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## Message from the President

**T**his is the last message I will be giving as the President of the Nigerian Association for Energy Economics (NAEE). It seems like yesterday when we inaugurated the Association at the NNPC Towers in Abuja on 6 December, 2006. At the end of that inaugural conference, Professor Akin Iwayemi, FNAEE, was elected the first President and I became one of his two Vice-Presidents. In 2011, I was elected by members to succeed him as the second President of the Association.

There is no doubt in my mind that the Association has made significant strides since its formation, despite the many challenges that threatened its existence since inception. However, every step of the way, we have received help from above and from committed members who supported the vision of building a platform for energy professionals to contribute to the discussion of energy policies in Nigeria. We have also enjoyed tremendous support from the parent body, the International Association for Energy Economics (IAEE).

As I hand over the baton of the leadership of the Association this year, I cannot but remember the journeys of the past decade or so. The association has grown in its membership, the size of attendance at its annual conferences, the numbers of papers presented at these conferences, as well as the calibre of professionals who attend the conferences. The students' arm of the association is undoubtedly the most virile and the fastest growing in the association. It is satisfying to see the hope, aspirations, excitement, as well as the joy and satisfaction in the eyes of these budding professionals at the end of each conference. I have deep feeling within me that among these future energy professionals lie the solution to Nigeria's energy sector. I feel at once both sober and energized that we took the right decision in starting the association and making the sacrifices we have had to make over the years.

But we did not have to journey alone, as many individuals and organizations have rallied to our assistance. We have gratefully recognized many of these individuals and organizations that have made major contributions to the development of the energy sector in Nigeria. We have been uncompromising in terms of keeping to strict standards in our decisions on those who merited these awards. Among those we have given our awards since 2008 include Professor Anthony Adegbulugbe, Mr. Mutiu Sunmonu, Professor A.S. Sambo, Dr. Emmanuel Egbogah, Chief Philip Asiodu, Professor Akin Iwayemi, Professor Layi Fagbenle, Professor Wumi Iledare, Dr. Tim Okon, Mr. Reginald Stanley, Professor Yinka Omorogbe, Mr. Funso Kupolokun, and Dr Sam Amadi. We have also recognized the Central Bank of Nigeria, Platform Energy, the Nigeria Liquefied Natural Gas (NLNG), the Federal Ministry of Power, Bureau of Public Enterprises, and Schlumberger.

Our Conference themes over the years have been carefully chosen to provide a platform for NAEE members and non-members within and outside Nigeria to provide evidence-based contributions to current policy discussions and debates that concern our three main stakeholders – the government, the energy industry and the academia. The themes of the past seven conferences in chronological order are: Developing and Supporting Critical Energy Infrastructure for Vision 2020: Challenges, Constraints and Prospects; Energy Industry Restructuring: Interactions between Business, Economics and Policy; Energy, Environment and Economic Growth; Green Energy and Energy Security: Options for Africa; Energy Technology and Infrastructure for Sustainable Development; Energy Resource Management in a Federal System: Challenges, Constraints and Strategies; Energy Access for Economic Development: Policies, Institutional Framework and Strategic Options. The 8th Conference holding between 26 and 28 April, 2015 with the theme, "Future Energy Options: Policy



(Continued on page 2)

Formulation, Assessment and Implementation”, is by no means less relevant.

In the past nine years, the Association has witnessed significant developments in the national and global energy industry and energy markets. These include the volatility in the global oil markets, the reforms and privatization of the Nigerian power sector, the slump in global economy due to the global financial crises, and the subsequent recovery. We have also witnessed the continuous transformation of previously unconventional energy sources, such as shale oil and shale gas, with the attendant shifts in the locus of global oil market demand and supply, as well as differential impacts on energy exporters and energy importing countries, the perpetual crisis in the Middle East, fuelled lately, by the battle of wit between the West and Russia, renewed global attention on clean energy, energy access and energy security. The NAEE has followed all of these issues with keen interest and our annual conference proceedings have detailed academic contributions to their evolution.

Finally, as I bow out as the 2nd President of the NAEE, I wish to express my deep appreciation to Engr. Fisoye Delano, with whom the dream of NAEE was conceived during our flight between Lagos and Zurich in 2006; Professor Iledare who along with Drs Michelle Foss and Gurcan Gulen, strongly recommended us to the IAEE, which expressed doubt that any credible association could emerge from Nigeria. Since 2008, when I met him formally, Professor Iledare has made much sacrifice on my behalf and on behalf of NAEE and his support for us has been unquantifiable. I also wish to thank Professor Akin Iwayemi, who lent his status and credibility to the association in its formative years and has remained very supportive; Professor A.S. Sambo, who throughout his term as Director General of Energy Commission of Nigeria, provided moral and financial support for our conferences; the IAEE Executive Director, Dave Williams, for his support and special understanding of our peculiar situation, Past Presidents of IAEE, who ignored several warnings and the negative advice from their countries' embassies to attend our conferences in Abuja and Lagos. I appreciate members of the successive NAEE Councils and the NAEE Administrative Officer, Bukola Ayeyo. I cannot forget Toye Aladedunye for the sacrifices he had to make over the years, especially during our annual conferences. I thank our student members and all members of the Association for their continued support. I trust that the same support will be given to the incoming President and members of his Council. To the former Special Adviser to the President on Energy Matters, Professor A.O. Adegbulugbe and the other 16 members who were present at the "upper chamber" of the NNPC Towers in 2006, I thank you all for accepting the invitation to start this Association.

I must acknowledge the support of organisations like Shell, Chevron, NNPC, ECN, CBN, Centre for Petroleum, Energy Economics and Law (CPEEL), Emerald Institute, (EI), Schlumberger, PPPRA, Federal Ministry of Power, ENERGIA, NERC, NPDC, NAPIMS, Platform Energy, IAEE, and others who have provided financial support to the NAEE over the years.

Nearly a decade after its formation, the NAEE remains the only African affiliate among the nearly 100 affiliates of the IAEE worldwide! To God be all the glory.

Thank you, and God bless.

ADEOLA ADENIKINJU

## NAEE Mission Statement

### Mission Statement

The Association is a nationwide nonprofit organization with a membership drawn from business, government, the academia and other professionals and a mission to advance the understanding and application of economics across all facets of energy development and use, including theory, business, public policy, and environmental consideration.

### 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;
- \* Fosters an improved understanding of energy economics and energy related issues by all interested parties; and
- \* Provides a forum for contribution to national discourse on energy policy issues in Nigeria.



The Nigerian Association for Energy Economics NAEE  
c/o Professor Adeola Adenikinju  
Department of Economics  
University of Ibadan, Ibadan  
Tel: 08053527260, 08023440018  
Email: president@naee.org.ng  
af.adenikinju@ui.edu.ng  
adeolaadenikinju@yahoo.com

**Administrative Officer**  
Nigerian Association for Energy Economics (NAEE)  
Email: admin@naee.org.ng



**CPEEL2015**  
SECOND REGIONAL CONFERENCE  
**ON ENERGY**

[www.cpeel.ui.edu.ng](http://www.cpeel.ui.edu.ng)

Theme:

**“TRANSFORMATIONS IN THE GLOBAL ENERGY INDUSTRY: SETTING THE AGENDA FOR GULF OF GUINEA”**

Date: Monday 7th September – Tuesday 8th September 2015.

Venue: Trenchard Hall, University of Ibadan, Ibadan, Oyo State, Nigeria

## Editor's Note

Welcome to the third edition of the NAEF Energy Forum, the official Newsletter of the Nigerian Association for Energy Economics (NAEF). This edition comes at a time of great volatility in the international oil market, with oil price fallen by more than 40 percent after nearly five years of relative stability, and predictions of further plunge already being echoed in view of low demand, growing switch from oil to other fuels, and geopolitical turmoil in major oil producing countries. The resultant effect being that countries like Nigeria, who depend heavily on revenues derived from oil resources are already 'feeling the pain'. Understandably, the interest of members is focused on the impact of these happenings on the economy of Nigeria with articles articulating dynamic options that could transform the outlook of the country from a monolithic economy to a diversified economy.

