturing output to 20% of GDP by 2025.

Following from the foregoing, the estimated electricity generation potential of this is estimated to be between 3.5GW and 7GW depending on the ideal potential or actual output from these identified 36 sites throughout the federation, with each site projected to produce at least 100MW of Renewable Electricity. In order to effectively harness these naturally endowed locations where the convergence of these natural elements makes it conducive to establishing these 3-in-1 Energy Farms throughout the country, the government should take immediate steps to realise this potential. This project is a win-win situation for all concerned.

Further, beyond the obvious increased electricity generation and food security guaranteed by this study outcome, it is also a means of providing massive job opportunities, as the Project will serve as an ideal way of re-integrating previously displaced local farmers and those in IDP Camps in the northeast. Agro-allied produce Processing & Packaging Plants will also, as a necessity, be established to serve as halfway houses for a harvested product, so as to drastically improve the storage and shelf-life of produce, thereby eliminating waste and increasing value to both Farmers and Consumers. This model can

(https://www.irena.org/newsroom/articles/2020/Jun/How-Falling-Costs-Make-Renewables-a-Cost-effective-Investment) Retrieved 4:55pm, 6th June, 2020.

10. Jaimon, C. V., Sankar, A., Krishnakumar, P. C., Radhakrishanan, R., & Saad, M. C. (2019). Vertical Axis Wind Turbines: A Review. Advancement in Mechanical Engineering

also be adopted and operationalised in ideal regions throughout Sub-Saharan Africa, which will solve the problems of job creation and lack of energy in those areas. It can also be adapted in other forms to suit the peculiar needs of urbanised areas in Nigeria. Other regions with the right climatic conditions, like the Middle East, can also benefit from this integration model.

Nigeria is on a quest not only to increase and improve its electricity generation, transmission, and distributive capacity but also to diversify its electricity generation mix so as to increase energy access and efficiency. This paper identifies thirty-six (36) ideal geographical locations with the required conditions for the actualisation of the establishment of a series of 3-in-1 Hybrid Energy Farms throughout Nigeria. The paper highlights unique ways of electricity generation with a convergence of existing and emerging technologies yielding between 3.5GW and 7GW of Renewable Electricity by a combination of Wind and Solar Technology. The paper further incorporates the retooling of both technologies to achieve economies of scale by introducing Greenhouse Fruit, Spices and Vegetables all under one Solar Panelled Roof. The study is unique in its interplay of blended sustainable technology accretion and environmental sensitivity in identifying and harnessing ingenious solutions aimed at solving some of Nigeria's socioeconomic issues. It brings together Solar, Wind and Greenhouse Technologies to address recurring problems like insufficient power generation, food/dietary issues, unemployment and successful resettlement of internally displaced persons (IDPs).

POLICY RECOMMENDATIONS

1. Special Purpose Vehicles to be registered and domiciled at Renewable Energy Agency (REA), with the aim of co-ordinating and bringing to fruition all national Renewable Energy Projects of 10 MW and above, with a view to harmonise and ensure speedy completion.
2. The national Electricity Grid Rehabilitation, Modernisation, and Expansion being undertaken by Siemens of Germany is to be prioritised and given adequate attention with a view to early completion. The Grid should be made ready to connect and transmit all forms of generated electricity in the country.
3. Ongoing Oil Sector Reforms particularly to ensure successful implementation of the nations' Gas Masterplan aimed at fostering Gas-To-Power, Gas-To-Homes, Industrial Development as well as improvement and expansion of existing gas networks to industrial hubs should be vigorously pursued to realisation.
4. Mega gas reservoirs with 6- 12 months of plant usage/storage capacity should be located at all power plants in Nigeria to eliminate the intermittent power outages experienced at every turn due to hiccups in the gas pipelines. These Reservoirs will act as needed buffer stock to limit incessant plant outages.
5. Improved Power Sector Management and Governance would help to reduce outages, power theft and transmission losses. Failure to do this would not only impede industrial growth but would also mean continued high levels of use of polluting back-up generation.
6. Availability of cheap, reliable and affordable electricity should be the watchword in both urban and rural areas, particularly the latter, so as to be able to wean rural dwellers off or drastically reduce their bioenergy dependence and use across all sectors, not least because its use is strongly linked to deforestation and air pollution.
7. By strengthening Nigeria's carbon trading capacities, the temporary trade-off in cheaper electricity tariffs gained in the sale of credits guarantees not only an attraction of big industries needed for the teeming mass of unemployed persons in Nigeria, but it acts as a catalyst that spurs MSMEs which are the backbone of any great economy.

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SUSTAINABLE DEVELOPMENT IN NIGERIA: DOES THE NIGERIA SOVEREIGN INVESTMENT AUTHORITY MATTER?

Jean BALOUGA

Introduction

A sovereign wealth fund (SWF) is a state-owned investment fund composed of financial assets namely stocks, bonds, property, precious metals and other financial instruments. Some sovereign wealth funds may be held by a central bank, which accumulates the funds in the course of its management of a nation's banking system. This type of fund is usually of major economic and fiscal importance. Other SWFs are simply the state savings that are invested by various entities for the purpose of investment returns, and that may not have a significant role in fiscal management. The accumulated funds may have their origin in, or may represent, foreign currency deposits, gold, special drawing rights (SDRs) and International Monetary Fund (IMF) reserve positions held by central banks and monetary authorities, along with other national assets such as pension investments, oil funds, or other industrial and financial holdings. These are assets of the sovereign nations that are typically held in domestic and different reserve currencies (such as the dollar, euro, pound and yen). Such investment management entities may be set up as official investment companies, state pension funds, or sovereign oil funds, among others. Does Nigeria need such an entity?