In the lead article, Sanusi Gbenga makes a case for the diversification of Nigeria's economy not necessarily through a total shift from the energy sector, but rather, through leveraging on the natural energy resources to develop other potentially economic and viable sectors. He advocated for the passage and implementation of the Petroleum Industrial Bill and the actualization of the goals of the Nigeria Industrial Revolution Plan (NIRP), which requires a paradigm shift from exportation of raw materials at the low ebb of the value added chain to production of what is locally consumed and exported.

Damilola Olawuyi and Omolola Olarinde, while acknowledging the existence of some legal barriers to free trade in the country, outline the advantages inherent in Nigeria's engagement in mass production of bio-fuel and offer the use of tested fiscal incentives as a means to facilitate increased investments in Nigeria's bio-fuel sector. Bio-fuel is also the focus of the two articles by F. O. Kolawole. In the first article, Kolawole examines the rationale behind the clamour for alternative sources of energy and suggests 'responsible' utilization of bio-fuel as a way of sustainably meeting the energy needs of Nigeria. In the second article, he lauds the importance of incorporating renewable energy in the energy mix of the country and advocates for the adoption of small-scale bio-gas system for production of energy for the rural areas of the country. This he identified as one of the ways to reduce the dependence of the country on crude oil. In addition to providing an alternative source of fuel, the author believes that such a move would reduce the carbon footprints of the country and would be a significant contribution to the growing global need for energy security.

The article by Olugbenga Adesanya examines Nigeria's drive towards the attainment of secure and sustained energy security in the area of electricity supply and calls for a review of the Roadmap for Power Sector Reform 2010 to bring it in line with the acknowledged practical realities of the country and to positively position the country on a strong footing within the MINT (Mexico, Indonesia, Nigeria and Turkey) Club. John Sylvester Afaha writes about the need for shift of focus in political discourse from the rather superficial political talks to the development of strategies to deal with challenges posed by climate change and the likely impact of shift in energy needs from fossil-fuel to greener energy sources on the development plan of the country.



Oluwasola Emmanuel Omoju writes on the nexus between energy, economic growth and poverty reduction; and decried the alarming rate of coal consumption in the world, which he claims is significantly eroding the progress made in global poverty reduction. While acknowledging the strides made in the development of clean coal technologies to reduce the volume of greenhouse gas emission, the author expressed doubt as to the possibility of the attainment of such goal in view of low deployment rate of the technologies. Monica O. C. Maduekwe examines the challenges of increased number of fossil-fuel powered private and public vehicles in use in Lagos State and proffers concrete policy pathways that could lead to the attainment of the objectives of the Avoid-Shift-Improve (A-S-I) approach introduced by the Lagos Metropolitan Area Transport Authority (LAMATA) through its Strategic Transport Master Plan (STMP).

Suleiman Ikpechukwu Oji advocates for the enforcement of retributive law vide penal technique methods, as against remedial technique methods, in cases of criminal negligence against persons responsible for spillage in oil production in Nigeria; identifying such approach as the most effective way to curtail the nonchalant attitude of some operators in the industry. Olusanya E. Olubusoye makes a case for the establishment of a robust and comprehensive energy information system for Nigerian Universities where empirical data on energy demand, supply and consumption trend could be developed; based on which, future demand and expansion projections could be made. Jean Balouga examines the role of Small and Medium Enterprises (SMEs) in the economic growth of nations, and dissects the challenges to their survival, one of which is the hurdle in the fulfilment of their requirement for energy.

Apart from these riveting articles, this edition features information on past and up-coming events of the IAEE and NAEF. It contains excerpt of events at the 7<sup>th</sup> NAEF Annual International Conference held at the Sheraton Hotel Abuja, from Nigeria 16 to 18 February, 2014; information on the 38<sup>th</sup> IAEE International Conference, which will take place in Antalya, Turkey between 24 and 27 May, 2015; the **5<sup>th</sup> IAEE Asian Conference, to be held in Perth, Australia, 14-17 February, 2016**; and the 33<sup>rd</sup> USAEE/IAEE North American Conference, which will hold 25-28 October, 2015 in Pittsburgh, PA, USA.

We heartily thank all the contributors to this edition, members of the editorial team, especially Oluwatosin Adeniyi of the Department of Economics, University of Ibadan, the support staff, and all those who have made invaluable contributions to the success of the Newsletter. We look forward to your continued contributions and support; and welcome suggestions, views and comments on all aspects of the Newsletter. We also welcome articles on any subject of interest to NAEF members for publication in forthcoming editions. Articles should be in English using the MS Word (1997-2007) format and Times New Roman font style font size 12. Text layout should be kept simple, with regular headings, subheadings (where appropriate) and paragraphs. Articles should be in the region of 700-1,500 words; and should include the contributor's name, email address, phone number and affiliation. Pictures may be included in a separate file in JPEG format. Our contact email addresses are: [naeenewsletter@gmail.com](mailto:naeenewsletter@gmail.com) and [balkisaidu@yahoo.co.uk](mailto:balkisaidu@yahoo.co.uk).

We thank you for your patronage!

DR BALKISU SAIDU  
April, 2015

## LIST OF CONTRIBUTORS

### PROF. WUMI ILEDARE,

PH.D., FNAEE, 2014 IAEE President  
Emeritus Professor, LSU Center for Energy Studies,  
USA  
Chirota & Emmanuel Egbogah Distinguished Professor  
Director, Emerald Energy Institute, UNIPORT, Nigeria.

### PROFESSOR YINKA OMOROGBE, FNAEE

Nabo Graham Douglas Distinguished Professor of Law,  
Nigerian Institute of Advanced Legal Studies,  
Abuja.

### SANUSI GBENGA P.

E-mail: [petersbanks1@gmail.com](mailto:petersbanks1@gmail.com)  
Tel: +2347037855635. Department of Economics,  
University of Ibadan (Postgraduate Student)

### DAMILOLA S. OLAWUYI<sup>+</sup> and OMOLOLA S. OLARINDE<sup>++</sup>

Dr. Damilola S. Olawuyi, LL.M (Calgary), LL.M  
(Harvard), Ph.D (Oxford), Executive Director, Institute  
for Oil, Gas, Energy, Environment and Sustainable  
Development (OGEES),  
Afe Babalola University, Nigeria.  
Email: [dolawuyi@ogeesinstitute.edu.ng](mailto:dolawuyi@ogeesinstitute.edu.ng)  
<sup>++</sup> Omolola S. Olarinde, B.Sc (Economics, Romania),  
M.Sc (Economics, Ibadan), M.Phil (Economics, Ibadan)  
Lecturer at the Elizade University, Ilara-Mokin and  
Research Fellow, Institute for Energy, Environment and  
Sustainable Development,  
Afe Babalola University, Nigeria.  
E-mail: [omolola.olarinde@elizadeuniversity.edu.ng](mailto:omolola.olarinde@elizadeuniversity.edu.ng)

### MR. F. O. KOLAWOLE

E-mail: [fkopresido@yahoo.com](mailto:fkopresido@yahoo.com); Tel: 07037567244  
Department of Materials and Metallurgical Engineering,  
Federal University Oye-Ekiti, Ekiti State.

### OLUGBENGA ADESANYA

Energy Economist & Chevening Scholar.

### JOHN SYLVESTER AFAHA

Lecturer- Department of Economics, Caleb University,  
Imota, Lagos, Nigeria and CPEEL University of Ibadan,  
Ibadan, Nigeria. Phone: +2348060177138  
E-mail: [johnafaha@yahoo.com](mailto:johnafaha@yahoo.com)

### OLUWASOLA EMMANUEL OMOJU

The author is a PhD Student and Researcher at China  
Center for Energy Economics Research (CCEER),  
School of Economics, Xiamen University, China.  
Contact Email: [sholley@yahoo.co.uk](mailto:sholley@yahoo.co.uk)

### MONICA O.C MADUEKWE

ECOWAS Centre For Renewable Energy and Energy  
Efficiency. Email at ; [monicamaduekwe@yahoo.com](mailto:monicamaduekwe@yahoo.com)  
Tel: +2389899689

### SULEIMAN IKPECHUKWU OJI, PH.D

Acting Head, Department of Public Law and  
Jurisprudence, Faculty of Law  
Usmanu Danfodiyo University, Sokoto

### OLUSANYA E. OLUBUSOYE

Department of Statistics, University of Ibadan  
E-mails: [oe.olubusoye@mail.ui.edu.ng](mailto:oe.olubusoye@mail.ui.edu.ng)  
[busoye2001@yahoo.com](mailto:busoye2001@yahoo.com)  
Tel.: +234 8058258883

### JEAN BALOUGA

Department of Economics, University of Lagos, Nigeria  
E-mails: [balougaje@live.com](mailto:balougaje@live.com); [jbalouga@unilag.edu.ng](mailto:jbalouga@unilag.edu.ng)  
Tel. no: 08036006471

# Nigeria Industrial Revolution Plan and the Criticality of the Energy Sector

Sanusi Gbenga P.\*

## Introduction

History shows that a country becomes poorer by specialising in the export of only raw materials without the industrial sector which has the capacity of multiplying national wealth (NIRP, 2014). This assertion, memorably encapsulate the need for industrial revolution as detailed in the Nigeria Industrial Revolution Plan (2014) document. The leverage or spring board for the dramatic change being envisaged is the energy sector in which the country is naturally endowed and has an intense comparative advantage.

## Nigeria Industrial Revolution Plan

The Nigeria Industrial Revolution Plan (NIRP) is designed as a 5-year plan to accelerate the build-up of industrial capacity within Nigeria. The plan aims to increase manufacturing's contribution to GDP from 4 per cent, to 6 per cent by 2015, and above 10 per cent by 2017. The plan aims to develop the sectors where Nigeria has a natural comparative advantage; the energy sector stands tall in this regard.

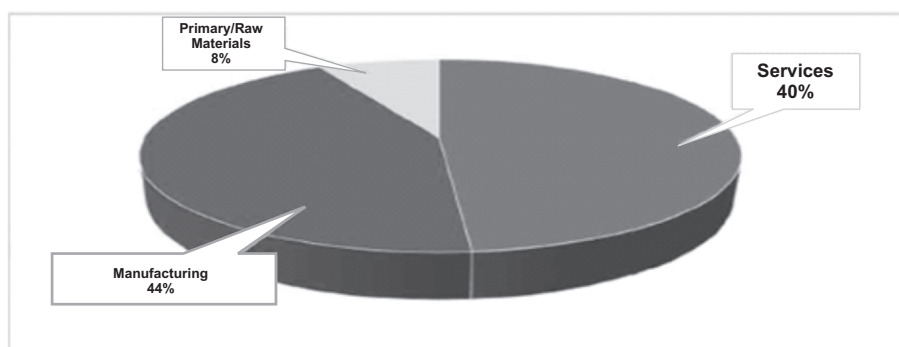
A paradigm shift from specialization in the exportation of major raw materials which are basically at the low ebb of the value added chain to production of what is locally consumed and exported is essential. The Nigeria industrial sector contributes 3 per cent to export income, but accounts for more than 50 per cent of the country's import (NIRP, 2014).

Oil has however, dominated the total exports (90 per cent). Harnessing the abundance of oil could reverse not only the negative trade balance of the impact of industrial importation, but also provide the solid base for industrial sector expansion.

Competitiveness is a definite path to industrial revolution. The philosophy of the NIRP is based on long-run global competitiveness. A competitive business environment demands that infrastructure should be reliable, government red tape minimized, and ensuring that operating cost are not totally profit eroding. Since countries leverage on the limited resources at their disposal, energy sector can be the anchor of the Nigeria industrial development plan.

Nigeria has a population of over 166.6 million (UN, 2012), nominal GDP output at constant price in 2013 was put at US\$510 billion (N79.050 trillion), after the rebased exercise and the GDP growth rate revised down to 5.5 per cent (Thisdaylive, 2014). Nigeria has the largest natural gas reserves on the continent and endowed with about 44 solid minerals in commercial quantity. With these large reserves of natural resources, Nigeria has every potential to build a prosperous and sustainable economy. This will significantly create wealth by reducing poverty, and changing the tortuous long path that has taken the country farther from the league of regional economic powers that can attract more foreign direct investment in strategic sectors of the economy. Figure 1 shows that countries with robust industrial and services sectors attract more foreign direct investment than countries that specializes in the production and export of raw materials.

\*petersbanks1@gmail.com  
+2347037855635.  
Department of Economics,  
University of Ibadan  
(Postgraduate Student)



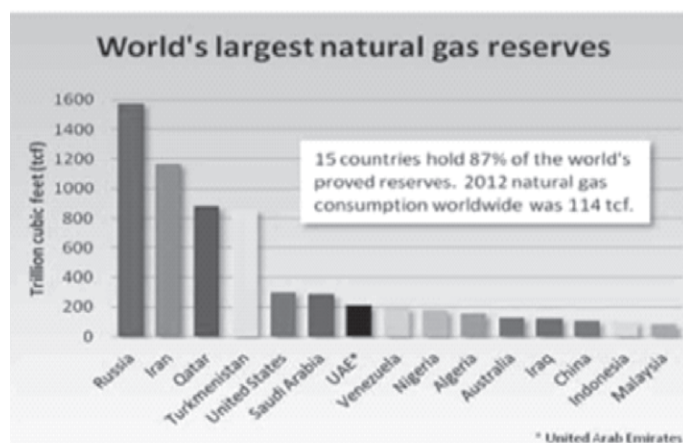
**Figure 1:** Global FDI distribution by Primary, Service, and Manufacturing sectors.

**Source:** UNCTAD, 2012. Cited in NIDP, 2014

### Lessons from China and Brazil

The Nigeria Industrial Revolution Plan draws inspirations from the experiences of China and Brazil. China has transformed from a typical traditional agricultural economy to a modern industrialized country. This has created jobs and wealth in the economy. Brazil's economic growth was through rapid expansion of industry. The magnitude of structural changes in the industrial sector has been rapid over the years. Brazil had 90,700 megawatts of installed electric power capacity in 2004, and over 60 per cent of its exports consisted of industrial products. These examples of China and Brazil show that every country must develop its own unique recipe to industrialization.

The NIRP document therefore highlights the strengths, weaknesses, opportunities and the threats (SWOT) strategy of achieving similar fate in Nigeria. The strength of Nigeria in terms of natural endowments is more in energy resources. These resources include large commercial minerals of coal, oil and gas, iron ore, zinc, and uranium. This is aside the industrial minerals such as limestone, dolomite, clays, and glass-sand which are in large amounts within the country. Nigeria has the 12th largest iron ore reserves in the world. This is an input for the steel industry. Moreover, the gas reserves of 187tcf and oil reserves of about 37 billion barrels, ranks Nigeria as the 7th and 10<sup>th</sup> respectively and, largest globally (See Figure 2).



**Sources:** NIRP, 2014.

Nigeria has the regional and the international political sway to expand her industrial development processes. This political leverage to access new markets and expand old market through bilateral and multilateral relationship is the resultant effect of the country's richness in energy resources. The strategic location of the country in the Gulf of Guinea gives a direct freight access to other continents' markets (North America and Europe via the Atlantic Ocean).

The weaknesses of the country are the consequence of the neglect and mismanagement or misuse of the energy resources revenue over the years. For instance, the infrastructure backwardness of the country which is evident in the epileptic supply of electricity and poor transportation network are constraints to productivity of the industrial sector. The

implication is the increasing production cost of industries thereby, leading to higher product prices.