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1.Purpose

Sovereign Funds are generally categorized as stabilization funds and saving funds. Stabilization SWFs are created to reduce the volatility of government revenues and to counter the boom-bust cycles' adverse effect on government spending and the national economy. Saving SWFs build up savings for future generations. One such Fund is the Government Pension Fund of Norway. It is believed that SWFs in resource-rich countries can help avoid resource curse, but the literature on this question is controversial. Governments may be able to spend the money immediately, but risk causing the economy to overheat, e.g. in Hugo Chavez's Venezuela or Shah-era Iran. In such circumstances, saving the money to spend during a period of low inflation is often desirable.

SWFs are typically created when governments have budgetary surpluses and have little or no international debt. This excess liquidity is not always desirable to hold as money or to channel into immediate consumption. This is especially the case when a nation depends on raw material exports like oil, copper or diamonds. In such countries, the main reasons

for creating an SWF are high volatility of resource prices, unpredictability of extraction, and exhaustibility of resources.

Other reasons for creating SWFs may be strategic, such as war chests for uncertain times. For example, during the Gulf War the Kuwait Investment Authority managed excess reserves above the level needed for currency reserves (although many central banks do that now). Singapore's Investment Corporation and the Temasek Holdings are partially the expression of a desire to bolster Singapore's standing as an international financial centre. The Korea Investment Corporation has since been similarly managed. The Nigerian Sovereign Investment Authority (NSIA) was set up in 2011 in accordance with the NSIA Act 2011.

2.Investment Policy

Think tanks such as the World Pensions Council have argued that the extended investment horizon of SWFs allows them to act as long-term investors in less liquid assets such as commodities, real estate and infrastructure assets, a trend likely to develop further as banks and insurance companies decrease their exposure to these asset classes in the context of the Basel 2 and Solvency2 regulatory constraints.

3.Size

There are currently 176 active Funds with international assets totaling about US$ 11.5 trillion. Commodity SWFs are funded by commodities' exports, primarily oil and gas exports, while non-commodity SWFs are typically funded by transfer of assets from official foreign exchange reserves, and in some cases from government budget surpluses and privatization revenue. Asian countries account for the bulk of such funds. According to the SWF Institute, most oil-producing nations in the Gulf have a higher SWF-to-Foreign Exchange Ratio - for example, the Qatar Investment Authority (5.89 times) compared to the China Investment Corporation (.12 time) - reflecting a more aggressive stance to seek higher returns. An SWF-to-Foreign Exchange Ratio shows the proportion a government has in investments relative to currency reserves. The Gulf Cooperation Council states are investing wisely through SWFs and are using those means to generate economic growth and wealth for their countries, buying stakes in major companies in advanced economies as well as emerging markets. They are also ploughing their money back into regional and country development. That notwithstanding, the growth of SWFs is becoming a great concern for several reasons.

4.Concerns

- Generally, as SWFs' asset pools continue to expand in size and importance, so does their potential impact on various asset markets.
- Some countries worry that foreign investment by SWFs raises national security concerns because the purpose of the investment might be to secure control of strategically important industries for political rather than financial gain. These concerns have led the European Union (EU), for example, to reconsider whether

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3. Komolafe, B. (2012). "Sovereign Wealth Fund: Task Before the Rasheed-led Board", 26 October, Vanguard.

or not to allow its members to use "golden shares" to block certain foreign acquisitions. However, this strategy has largely been excluded as a viable option by the EU, for fear it would give rise to resurgence in international protectionism. In the U.S., these concerns are addressed by the Exon-Florio Amendment to the Omnibus Trade and Competitiveness Act of 1988, Pub. L. No. 100-418, § 5021, 102 Stat. 1107, 1426 (codified as amended at 50 U.S.C. app. § 2170 (2000)), as administered by the Committee on Foreign Investment in the United States (CFIUS).

- The transparency of Funds is a concern to investors and regulators: Why this size? What is the source of funds? Why these investment goals? What are the internal checks and balances? How about disclosure of relationships? What is the policy *vis-a-vis* holdings in private equity funds?
- SWFs are not nearly as homogeneous as central banks or public pension funds.
- Specifically, the leadership of the NSIA faces a Herculean task given the opposition surrounding the establishment of the Fund- opposition on the grounds that Nigeria is not ripe for such a fund, given that she is bedeviled with high unemployment, and inadequate infrastructure. No doubt the first test the management of the NSIA would have to pass is the test of independence from whosoever. Those opposed to the creation of the Fund watch and scrutinize every move and decision of the Fund's management team to discern any sign of the involvement of the federal government in the running of the Fund.
- The structure as well as take-off grant of the NSIA appear problematic. NSIA is structured as a 'three-in-one' sort of organization. It is made up of (i) the Future Generations Fund; (ii) the Nigeria Infrastructure Fund; and (iii) the Stabilization Fund. Each of these seemingly autonomous Funds, which are unified under one single authority, governing council and management team, is reported to have received 20 percent of the initial $1 billion earmarked for the take-off of the Authority. What to do with the remaining 40 percent will be decided by the Board of NSIA, taking into consideration the macroeconomic conditions of the economy. This is subject to abuse.