Furthermore, high interest rate charged by banks to the real sector is another highlighted problem. These lending rates are unsustainable to support significant industrial development. Aside other economic factors which affect the interest rate, the international oil price is another key factor. The recent dwindling oil price which fell from about US\$110 to US\$68 per barrel has made the CBN to devalue the naira and increased the benchmark interest rate- monetary policy rate (MPR) from 12 percent to 13 percent. Automatic adjustment of the financial institutions lending rate is expected as well.

Industrialization provides the opportunities to diversify the exports and subsequently the foreign exchange sources. Nigeria's vast oil and gas reserves provide the feedstock needed to enable rapid diversification of Nigeria's export.

Recent discoveries of shale oil and gas globally is a threat which could lead to a possible further fall in the price of crude oil for a longer period than expected. This will invariably lead to huge fall in government revenue. Hence, Nigeria needs to urgently diversify its sources of foreign exchange, through industrialization.

## Criticality of the energy Sector

Energy is central to sustainable economic growth and wealth creation through industrialization (Iwayemi, Adenikinju and Diji, 2014). The energy industry contributes to economic growth by creating jobs and value through extraction, transformation and distribution of energy commodities. Similarly, energy underpins the rest of the sectors in an economy. Energy is an input for the production of nearly all goods and services (World Economic Forum, 2012).

Nigeria is endowed with large oil and gas reserves. Nigeria's current proven oil reserves are estimated at 37.14 billion barrels. This is the 10th largest in the world, and gas reserves estimated at 187 TCF, the 7th largest globally. Oil production has historically ranged between 1.7bpd and 2.4 bpd, while about 2.4 TCF of gas is produced annually, of which a third is flared. The Nigerian oil and gas industry accounts for 95 per cent of foreign exchange earnings and about 70 per cent of total government revenue (NIRP, 2014).

Opportunities for industrialization in the oil and gas sector are enormous through investing heavily in Petrochemicals, Methanol, Fertilizers, Refineries, and other Gas-based processing activities. Trinidad and Tobago has less gas reserves than Nigeria, but, the country is the second largest exporter of ammonia and nitrogenous fertilizer globally. Nigeria can do the same, and follow the path of building up industrial activities, to create wealth and jobs.

Nigeria currently has only one Petrochemical Plant (Eleme Petrochemicals), which as of 2013, had an annual installed capacity of 300,000 metric tonnes of olefins, 250,000 metric tonnes of polyethylene and 80,000 metric tonnes of polypropylene. These can be expanded to fully develop the energy sector (NIRP, 2014).

The key specific challenges of oil and gas industrial activities that must be overcome include: Insufficient oil and gas pipeline infrastructure; supply irregularity; international competition for investors; major foreign investors or partners should not be driven out of business through frequent changes in fiscal terms in the energy sector (Izuora, 2014) and; since oil and gas industrial assets are typically capital intensive, it requires technology accessibility. Barriers to creation of oil & gas industrial cities should be eliminated. Ensuring domestic supply of gas to gas-based industries is paramount. The regional market for Nigerian oil and gas products in West and Central Africa has to be further explored and penetrated.

## Conclusion

Diversification of the economy should not be premised on the total shift from the energy sector, but rather, leveraging on the natural energy resources to develop other potentially economic and viable sectors. This is where the Petroleum Industrial Bill (PIB) passage and implementation is paramount. The desired impact of the Bill on the economy will be hampered if the passage of the Bill is delayed. Therefore, the PIB should not be allowed to be overtaken by events and global changes.

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## Minding the Gap: Addressing the Impacts of Legal Barriers and Trade Restrictions on Sustainable Biofuel Production in Nigeria

Damilola S. Olawuyi\* and Omolola S. Olarinde\*\*

Nigeria undoubtedly holds vast potential for large-scale agricultural production, given its extensive arable land, labour, favourable agro-ecological conditions as well as history of cocoa and groundnut production and export. What is less known is that Nigeria has also traded internationally in sweet sorghum, sugar cane, jatropha curcas, soya, oil palm and coconut; all raw materials for biofuel production. This paper rests on a simple principle that has maintained its validity over time, Riccardo's law of comparative advantage (1817). Riccardo considered that a country should focus on producing what it is more efficient at since this yields a lower cost commodity, then, trade the excess for a different good produced by another country following the same principle. Both nations are better off for this. Applying the proposition to alternative energy we can establish whether it is relatively efficient for Nigeria to engage in biofuel production and move to discuss barriers to its trade.

Africa has generally benefitted from low average cost of agricultural production for some of the reasons earlier stated, in addition to high yield variety of crops and rapid population growth. Indeed, the cost of Straight Vegetable Oil (SVO) from jatropha production in Tanzania, Zimbabwe or Malawi is 0.686 USD per litre<sup>1</sup>. It is lower in comparison to 1.00 USD estimated for Canada and the United States, but higher than Brazil which stands between 0.19 and 0.25 USD per litre. Further, compared to 0.90 USD per litre of fossil fuels even for an oil producing country like Nigeria, biofuels is an efficient alternative, having a comparative advantage in its production. Although by the same principle since Brazil is closer geographically to the United States of America (USA) because of transportation cost. Africa is at a disadvantage relative to Brazil. This should not be a deterrent since the renewable energy market remains unsaturated, so that Africa and indeed Nigeria may fill additional demand from Europe, USA, Canada, Asia; or even export within the region.

Free channels for exports reduce direct and indirect costs of doing business. Everyone would have a more satisfying trade if cumbersome procedures were done away with. For Nigeria, an update of the existing laws and clarity in the roles of energy regulatory bodies is needed. Biofuels are clean and green energy sources; like many environmentally friendly products, their social benefits exceed the returns to individuals/firms, for example better living conditions for future generations. The government therefore has a role in their market. Tax breaks and rebates, subsidies, preferential agreements, funding of research and development, assistance in acquiring land and similar support services to encourage investors in bio-fuels usually form part of the legal framework of countries as structurally different as Brazil, India, Canada and China. Perhaps all these nations recognize that to break the inertia of reliance on fossil fuel, some nudge from the government is useful. These incentives for biofuel production are missing from Nigeria even when more recent laws such as the 2007 Energy Commission of Nigeria Act address renewable energy production.

Furthermore, the transfer of know how is essential to efficient production. Such measures would ease the process of transferring technologies so that investors are subject to

\*Dr. Damilola S. Olawuyi, LL.M (Calgary), LL.M (Harvard), Ph.D (Oxford), Executive Director, Institute for Oil, Gas, Energy, Environment and Sustainable Development (OGEES), Afe Babalola University, Nigeria. [dolawuyi@ogeesinstitute.edu.ng](mailto:dolawuyi@ogeesinstitute.edu.ng)

\*\*Omolola S. Olarinde, B.Sc (Economics, Romania), M.Sc (Economics, Ibadan), M.Phil (Economics, Ibadan) Lecturer at the Elizade University, Ilara-Mokin and Research Fellow, Institute for Energy, Environment and Sustainable Development, Afe Babalola University, Nigeria. [omolola.olarinde@elizadeuniversity.edu.ng](mailto:omolola.olarinde@elizadeuniversity.edu.ng)

<sup>1</sup>Global Forum on Agricultural Research, Executive Brief. 2013. <http://www.egfar.org/news/imported/executive-brief-update-2013-oil-crops-sector>, accessed 19 January 2014.

simpler and more convenient processes. There is therefore a need for a holistic update to the National Office for Technology Acquisition and Promotion Act of 1979, in order to facilitate the transfer of renewable technologies into Nigeria and remove unnecessary bureaucratic hurdles to technology transfer processes. Similarly, while many key players in the energy market may weigh initial investment costs and might be lethargic to exploring a new venture, tax rebates, subsidies, tax breaks and similar fiscal incentives are required to spur investors in the transfer of technology.

Finally, there is an established link between institutions and productivity. Voluntary Partnership Agreements, bilateral and multilateral trade agreements facilitate exchanges of goods and services by reducing taxes and other transactional costs. These agreements may be particularly important for trade within Africa but need not be restricted to the region. Liberalizing the market for bio-fuel could significantly reduce the overall cost of doing business in Nigeria, and remove bureaucratic bottlenecks and hurdles to investment and trade.

Nigeria has strong potentials to be a major player in African and global bio-fuel markets. By providing fiscal incentives and establishing efficient and less cumbersome legal and institutional processes that would facilitate technology transfer and increased investments in Nigeria's bio-fuel sector, Nigeria would be well positioned to take advantage of its comparative advantage as an agricultural nation to situate itself as a significant player on global renewable energy markets.

## Biofuel: A Source of Alternative Energy for Nigeria

F. O. Kolawole\*

The primary application of fuel is in the storage of a stable form of energy that can easily be transported to the location of utilization. Almost all fuels are chemical fuels. This fuel generates heat or performs mechanical work, such as powering an engine. It may also be used to produce electricity, which is further used for heating and air conditioning, lighting and the multi-functional powering of electronic devices.

As the population of the world approaches 7 billion inhabitants, the demand for energy is becoming an even more critical challenge for the world. Governments are looking for sustainable solutions that provide the most competitive energy supplies from secure sources, while at the same time trying to balance the long-term, and in some cases, the short-term needs of the environment. Nigeria produces an average of 2.18 million barrels of crude oil per day. Crude oil has been Nigeria's major source of revenue for the past 40 years with exports of 1.73 million barrels per day. Nevertheless, crude oil is not sufficient to meet the needs of approximately 170 million Nigerians. Therefore, it is necessary for Nigeria to explore alternative sources of fuel. These sources should be cheaper, while reducing the carbon and environmental footprints of production processes.

Biofuels offer an alternative approach that can be used to produce alternative energy from available biodiversity. With the success of Brazil and, the United States of America (USA) in the first generation biofuels produced from food, such as sugarcane and corn, there has been a shift in sugarcane and corn production towards the production of feedstock for biofuels. In the case of USA, more corn is used for the production of fuel than for animal feedstock. This clearly poses a potential threat to future food security, in developing countries with fragile food sources.

Furthermore, with the cyclical changes in the price of crude oil, linkages between the cost of biofuels and the cost of food, these could have unsettling effects on the cost and availability of food. This is particularly important in Africa, where a large number of people depend on corn and cassava as their stable sources of carbohydrates. There is, therefore, a need to explore the possibility of producing biofuels from biodiversity that is not consumed as food. Such need has stimulated recent efforts to develop third generation biofuels from non-food lignocellulosic feedstock, such as bamboo and palm that are readily available in most developing countries. However, before such possibilities can be fully explored, there is a need to study the yields of biofuel that can be obtained from the available production processes that typically involve chemical hydrolysis of carbohydrates into sugars, prior to the fermentation processes that can result in the production of bio-ethanol or bio-butanol. As a fuel, butanol has a number of advantages over ethanol. First, butanol has a higher calorific value of 29.2 MJ/L than ethanol, which has a calorific value of 21.2 MJ/L. However, both have calorific values that are less than that of gasoline of 32.5 MJ/L<sup>1</sup>. Butanol is also less corrosive than ethanol. Hence, no infrastructure modifications are needed to use existing tanks, pipelines, pumps and filling stations, as is the case for ethanol. Furthermore, sulphur and nitrogen oxides, which are present in fossil fuels, are not released in the combustion of

E-mail: [fkopresido@yahoo.com](mailto:fkopresido@yahoo.com)  
Tel: 07037567244  
Department of Materials and  
Metallurgical Engineering,  
Federal University Oye-Ekiti,  
Ekiti State

<sup>1</sup>Kolawole Funsho Olaitan  
(2013), A Study of the  
Pre-treatment  
Temperature of  
Lignocellulosic  
Butanol as an  
Alternative Fuel  
(biofuel) Produced  
From Bamboo Using

*Clostridium acetobutylicum*,  
A Thesis Submitted to  
the African  
University of Science  
and Technology  
Abuja, Nigeria,  
<https://repository.aust.edu.ng/xmlui/bitstream/handle/123456789/114/Kolawole,%20Funsho%20Olaitan.pdf?sequence=1&isAllowed=y>

butanol. Butanol is less miscible in water and less volatile than ethanol. However, it was found that cellulosic ethanol has a better yield per unit volume of biomass feedstock. Nevertheless, in order to be competitive, a higher production of butanol is necessary.

Bamboo is a taxonomic group of large woody grasses that grows naturally in sub-tropical and temperate zones across the world. Bamboo species have high growth rates, the ability to grow in a wide range of climates, sequester carbon and have low ash content and alkali index. According to the United Nations Food and Agriculture Organisation (FAO), sub-tropical bamboo can grow up to an average of 20-30 cm on a daily basis. Unlike tree root systems, which die once the tree has been cut, the rhizome and root system of bamboo continues to live and give rise to new culms. For the production of fuel from biomass, it is important to find optimal treatment conditions that are specific to each feedstock material. However, prior biofuel research on bamboo has been very limited. Furthermore, only lignocellulosic ethanol has been produced from bamboo feedstock in prior work.

In the production of biofuel, there are about three main stages: the pre-treatment of biomass, the enzymatic hydrolysis of the biomass and finally the fermentation stage. Pre-treatment techniques can be physical, chemical and biological. Since each technology has inherent advantages and disadvantages, there is no 'winning' method for pre-treatment as of yet. Physical pre-treatment approaches include: steam explosion; hot water; mechanical grinding or milling and high energy radiation. Mechanical comminution disrupts cellulose crystallinity and increases the surface area of the biomass. However, it does not remove lignin. Seldom used exclusively, mechanical techniques are time and energy intensive.

Using biological processes, butanol can be produced by bacterial fermentation, under mild conditions, with little additional energy input. Hence, bio-butanol production can become an attractive method for the production of renewable fuels. Chemical pre-treatment is perhaps the most widely studied group of technologies, with industrial applications of chemical pre-treatment in paper production. Acid, alkaline, ammonia fiber explosion (AFEX), organosolv and ionic liquid pre-treatment are major chemical pre-treatment techniques. Of course, the effectiveness of each pre-treatment depends on the substrate and treatment conditions. Acid or base pre-treatments can promote hydrolysis and improve the glucose yield by removing lignin and hemicellulose. While concentrated acid treatments are effective, the recovery and neutralization of the acid, as well as the reactors necessary to handle the hazardous and corrosive acid are expensive. Dilute acid treatments have been further investigated as feasible processes. Dilute sulfuric acid, dilute nitric acid, dilute phosphoric acid and dilute hydrochloric acid have been reported in literature.

Although non-fuel applications of bamboo biomass may be more profitable than energy recovery, there is the potential for the co-production of sugar and fuel from bamboo processing. As bamboo continues to develop as a substitute for wood in the pulp and paper industry, as well as applications in furniture and building materials, there is bamboo waste. Such waste can be processed into higher value products, such as biofuel.

Biofuel is one of the many sources of renewable energy in Nigeria, and so it qualifies as an alternative source of energy. Nigeria as a country at this moment really needs to consider synergizing its different sources of energy for maximum optimization of its energy sector, if the amount of energy derived from biofuel, solar, biogas, hydro-power, geothermal, ocean energy, wind energy, hydrogen and fuel cells can be put to use at the same time, depending on the type of energy source that can be derived from the six (6) geo-political zones of the country, the nation at large will not have to depend majorly on only the electricity companies for the supply of electricity. Another advantage is that the renewable energies are cheaper and easily affordable. So, innovators, investors, entrepreneurs, researchers, private sector and public sector should be encouraged to diversify and synergize the different sources of energy available in the country.