The need to address some of the above-mentioned concerns, among others, led to the development of the Santiago Principles, a set of Generally Accepted Principles and Practices (GAPP) for SWFs. These Principles were proposed in 2008 through a joint effort between the IMF and the International Forum of Sovereign Wealth Funds (IFSWF). Over 25 nations have signed these Principles, whose main objective is to monitor the legal, institutional, and governance framework, investment policies and risk management of SWFs. Some of the Principles state that, "The legal framework for the SWF should be sound and support its effective operation and the achievement of its stated objective(s); the policy purpose of the SWF should be clearly defined and publicly disclosed; and where the SWF's' activities have significant direct domestic macroeconomic implications, those activities should be closely coordinated with the domestic fiscal and monetary authorities,

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so as to ensure consistency with the overall macroeconomic policies". Specifically, the fourth GAAP Principle requires clear and public disclosure of policies, rules, procedures or arrangements in relation to SWF's general approach to funding, withdrawal, and spending operations. The sixth GAAP Principle proposes a clear division of roles and responsibilities under the SWF's governance framework to facilitate accountability and operational independence.

5. Is there Need for a Nigeria SWF?

Countries need SWFs for sustainable development. Sustainable development is one of the most critical, challenging and fundamental issues most developing countries, including Nigeria, face today. Sustainable development ensures that a country is in charge of its economic destiny and national resources in order not to unfairly mortgage the interests of her future generations. In the end, sustainable development ensures the creation of national wealth, durable growth, economic progress, prosperity and an egalitarian and better society, based on equitable distribution of resources to engender social justice and dignity of the human being. So, without the mobilization of long-term savings to support the consolidation of future growth and development, there cannot be sustainable economic development. The Norwegians, for example, have used their North Sea riches to set up an SWF now one of the biggest investors and a financial anchor for the country. They have carefully used their indigenous oil industry to build up an internationally competitive oil services sector and exported their know-how to help countries benefit from their oil wealth without falling prey to corruption and instability. The United Arab Emirates, whose wealth comes from a combination of natural resources, industrial production, and a diversified economy, have also floated a Fund, the Abu Dhabi Investment Authority, the largest sovereign fund to date, with a little less than US$ one trillion.

In contrast, Nigeria, Africa's top energy producer and economy, pumping over 2 million barrels of oil a day, has frittered much of its oil wealth away over the years, on government wages, other (mostly) recurrent spending and corruption. Nigeria is estimated to have earned over $400 billion from crude oil sales since the 1970s, but the only attempt to save part of its oil earnings started as late as 2003when the Obasanjo government set up the Excess Crude Account (ECA), which critics say is too opaque and can be too easily abused. For example, the ECA had US $20 billion in 2007 but fell to $3 billion after the presidential elections in 2011, despite 5 years of high oil prices. As at August 2023, the ECA balance was about US$474,000 only. Moreover, a situation in which the ECA – which is meant to serve as a proxy for fiscal savings where the country saves earnings above the crude oil price benchmark - keeps getting depleted due to deductions by the federal government for sharing to the three tiers of government, has further made the creation of the SWF strategically imperative.

It may be difficult for Nigeria to achieve sustainable development as long as the national economy is mono-cultural. While crude oil constitutes only about 20 percent of the

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7. Obasa, R. (2011). "Sovereign Wealth Fund: What's all the heat about?" *Nigeria's Oil and Gas*, November. pp. 16-18.

country's GDP, it accounts for over 80 percent of government revenue and 90 percent of its foreign exchange earnings. The dependence of the Nigerian economy on crude oil export as the main source of foreign exchange earnings puts the country at risk; this makes Nigeria extremely vulnerable to oil-price volatility. For example, recent reports suggest that Nigeria may be exposed to yet another potential oil price shock due to a combination of new supplies coming on stream from non-OPEC member countries and lower exports to the United States (Nigeria's erstwhile largest crude oil importer). This concomitant effect may lead to a serious squeeze in Nigeria's government revenues from oil and gas exports.

According to the World Bank, the average, real change in inventories in Nigeria between 1960 and 2011 is about negative 2.83%. Moreover, Nigeria has a low manufacturing capacity utilization in 2023 of about 55 percent – lower than Cameroon (60 percent), Ghana (77.9 percent), South Africa (78.5 percent), Egypt (83.7 percent), - and is exposed to oil price shocks, persistent dwindling government revenue and massive corruption. Meanwhile, the progress in the power reforms, the addition of Nigeria to the JP Morgan emerging market index, and Nigeria's recent credit rating upgrade by S&P (all positives that should drive increasing investment interest in Nigeria), have reinforced the need to create an additional mechanism for mobilizing national savings and fiscal revenue in a bid to overcome the shortage of accumulated domestic capital for investment and developmental purposes. However, so far, NSIA has undertaken the following projects:

(i) The running of an infrastructure fund.
(ii) Development of Nigeria's financial markets infrastructure through the Infrastructure Credit Guarantee Limited (InfraCredit), Nigeria Mortgage Refinance Company, and Family Homes Funds Limited.
(iii) Health Care: NSIA prioritized the Tertiary Health Care and began bridging the gaps; tackling non-communicable diseases (namely, oncology, orthopedics, renal, cardiovascular diseases), characterized by high incidence, high mortality rates, and high medical tourism; the reversal of medical tourism estimated in 2015 at $1 billion per year; the creation of an enabling environment for capacity building (NSIA Health care Development and Investment Company); NSIA – LUTH Cancer Care Centre, built at the cost of $12.5 million, has treated over 4,000 patients since commissioning in May 2019; NSIA-Kano Diagnostic Centre and NSIA – Umuahia Diagnostic Centre, first-rate facilities, cost $5.5 million each, offer timely, cost-effective and high-quality diagnostic care, have attended to 20,000 patients since inception in March and August 2020, respectively;
(iv) NSIA plans to provide 34 healthcare facilities to over one million patients per annum, comprising of 22 diagnostic centres, 2 multispecialty hospitals, 9 single specialty hospitals and one pharmaceutical manufacturing company, and
(v) The construction of a 30-megawatt solar power plant in Kano, to power between 3,000 and 5,000 households, among other projects.

6. Conclusion

8. Oluwa, K. (2012). "Toward Economic Diversification and Sustainable Development", BusinessDay, 9 July, p. 14.
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Nigeria's prospects for economic transformation and sustainable development will depend, to a large extent, on the political will, strength of character and strong commitment of the leadership, more than mere vision statements or contents of laudable economic policies and blueprints,.

There is no doubt that the pioneer team that nurtured, developed and grew this very vital, extraordinary and strategic institution were necessarily extraordinary in the sense of knowing and understanding the kinds of jobs they had to do for, and on behalf of, the present and future generations of Nigerians. It is reported that the team comprised tested and experienced people, men and women of exemplary character, decorum and transparent honesty. Given their top place in their various professional callings, spanning over many years in different highly respected organizations within and outside Nigeria, much was expected from them by Nigerians yearning to benefit from President Jonathan's promise of national transformation dividends by 2013.

The Aina blanckson Report posits that doing the right thing is the only way Nigeria can enjoy the objectives and benefits of having an SWF and thus win over those opposed to its establishment. The report advises that: "The NSIA would do well to adopt best practices from existing SWFs, such as the Norwegian SWF's practice as well as the Chinese SWF practice, to mention a few. This should help in improving the management of Nigeria's public finances and supporting growth, as well as in placing the country in a strong financial position internationally."

7. Recommendations

Given the worrisome perceived high level of corruption and habitual mismanagement of the national wealth over the years, there should be transparency and sound corporate governance in the management of the NSIA. Having been given nine points out of ten for best practice (transparency ratio) in the Linaberg-Maduell index administered by the Sovereign Wealth Institute, NSIA is ranked with the U.S., France, Malaysia and Brazil.

For now, Nigeria does not need the Norwegian, Swiss, State of Wisconsin, State of California SWF models, which primarily focus on portfolio investments. Rather, Nigeria could adopt or adapt the Chinese, Singapore, Hong Kong, Malaysia and UAE models, where the focus is on aggressively attracting and driving high tech, capital – intensive industries (power, petrochemicals, food processing, and steel), and low tech, labor-intensive, industries into their countries. Nigeria needs a Sovereign Wealth Fund that will use its offshore investments to drive in critical foreign direct investment (FDI) and infrastructural investments through public private partnership (PPP), for example.

In order to achieve inclusive growth, macro-economic stability and sustainable development, Nigeria must begin to de-emphasize conspicuous consumption and ostentatious living. The nation should imbibe the culture of savings and wealth creation based on increased productivity, value addition, economic diversification and self-

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15. World Bank *World Development Indicators* (2011).

sustenance.

If care is not taken the present structure of the NSIA will impact negatively on its performance. This should be guarded against.

NSIA's activities must be extensively and vigorously publicized in order to counter the negative impressions peddled against its establishment and operations by its detractors. NSIA's management efficiency, transparency and accountability are the first step in this regard.

16. www.worldbank.org. WWW.ceicdata.com/en/nigeria/capacity-utilization-rate/ accessed on 24/07/2024

PICTURES EXCERPT FROM NAEE'S EVENTS IN 2023

NAEE President Dr Hassan Mahmud and NAEE Vice President (Membership & Liaison) Mrs. Folashade Oje

Group Pictures of NAEE Members & 2023 World Energy Day participants

Participants

NAEE Immediate Past President Prof. Yinka Omorogbe SAN FNAEE & invited Speakers

NAEE Treasurer during the World Energy Day event


NAEE PRESIDENT
PROF. NNKA OMOROGBE, SAN, FNAEE


NAEE PRESIDENT

ENERGY COMMISSION OF NIGERIA

Coordinating National Energy Policies towards Energizing the Nation

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Nigerian Association for Energy Economics (NAEE)
Abuja.

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CEO, EtinPower Limited, Benin City.

Vice President (Conferences & Publications)
Prof. Ben Obi
Department of Economics, University of Abuja.

Vice President (Membership & Liaison)
Mrs. Folashade Oje
Federal Ministry of Health
Abuja.

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Dr. Mrs. Margaret Hilili
Central Bank of Nigeria (CBN),
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Secretary
Mr. Ere I alla
Petroleum Technology Development Fund (PTDF)
Abuja.