## Small-Scale Biogas System for Energy Production in Rural Areas

F. O. Kolawole\*

Biogas is an important energy source which can serve in the rural areas. The design of a small-scale biogas system for production of energy is of great importance to the rural areas, since most of the wastes in the rural areas are dumped on roads, beside houses, in streams and they serve as nuisance. Most of the waste which are biodegradable in nature can be converted into methane by the action of various groups of anaerobic bacteria because faecal matter is rich in minerals, which activates fermentative bacteria. This process essentially involves the flow of carbon from complex polymers to methane with the aid of microbes. Small-scale biogas system for the production of energy in the rural area is very important for a country like Nigeria, because Nigeria solely depends on the revenue generated from the oil and gas sector, which is not encouraging. Nigeria as at present produces an average of 2.18 million barrels of crude oil per day, with exports of 1.73 million barrels per day. Nevertheless, crude oil is not sufficient to meet the needs of approximately 170 million Nigerians. Therefore, it is necessary for Nigeria to explore alternative sources of fuel, especially in the rural areas; this will reduce the burden on the nation's crude oil. The biogas system will be cheaper and affordable to everyone and will also reduce the carbon and environmental footprints of production processes. Waste materials such as cattle waste, piggery waste, chicken waste, cow dung, human excreta, biomass from plants and leaves from trees that fall on a regular basis have the potential to produce biogas and their respective gas yield has been studied through research.

As far back as ancient Persians, it was observed that rotten vegetables produce flammable gas. The first sewage plant was built by the Indians in 1859. The Chinese also made use of covered sewage tanks as far back as 2,000–3,000 years ago in ancient China. In 1895, the Britons introduced the idea for the manufacturing of gas by producing wood gas from wood and later coal. Street lamps and homes were powered using the resulting biogas as source of fuel.

Biogas is a carbon neutral fuel that is produced when bacteria degrade biological material in the absence of oxygen, a process known as anaerobic digestion, or fermentation of biodegradable materials such as biomass, manure, sewage, municipal waste, green waste, plant material and energy crops under favourable temperature and pH condition. Biogas is composed primarily of methane (55%) and carbon dioxide (45%) which can be used as a source of energy for cooking especially in the rural areas. Biogas has a calorific value of 5871 kCal/m<sup>3</sup> and can be used as a low-cost fuel in any country as source of direct heat for thermal applications. Renewable biogas fuel is produced from domestic biogas plants. Biogas is majorly used in developing countries and rural areas as a substitute to fossil fuels, whose combustion contributes to global warming.

It can also be used in modern waste management facilities where it can be used to run any type of heat engine, to generate either mechanical or electrical power. Biogas can be compressed, much like natural gas, and used to power motor vehicles. In the United Kingdom (UK), for example, biogas is estimated to have the potential to replace around 17 per cent of vehicle fuel. Biogas is a renewable fuel, so it qualifies for renewable energy subsidies in some parts of the world. This has brought the need for us to focus on the material

E-mail: [fkopresido@yahoo.com](mailto:fkopresido@yahoo.com)  
Tel: 07037567244  
Department of Materials and  
Metallurgical Engineering,  
Federal University Oye-Ekiti,  
Ekiti State

<sup>1</sup>Wikipedia: Energy Security  
[http://en.wikipedia.org/wiki/  
Energy\\_security](http://en.wikipedia.org/wiki/Energy_security)

design for small-scale household bio-plant in Nigeria.

The ability to capture methane and use it as a fuel source is important since methane is a significant contributor to global warming. Methane is 20 times more effective than CO<sub>2</sub> at trapping heat in the atmosphere than CO<sub>2</sub>. Animal wastes are inherently anaerobic and release methane into the atmosphere during the process of decomposition unless they are managed. Through the use of domestic biogas plants, the natural generation of methane can be captured and used as a clean, nontoxic fuel source. Furthermore, the use of methane as a fuel source will offset the need for fossil fuels. Switching from fossil fuels to biogas will result in CO<sub>2</sub> emission reductions as half of the greenhouse gas (GHG) emissions being released into the atmosphere are from CO<sub>2</sub> produced by fossil fuel combustion.

The main sources of affordable energy for domestic need, especially in the rural communities, are trees (wood) used directly by burning or that are converted to charcoal and kerosene used in cooking stoves, and household lamps. This has resulted in deforestation, desert encroachment, greenhouse effect and health hazards such as respiratory problems, etc. The alternative petroleum gas is not readily available and where it is available, it is not easily affordable. The increase in human population calls for alternative sources of energy for domestic purposes such as cooking, heating, lightening etc., in the country.

Biogas, produced by anaerobic digestion of biodegradable waste, seems a laudable alternative. Cow dung and biodegradable waste, which are presently inappropriately disposed around the abattoirs and human settlements, causing environmental pollution, are presently under-utilized could be appropriately used as source of active bacteria for the bio-gas digester plant. A typical bio-digester plant can produce 35-40 litres of biogas per kg of dung fed. This biogas, which contains large proportion of methane can be used as an alternative source of affordable energy in the rural settlements.

### Biogas Plant

The plant where biogas is produced is called *biogas plant*. The design of the plant is tailored to use cattle dung and other substrates like piggery waste, chicken waste, buffalo waste etc. as feed stock. Cattle dung and water is mixed in the ratio of 1:1 and the resultant slurry containing 8-9 per cent total solids are fed to the biogas plant by gravity. This slurry is retained in the digester for a period of 35-50 days. During this retention period, 35-40 litres of biogas could be recovered per kg of dung fed. Once the digester is activated, biodegradable waste such as kitchen and household cooking wastes such as peels from yams, potatoes, cassava, plantains, banana, onion backs, leftover food scrap wastes and any other biodegradable waste materials can be added regularly for continuous gas production. Biogas may be improved by filtering it through limewater to remove carbon dioxide, iron filings to absorb corrosive hydrogen sulphide and calcium chloride to extract water vapour after the other two processes. Biogas plant design is primarily of two types, though new improved designs are emerging.

**Floating Dome Design:** This design consists of a tank or a well with a partition wall to prevent shorting of influent fresh dung slurry with the outgoing spent slurry. The gas produced is trapped under a plastic or a metallic drum. With the continuous production more gas is trapped under this bell and the drum rises. This acts as a gas storage unit and when the tap above is released, the gas is discharged at more or less constant pressure.

**Fixed Dome Design:** This is designed to reduce the overall cost of the biogas plant. Here the slurry is fed to a spherical masonry plant. When the gas is produced owing to the rigid nature of the masonry dome, the trapped gas exerts a pressure on the slurry surface and a corresponding amount of slurry is displaced into a wide outlet and inlet. As a result, the pressure of gas stored varies significantly.

### Market Need

The world is in need of increased energy security<sup>1</sup> and a global movement towards the generation of renewable energy. There is a serious demand to help meet increased energy needs and a search for an alternative power supply. The populace in any country needs a low-cost fuel for heating purpose such as cooking. In Nigeria, the increase in human population calls for alternative sources of energy for domestic purposes such as cooking, heating, lightening etc., especially in the rural areas. In this view it becomes necessary for Nigerians to focus on the design of small-scale household bio-digester for cooking purposes and lightening in the rural areas. Biogas provides opportunities for rural lighting, cooking and entrepreneurial opportunities. There is a need for developing countries such as Nigeria to encourage the use of biogas as an alternative source of energy.

## Beyond Power Mourning

Olugbenga Adesanya\*

Four months after handing over to the new investors, the Nigerian Electricity sector got plunged into a mixture of brown outs and total darkness with the Discos having a close semblance with the mischievous handset flashers toying with the power needs of consumers, be they domestic, commercial or industrial. The Power Ministers, Presidential task force leaders, NERC Chairman and the hapless Chief Executive Officers (CEOs) of the Discos and Gencos agree on one 'enemy', vandalized Gas pipeline leading to shortage of or zero gas supply to the thermal plants that constitute 80 per cent of Nigeria's installed generation capacity.

The Minister of State for Power tried calming frayed nerves with his announcement of a Memorandum of Understanding (MOU) with Democratic Republic of Congo (DRC) to import electricity into Nigeria through an integrated system encompassing the West African Power Pool. A cause for worry is the fact that the power importation is only possible from Inga 3, which would generate just 4,300 MW from 2016 and has already sold 2,500 MW to South Africa. The six phase Inga project that is expected to generate 40,000 MW when fully built might not prove so useful to Nigeria's electrification strategies on the long term. No one is even looking at the possibility of sabotage from the DRC pained citizens, 94 per cent of who have zero access to electricity.