Assistant Secretary
Mr. Simeon Abiri
Nigerian Upstream Petroleum
Regulatory Commission (NUPRC), Abuja.

Public Relation Officer (PRO)
Mr Feso Bright
NNPC Upstream Investment Management
Services (NUIMS)
Abuja.

Auditor
Mrs. Amina Danmadami
Nigerian Midstream & Downstream
Petroleum Regulatory Authority (NMDPRA)

Legal Adviser
Dr. Terhemen Andzenge
Research Fellow, University of Cape Town,
South Africa

Editor
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Covenant University, Canaanland Ota.

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Centre for Petroleum Energy Economics & Law
University of Ibadan.

Ex-officio Members
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Nnamdi Azikwe University, Awka

Mrs. Priscillia Ekpe
Nigerian Midstream & Downstream Petroleum
Regulatory Authority, Abuja.

Dr. Oge Funlola Modie
Former SSA to the President on
Strategic Communications, The Presidency
Aso Villa, Abuja.

Council Advisers
Prof. Akin Iwayemi
CPEEL, University of Ibadan.

Prof. Adeola Adenikinju
President, Nigerian Economic Society, Abuja

Prof. Wumi Iledare
Executive Director,

Emmanuel Egbogah Foundation,
Abuja, Nigeria.

Mr. Jide Adebulehin
Petroleum Technology Development Fund (PTDF)
Abuja.

CHAIRMAN AND KEYNOTE SPEAKER OF EACH OF THE PAST NAEE CONFERENCES IN NIGERIA, 2008-2023

CONFERENCE	THEME	KEYNOTE SPEAKERS	CHAIRMAN	DATE AND VENUE
1ST ANNUAL CONFERENCE	DEVELOPING AND SUPPORTING CRITICAL ENERGY INFRASTRUCTURE FOR VISION 2020: CHALLENGES, CONSTRAINTS AND PROSPECTS.	CHIEF P. C. ASIODU, CON	AMBASSADOR BABA GANA KINGIBE, FORMER SECRETARY TO THE FEDERAL GOVERNMENT OF NIGERIA	29TH-30TH APRIL, 2008. TRANSCORP HILTON HOTEL, ABUJA.
2ND ANNUAL CONFERENCE	ENERGY INDUSTRY: RESTRUCTURING INTERACTIONS BETWEEN BUSINESS, ECONOMICS AND POLICY	DR. TAIWO IDEMUDIA, FORMER HEAD, ECONOMIC SECTION OPEC	ENGR. MUTIU SUNMONU MD, SHELL PETROLEUM DEVELOPMENT CORPORATION OF NIGERIA	23RD-24TH APRIL, 2009. SHERATON & TOWERS, ABUJA.
3RD ANNUAL CONFERENCE	ENERGY, ENVIRONMENT AND ECONOMIC GROWTH	PROF. A.S. SAMBO, FNAEE, DIRECTOR GENERAL, ENERGY COMMISSION OF NIGERIA AND SPECIAL ADVISER TO THE PRESIDENT ON ENERGY	DR EMMANUEL EGBOGAH, FORMER SPECIAL ADVISER TO THE PRESIDENT OF NIGERIA ON PETROLEUM MATTERS.	19TH - 20TH APRIL, 2010. NEW CHELSEA HOTEL, ABUJA.
4TH ANNUAL CONFERENCE	GREEN ENERGY AND ENERGY SECURITY: OPTIONS FOR AFRICA	MR. OSTENOLORUNSOLA, FORMER VICE PRESIDENT, GAS, SHELL AFRICA, FORMER DIRECTOR, DPR	ENGR. CHIMAIBENECHIE, FORMER HONOURABLE MINISTER, NLNG	28TH – 29TH APRIL, 2011. SHERATON HOTEL & TOWERS, ABUJA,
5TH ANNUAL CONFERENCE	ENERGY TECHNOLOGY AND INFRASTRUCTURE FOR SUSTAINABLE DEVELOPMENT.	PROFESSOR EINAR HOPE, 2010 IAEE PRESIDENT	PROF. A.S. SAMBO, FNAEE, DIRECTOR GENERAL, ENERGY COMMISSION OF NIGERIA AND SPECIAL ADVISER TO THE PRESIDENT ON ENERGY	23RD – 24TH APRIL, 2012. ABUJA SHERATON HOTEL, ABUJA.
6TH ANNUAL CONFERENCE	ENERGY RESOURCE MANAGEMENT IN A FEDERAL SYSTEM: CHALLENGES, CONSTRAINTS AND STRATEGIES".	CHIEF PHILIP ASIODU, CON, FORMER MINISTER OF NATIONAL PLANNING	DR EMMANUEL EGBOGAH, FORMER SPECIAL ADVISER TO THE PRESIDENT OF NIGERIA ON PETROLEUM MATTERS.	22ND-23RD, APRIL, 2013. SHERATON HOTEL, LAGOS.
7TH ANNUAL CONFERENCE	ENERGY ACCESS FOR ECONOMIC DEVELOPMENT: POLICIES, INSTITUTIONAL FRAMEWORK AND STRATEGIC OPTIONS	PROFESSOR YINKA OMOROGBE, NABO GRAHAM DOUGLAS DISTINGUISHED PROFESSOR OF LAW, NIGERIAN INSTITUTE OF ADVANCED LEGAL STUDIES (NIALS), ABUJA.	PROFESSOR CHINEDU O. NEBO, PH.D, OON, NPOM HONOURABLE MINISTER OF POWER, FEDERAL REPUBLIC OF NIGERIA.	16TH -18TH, FEBRUARY 2014, SHERATON & TOWERS, ABUJA.