The Federal Government of Nigeria is advised to admit that the celebrated privatization or outright sale of substantial 'shares' of the Distribution Companies (Discos) and Generation Companies (Gencos) and transfer of the Transmission Company (Transysco) to Manitoba of Canada has failed to attract new investments and is gradually turning into heavy burdens and flare points in Customer-Supplier relations nationwide. Governor Adams Oshiomole of Edo State, putting on the garb of a Labour leader, overshot the 'runway' recently by directly wading in at the customers platform and engaging the Benin Disco CEO, giving direct military like orders to the Benin Disco investor to stop billing or collecting fees from customers. The writer is mindful of the US\$8 billion transmission planned investments and the Chinese funded proposed Prepaid Meter production project. These notwithstanding, it is suggested that the Presidential Power Committee urgently undertake a review of the Roadmap for Power Sector Reform 2010 put together by President Jonathan to be assured that it is on track and working. This has become necessary as the Minister for Power, Professor Nebo has reviewed power deliverable in December 2014 downwards to a mere 6,000 MW from the usual 10,000 MW often promised in Obasanjo's civilian rulership of 1999. One should state this as the Roadmap for Power Sector Reform 2010 promised 40,000 MW in 2020, less than six years away. Extrapolating, 34,000 MW would be generated 68 months via a plan that would deliver 6,000 MW in 60 months.

For an industrial economy, Nigeria needs between 120,000 and 150,000 MW of power to justify her membership of the nascent MINT club, which groups Nigeria with the new global economic leaders, i.e., Mexico, Indonesia, Nigeria and Turkey, expected to take over from the BRIC nations - Brazil, Russia, India and China. The MINT's common features include, huge and fast growing populations and high unemployment, but Nigeria is the only MINT nation that is not yet a member of the G20 group of developed and developing countries. The new GDP status of Nigeria that puts Nigeria ahead of South Africa and as the

\*Energy Economist and  
Chevening Scholar

<sup>1</sup>**Chibuike Oguh:** World Bank  
Offers \$1.19 billion guarantee  
to Nigerian power operators,  
Business News Report,  
[http://bnreport.com/featured/  
world-bank-offers-1-19-  
billion-guarantee-to-  
nigerian-power-operators/](http://bnreport.com/featured/world-bank-offers-1-19-billion-guarantee-to-nigerian-power-operators/)

world's 26<sup>th</sup> largest economy could mean that as the largest economy and the business hub of Africa, there exists greater pressure on its economic managers to plough bigger investments into infrastructure development with special focus on electricity. Even the 40,000 MW promised by the Roadmap would be grossly inadequate in 2020 as 135,000 MW is needed for a population of 230m by 2030 if the country was to remain relevant within MINTs club or achieve Brazil's GDP per capita of US\$10,000. Nigeria's rebased GDP as at end of 2013 rose to US\$510 billion from US\$263 billion. Rebased notwithstanding, the GDP of the other three MINT members stand at US\$1,178 billion for Mexico, US\$878 billion for Indonesia, and US\$789 billion for Turkey. This means that the nation's power need would be almost 20 times today's supply. To achieve this, Nigeria should build power generating plants at 8,000 MW annually for the next 16 years.

On a brighter note, the World Bank Group recently approved US\$1.19 billion partial risk guarantees to help power sector supply operators in Nigeria named 'Energy Business Plan for Nigeria. To breathe in oxygen, the Executive Board of the World Bank's three arms approved the loan packages targeted at assisting Energy projects/Independent Power Projects (IPPs) to increase much needed power generation. US\$245m and US\$150m partial risk guarantees by the World Bank, International Finance Corporation (IFC) and Multilateral Investment Guarantee Agency (MIGA) would be extended to 459MW Azura, Edo State Nigeria thermal plant and 533MW Qua Iboe thermal plant at Ibeno, Akwa Ibom State<sup>1</sup>. This development is encouraging as the focus is to restart the small and medium-sized enterprise (SME) revolution in Nigeria to create jobs speedily in a country in which the restlessness of the youth is disturbingly high.

In the light of the above, efforts should be made to tackle, in the short term, the transmission challenges in four areas viz;

- \* Poor funding, for example, Lagos Region consisting four sub-regions and one work centre gets a paltry N200m annually for operations and maintenance. Lagos Region wheels 45per cent of the nation's generated power;
- \* Inadequate manpower, the writer is not unaware of the 522 newly recruited Nigerians for transmission service training;
- \* Insufficient operational and maintenance equipment and vehicles;
- \* Lack of Health, Safety and Environmental (HSE), HSE facilities, including Fire Fighting Trucks.

Perhaps the new policy shift which favours the privatization of the Transmission Company of Nigeria (TCN) would help reposition the evidently weakest link in Nigeria's power delivery chain.

In spite of the Bulk Trader being in place and the hamstrung Nigerian Electricity Regulatory Commission (NERC) doing her 'best', it would be necessary to develop an efficient energy market that is self accounting and competitive, to avoid government coming to the rescue of the power sector with every sneeze.

The objective ought to be the supply of adequate quality electricity to all classes of consumers under the 3As pyramid of Availability, Accessibility and Affordability. Let us lay the 2030 power development blocks today to put an end to the avoidable mourning and payment for darkness that is rampant in Nigerian communities.

## The Science of Climate change and Green Growth Strategy for Sustainable Development

John Sylvester Afaha\*

Climate change refers to an increase in average global temperatures as confirmed by the Intergovernmental Panel on Climate Change (IPCC) Assessment Report. Natural events and human activities are believed to be contributory factors to this phenomenon, which is caused primarily by increases in greenhouse gases such as Carbon Dioxide (CO<sub>2</sub>). Nigeria is experiencing adverse climate conditions with negative impacts on the welfare of millions of people. Persistent droughts and flooding, off season rains and dry spells have sent growing seasons *out of orbit*, on a country dependent on a rain fed agriculture. Alarm bells are ringing with lakes drying up and a reduction in river flow in the arid and semi-arid regions. The result is fewer water supplies for use in agriculture, hydro power generation and other uses and rapid disappearance of snow. Climate Change has been confirmed following release of the 4<sup>th</sup> IPCC Assessment report. Africa will be worst hit by the effects of Climate Change which Nigeria is part of it.

Policies to curb the climate change by reducing the consumption of fossil fuels like oil, gas or carbon, have significant economical impacts on the producers and the suppliers of these fuels. Nigeria is the eighth largest oil supplier in the world and has the ninth largest deposits of gas. The Nigerian national economy would be massively affected by a sustainable reduction of fossil energy consumption. The country is practically a monoculture: about 80 per cent of the government income, 90-95 per cent of the export earnings and more than 90 per cent of the foreign exchange revenues evolve from the oil sector. However, currently, the government of Nigeria is making attempts to diversify its revenue base. Special attention is nowadays paid to gas which emerges in the joint-production of oil. So far, 75 per cent of such gas has mainly been flared simply because of lack of technical facilities to make use of it.

A study commissioned by the World Bank in 2007 indicates that Nigeria accounts for roughly one-sixth of the world-wide gas flaring which in turn, spews some 400 million tons of carbon dioxide into the atmosphere. However, the World Bank survey has listed Nigeria and 15 other oil producers, as countries that have progressively reduced gas flaring. Going 'green' in line with Kyoto-Protocol would be a double-edged sword for Nigeria: The probably positive long term effects on the climate change are opposed to the negative short term effects for the economic development of the country. Strict adherence to the Kyoto-Protocol would reduce the income of the Organisation of the Petroleum Exporting Countries (OPEC), amongst them Nigeria, about 25 per cent until 2010. This would be a catastrophe for the Nigerian development plan.