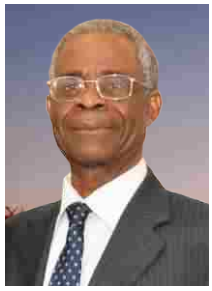
CHAIRMAN AND KEYNOTE SPEAKER OF EACH OF THE PAST NAEE CONFERENCES IN NIGERIA, 2008-2023

CONFERENCE	THEME	KEYNOTE SPEAKERS	CHAIRMAN	DATE AND VENUE
8TH ANNUAL CONFERENCE	FUTURE ENERGY POLICY OPTIONS: ASSESSMENT, FORMULATION AND IMPLEMENTATION TRENCHARD HALL, UNIVERSITY OF IBADAN, IBADAN, NIGER	AUSTIN O. AVURU, FNAPE, MD/CEO, SEPLAT PLC	DR. EMMANUEL EGBOGAH, OON, P. ENG. CHAIRMAN, EMERALD ENERGY RESOURCE &, FORMER SPECIAL ADVISER TO THE PRESIDENT ON PETROLEUM MATTERS	26TH- 28TH, APRIL, 2015, TRENCHARD HALL, UNIVERSITY OF IBADAN, IBADAN, NIGERIA
9TH ANNUAL CONFERENCE	ENERGIZING EMERGING ECONOMIES: THE ROLE OF NATURALGAS & RENEWABLE ENERGY	HIS EXCELLENCY, PROFESSOR YEMI OSINBAJO, SAN, GCON, VICE PRESIDENT, FEDERAL REPUBLIC OF NIGERIA, ABUJA	DR. H. ODEIN AJUMOGOBIA SAN, FORMER HONOURABLE MINISTER OF EXTERNAL AFFAIRS AND HONOURABLE MINISTER OF STATE FOR PETROLEUM	24TH – 26TH APRIL, 2016. SHERATON HOTEL & TOWERS, ABUJA.
10TH ANNUAL CONFERENCE	ENERGY, ECONOMY AND THE ENVIROMENT: THE INTERPLAY OF TECHNOLOGY, ECONOMICS AND PUBLIC POLICY	DR. E. IBE KACHIKWU, HONOURABLE MINISTER OF STATE FOR PETROLEUM RESOURCES, ABUJA	RESOURCES, FEDERAL REPUBLIC OF NIGERIA DR. E. IBE KACHIKWU, HONOURABLE MINISTER OF STATE FOR PETROLEUM RESOURCES, ABUJA	23RD-26TH APRIL, 2017. PTDF CONFERENCE CENTER, ABUJA, NIGERIA.
11TH ANNUAL CONFERENCE	NEW ERA IN GLOBAL ENERGY LANDSCAPE: IMPLICATIONS FOR AN EMERGING ECONOMY	MR. AUSTIN AVURU, CEO, SEPLAT PETROLEUM DEVELOPMENT COMPANY PLC	ENGR. FUNSHO KUPOLOKUN (DIRECTOR, FIRST ALLY CAPITAL LIMITED	22ND-24TH APRIL, 2018, PTDF CONFERENCE CENTER, ABUJA, NIGERIA.
12TH ANNUAL CONFERENCE	ENERGY EFFICIENCY AND ACCESS IMPERATIVES FOR SUSTAINABLE DEVELOPMENT IN EMERGING ECONOMIES	ENGR. FUNSHO M. KUPOLOKUN, DIRECTOR, FIRST ALLY CAPITAL LIMITED	PROFESSOR JAMES A. MOMOH, NIGERIAN ELECTRICITY REGULATORY COMMISSION	14TH-16TH APRIL, 2019. PTDF CONFERENCE CENTER, ABUJA, NIGERIA,
13TH ANNUAL CONFERENCE	"ENERGY AND PETROLEUM IN A POST COVID WORLD"	H.E. CHIEF TIMIPRE SYLVA, HONOURABLE MINISTER OF STATE FOR PETROLEUM RESOURCES	H.E. CHIEF TIMIPRE SYLVA, HONOURABLE MINISTER OF STATE FOR PETROLEUM RESOURCES	17TH DECEMBER, 2020. PTDF CONFERENCE CENTRE, ABUJA, NIGERIA.
14TH ANNUAL CONFERENCE	STRATEGIC RESPONSES OF ENERGY SECTOR TO COVID-19 IMPACTS ON AFRICAN ECONOMIES	H.E. MOHAMMED SANUSI BARKINDO, OPEC SECRETARY-GENERAL	H.E. CHIEF TIMIPRE SYLVA, HONOURABLE MINISTER OF STATE FOR PETROLEUM RESOURCES	25TH – 28TH JULY, 2021. PTDF CONFERENCE CENTRE, ABUJA, NIGERIA.
15TH ANNUAL CONFERENCE	ENERGY TRANSITION AND CLIMATE CHANGE POLICY: PATHWAY FOR SUSTAINABLE DEVELOPMENT IN AFRICA.	N. J. AYUK, EXECUTIVE CHAIRMAN, AFRICAN ENERGY CHAMBER	PROF. ELI BALA JIDERE, DIRECTOR GENERAL, ENERGY COMMISSION OF NIGERIA (ECN)	17TH – 19TH JULY, 2022. PTDF CONFERENCE CENTRE, ABUJA, NIGERIA.
16TH ANNUAL CONFERENCE	ENERGY EVOLUTION, TRANSITION AND REFORM: PROSPECTS FOR AFRICAN ECONOMIES.	DR. OMAR FAROUK IBRAHIM, THE SECRETARY-GENERAL, AFRICAN PETROLEUM PRODUCERS' ORGANIZATION (APPO), VICE CHAIR, AFRICA, WORLD ENERGY COUNCIL	ENGR. GBENGA KOMOLAFE, FNSE, COMMISSION CHIEF EXECUTIVE, NIGERIAN UPSTREAM REGULATORY COMMISSION (NUPRC)	9TH – 11TH JULY, 2023 AT THE PTDF CONFERENCE CENTRE, ABUJA.

NAEE Distinguished Fellowship Awardees (FNAEE)

Name	Organisation	Year of Award
Prof. A. S. Sambo	Former Director General, Energy Commission of Nigeria	2010

Name	Organisation	Year of Award
Prof. A.O Adegbulugbe	Former Special Adviser to the President on Energy Matters	2010



Name	Organisation	Year of Award
Prof. Akin Iwayemi	Former President, Nigeria Economic Society (NES) and Nigerian Association for Energy Economics (NAEE)	2011

Name	Organisation	Year of Award
Prof. Wumi Iledare	2014 IAEE President and Director, Emerald Energy Institute, University of Port Harcourt, Rivers State, Nigeria;	2013

Name	Organisation	Year of Award
Prof. Yinka Omorogbe	Nabo Graham Douglas Distinguished Professor of Law, (NIALS); CEO/Founder, Etin Power Limited	2013

NAEE Distinguished Fellowship Awardees (FNAEE)

Name	Organisation	Year of Award
*Prof. Layi Fagbenle *Late	Professor of Mechanical Engineering, University of Ibadan and Former Energy Adviser to Botswana Government	2013

Name	Organisation	Year of Award
*Dr. Emmanuel Egbogah,OON *Late	Chairman, Emerald Resource &, Former Special Adviser to the President on Petroleum Matters	2014

Name	Organisation	Year of Award
Dr. Tim Okon	Chief Executive Officer, International Institute of Petroleum, Energy Law & Policy (IPELP), Abuja.	2014

Name	Organisation	Year of Award
Prof. Adeola Adenikinju	Director, Centre for Petroleum, Energy Economics and Law, University of Ibadan.	2016

Name	Organisation	Year of Award
Dr. Bello Aliyu Gusau	Executive Secretary, Petroleum Technology Development Fund (PTDF)	2018

NAEE Distinguished Fellowship Awardees (FNAEE)

Name	Organisation	Year of Award
Mr. Osten Olorunsola	Chairman, Energy Institute	2018

Name	Organisation	Year of Award
Prof. Chidi Ibe	NUC Distinguished Professor in Diaspora, and Professor of Oceanography and Blue Economy	2019

Name	Organisation	Year of Award
Chief Michael Olorunfemi	Former Top Management Staff NNPC and OPEC; MD, Mak Mera Limited	2021

Name	Organisation	Year of Award
Dr. Reginald Chika Stanley	Former Executive Secretary, PPPRA	2023

Name	Organisation	Year of Award
Prof. Ben Obi	Department of Economics, University of Abuja	2023

2024 NAEE/IAEE CONFERENCE: LOCAL ORGANISING COMMITTEE

GENERAL SUPERVISION/COORDINATION / SPONSORSHIP

Dr. Hassan Mahmud	-	General Conference Chairman/Coordinator
Prof. Wumi Iledare	-	Plenary Session Chairman/Coordinator
Prof. Adeola Adenikinju	-	Concurrent Session Chairman/Coordinator
Prof. Ben Obi	-	Programme Committee Chairman/Coordinator
Prof Yinka Omorogbe	-	Coordinator Sponsorship Committee
Mrs Folashade Oje	-	Chair LOC /Coordinator Protocol & Logistics Sub-Committee
Mrs. Priscillia Ekpe	-	Coordinator Dinner & Award Night
Mr. Ere Iyalla	-	Member/Coordinator Secretariat Sub-Committee
Dr. Margaret Hilili	-	Member/Asst. Coordinator Sponsorship Sub-Committee
Mr. Feso Bright	-	Member/Coordinator Media &Publicity Sub-Committee
Dr. Gershon Obindah	-	Member/Asst. Coordinator Rapporteurs Sub- Committee

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Dr. Margaret Hilili CBN	Asst. Coordinator
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Mr Shaibu Faruk NUPRC	Member

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Mr. Edward Obokoh	NDPHC	Member
Mr. Olusegun Raphael	NAEE	Member

Protocol & Logistics Sub Committee

Mrs Folashade Oje	Fed. Min of Health	Coordinator
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Mr Salman Mifta'hu	PTDF	Member
Dr Margaret Hilili	CBN	Member
Dr. Joseph Echendu	NUPRC	Member
Mr. Rufai Abba Dabo	PTDF	Member

ABOUT NIGERIAN ASSOCIATION FOR ENERGY ECONOMICS (NAEE)

About NAEE

The Nigerian Association for Energy Economics (NAEE) is the Nigerian affiliate of the International Association for Energy Economics (IAEE) with a presence in over 120 Countries all over the World. The NAEE is however the first and currently the only affiliate of the International Association for Energy Economics in Africa.
The NAEE was formally inaugurated in Nigeria in December 2006 at the Nigerian National Petroleum Corporation (NNPC) Towers, Abuja, and one of the fastest growing affiliate in the IAEE.

Mission Statement

The Association is a nationwide nonprofit organization of business, government, academic and other professionals that advances the understanding and application of economics across all facets of energy development and use, including theory, business, public policy and environmental considerations.

To this end, the Association:

* Provides a forum for the exchange of ideas, advancement and professional experiences in energy economics.
* Promotes the development and education of energy professionals
* Foster an improved understanding of energy economics and energy related issues by all interested parties.
* Provides a forum for contribution to national discourse on energy policy issues in Nigeria.

Activities of the NAEE

The NAEE seeks to achieve its objectives through the following activities:

* Publication of Professional Journal, Books, Newsletters and Press release.
* Organizing Seminars, Conferences, Workshops, Public Lectures and other similar fora.
* Meetings and such other activities that will promote the objectives of the Association.

MEMBERSHIP

Membership of NAEE is open to interested persons from the academia, corporate sector, scientific fields and government. According to the IAEE Bylaws, to which NAEE subscribes, any person interested in economics of energy and willing to pursue the objectives and abide by the policies of the Association is eligible for membership.

The Association has the following categories of Membership:

- Direct Members
- Student Members
- Honourary Members
- Institutional Members

Membership of NAEE confers one with the following Benefits:

1. Receiving periodic issues of the Energy Journal as well as Economics of Energy & Environmental Policy
2. Participating in Energy Forum
3. Access to Online Worldwide Membership Directory and Online Conference Proceedings
4. IAEE Energy Blog
5. Keeping members informed of conferences and events within the energy industry.
6. Workings Paper Series
7. Placement Service
8. Student Programmes
9. Member Publication Listing
10. IAEE Merchandise
11. IAEE Website
12. IAEE membership
13. NAEE Membership Directory
14. Free downloading of materials in NAEE Website
15. NAEE Membership
16. Receiving Nigerian Energy Newsletter

HOW TO BECOME A MEMBER

Any person interested in the economics of energy and willing to pursue the objective of the Association is eligible for membership.

1. Membership shall be accomplished by submission of a written application (by completion of association's membership form) and payment of the first year's dues.
2. Each member shall have one vote, members may vote at meeting of the members in person or by written proxy.

Membership Dues

1. New Regular Membership - ₦30,000
   Renewal - ₦20,000
2. New Student Membership - ₦15,000
   Renewal - ₦10,000
3. Institutional Membership - ₦300,000

NAEE ACCOUNT DETAILS

Bank Name: Guaranty Trust Bank Plc.
Account Name: Nigerian Association for Energy Economics
Account Number: 0110538168

Bank Name: First City Monument Bank
Account Name: Nigerian Association for Energy Economics
Account Number: 1392531018

WEBSITE

The Nigerian Association for Energy Economics is on the World Wide Web and its address is **www.naee.org.ng** The website has general information about the Association. You can also visit our website of the International body at **www.iaee.org**

Membership registration can be made online via **https://naee.org.ng/portal/login** followed by subscription payment from the portal

Contact: for more information, you can write directly to: Nigerian Association for Energy Economics (NAEE)

President

Dr. Hassan Mahmud
Nigerian Association for Energy Economics (NAEE)
Email: president@naee.org.ng
Or madakihassan@yahoo.co.uk

Administrative Officer

Mr. Danjuma Mohammed
Nigerian Association for Energy Economics (NAEE)
Email: admin@naee.org.ng
Tel: +234 7 068811494

Nigerian Association for Energy Economics (NAEE) PUBLICATIONS

1. Energy, Environment & Economic growth (2010)
2. Green Energy and Energy Security: Options for Africa (2011)
3. Energy Technology and Infrastructure for Development (2012)
4. Energy Resource Management in a Federal System (2013)
5. Energy Access and Economic Development: Policies, Institutional Framework and Strategic Options (2014)
6. Future Energy Policy Options: Assessment, Formulation and Implementation (2015)
7. Energizing Emerging Economies: The Role of Natural Gas & Renewable Energy (2016)
8. Energy, Economy and The Environment: The Interplay of Technology, Economics and Public Policy (2017)
9. New Era in Global Energy Landscape: Implications for An Emerging Economy (2018).
10. "ENERGY EFFICIENCY AND ACCESS FOR SUSTAINABLE DEVELOPMENT IN EMERGING ECONOMIES" (2019)
11. "Energy and Petroleum in a Post–COVID World" (2020)
12. "Strategic Responses of Energy Sector to Covid-19 Impacts on African Economies" (2021)
13. "Energy Transition and Climate Change Policy: Pathways to Sustainable Development in Africa" (2022)
14. "Energy Evolution, Transition and Reform: Prospects for African Economies" (2023)