The country's politics and public discussions are barely addressing the mentioned problems. The last two years were so much dominated by the internal questions of power that political issues as regards content or even specific problems like the climate change would not have attracted real attention outside the circle of environment experts or Non-Governmental Organisations (NGOs). In terms of short term development policy, more urgent worries exist and strategic foresight is not a fixed part of politics in the country.

\*Lecturer- Department of Economics, Caleb University, Imota, Lagos, Nigeria and CPEEL University of Ibadan, Ibadan, Nigeria.  
Phone: +2348060177138  
E-mail: [johnafaha@yahoo.com](mailto:johnafaha@yahoo.com)

Furthermore, the climate change and its problems and solution strategies do not generate great publicity effects as they are too complex for rather superficial political talks. Nigeria's development plan does not recognize the economical threat caused by the climate change nor the menace of declining oil prices which could result from a reduced consumption of fossil fuels.

In the arid zones, droughts are getting worse and climate uncertainty is growing. Arid and semi-arid areas in northern Nigeria are becoming drier, while the southern part of the country are getting wetter. Climate change means that many dry areas are going to get drier and wet areas are going to get wetter. They are going to be caught between the devil of drought and the deep blue seas of floods. The “great tragedy” being that Nigeria had played virtually no role in Climate change; a problem was caused by economic activity of the rich, industrial countries, yet, it suffers from its effects. One of the biggest threats is growing climate unpredictability, which makes subsistence farming difficult. However, a better planning to reduce the risk from disasters, together with developing agricultural practices that can withstand changing climates, have been shown to work and could help mitigate the impact if used more widely.

The impact of the change will be difficult to handle and it will be potentially very long lasting. One thing that the scientific evidence on global warming is strengthening daily is that there are risks over and above those that are usually considered. The disproportionate impact on Nigeria will be for a combination of reasons. Global warming will be greater over land than over sea because land retains heat more than water. There is also increasing evidence that it will be particularly hit by the effect of vertical rises and falls in air currents. Climate change often appears very esoteric but in Nigeria, it's real. The country is already witnessing declining agricultural productivity and a rising number of heat waves. There is glaring evidence that climate change is not only happening but it is changing the lives of the people. Declining rainfall in already desert-prone areas in northern Nigeria is causing increasing desertification, the former food basket in central Nigeria is now potentially empty, and people in the coastal areas who used to depend on fishing have seen their livelihoods destroyed by the rising waters. Adapting to climate variability and mitigating its impacts is something that ought to be adopted. Knowledge about what climate change is, what contributes to it, and how to reduce its impacts is valuable.

The challenges associated with the devastating effects of climate change are enormous: changes in mean climate, extreme events, variability and sea level rise will bring about increased temperature and changes in precipitation reduces agricultural and natural resource which in turn brings about decline in industrial output and labour productivity. Consequently, changes in precipitation, run off and variability leads to greater water stress, with the attendant problem of reduced productivity and security of poor people's livelihood and assets, and reduced access for the poor to their livelihood assets; and lastly, changes in temperature, water and vegetation changes contribute to increased prevalence of diseases that culminated in less effective coping strategies among the poor, and increased vulnerability of poor people.

Green economic growth is the only way in which sustainable, inclusive development can be achieved that will satisfy the basic needs of 9 billion people and provide them with equal rights to material prosperity. A key challenge is the urgent need to reduce carbon emissions to avoid the catastrophic impacts of global warming. Another imperative is the need to increase natural resource productivity to meet unprecedented demands for clean water, food and urban development. The World Economic Forum's Climate Change Initiatives are addressing these needs through convening public, private and civil society leaders to advance innovative public-private solutions.

I believe that this generation has every responsibility to restore our planet as a ground for sustainable development for the next generation. Therefore I share the view that green growth is a viable strategy for creating a planet-responsible civilization, and efforts should be made to spread it around the world.

## Why Clean Coal Technology will not Address Global Environmental Problems

Oluwasola Emmanuel Omoju\*

The role of energy in human activities and economic development cannot be over-emphasized. It is crucial for economic growth and poverty reduction. Global energy consumption has risen significantly over the last few decades; it increased from 400.072 quad Btu in 2000 to 510.551 quad Btu in 2010, an increase of 27.5 per cent. The increase in global energy consumption could be largely attributed to economic growth and industrialization in emerging and developing economies, especially the BRICS (Brazil, Russia, India, China and South Africa).

However, majority of energy consumption in most developed and developing countries, with the exception of few, are dominated by fossil fuel. For example, coal accounts for about 80 per cent and more than 50 per cent of electricity consumption and total energy consumption in China. China is also the second largest oil consumer in the world behind the United States of America (USA). Similarly, energy and electricity consumption in South Africa and India are also based on coal. Furthermore, despite the shale gas revolution and the development of the renewable energy sector in USA, its coal consumption is still substantial. In addition, Germany currently consumes more coal than it does 20 years ago despite its claim of the largest “green” party in the world. The usage of coal has been buoyed by its availability in large quantity and its lower prices compared to other energy sources.

The continued use of coal and other fossil fuel as energy sources has however resulted in severe environmental problems, including air pollution and climate change. Coal burning is a significant contributor to global warming. There is considerable evidence that coal produces a large share of world's CO<sub>2</sub> emissions from fuel combustion. The increased use of coal has heightened the present challenge of global warming and climate change. Climate change is presently the greatest threat to the sustainability of progress already made in global poverty reduction. Though scientists are still uncertain about the extent of the impact of climate change, available evidences show that it is expected to have severe impact on the socio-economic aspects of human existence, particularly in poor developing countries.

In recognition of the adverse consequences of climate change, policy makers are already initiating measures to tackle the problem. One of such measures is the reduction of the share of coal and other fossil fuel in the energy mix. This has however not been achievable given the substantial global dependence on coal. The Kyoto Agreement and other climate agreements have also failed to compel countries to reduce coal consumption, and consequently greenhouse gas emissions. Based on the current global energy landscape, coal would be a significant part of the global energy mix in the foreseeable future. The overwhelming conviction of the important role of coal in the energy mix in the future has prompted the increasing emphasis on the development of clean coal technologies in recent years. This is based on the idea that if there is no possibility of considerable reduction in coal consumption in the nearest future, there is need to make significant modification in the way coal is utilized in order to reduce emission associated with its use. This fuels the development of clean coal technologies.

Clean coal technologies are improved technologies that can sustain the utilization of coal for electricity generation and other activities while significantly reducing its greenhouse gas emissions. However, the potential of clean coal technologies to

\*The author is a Ph.D Student and Researcher at China Center for Energy Economics Research (CCEER), School of Economics, Xiamen University, China.  
Email: sholley@yahoo.co.uk

significantly reduce greenhouse gas emission in accordance with global targets is a contentious issue, and this is what this article examines. This article explains reasons why clean coal technology is not a sustainable solution to emissions, and why it could even aggravate environmental degradation now and in the future.

Clean coal technology could help to reduce the amount of carbon emission from electricity generation and large industrial projects. However, the potential for clean technology to reduce CO<sub>2</sub> emissions is bleak due to the low deployment rate. The lag in the mass deployment of the technologies is mainly due to the huge cost outlay, and the long period it takes to develop the technologies. Financial institutions may be skeptical to invest in new technologies because of uncertainties about future climate policies and long pay-back periods. Furthermore, the development of these technologies has focused extensively on developed countries such as the USA, Denmark, Norway and Germany, and to some extent China, while neglecting developing countries. Developing countries, which are likely to be major consumers of coal in the future, are not carried along in the process. Thus, when developed countries shift to more environmentally friendly energy sources in the future, developing countries would still depend substantially on coal and other fossil fuel, and will continue to emit greenhouse gases. The issues of intellectual property rights, regulations and international politics associated with technology transfer would also have significant effects on the deployment of clean coal technologies.

The costs and benefits of the adoption of clean coal technologies will substantially vary across industries, sectors and countries. World-wide mass adoption of clean coal technologies will have different impacts on different sectors, countries and at different times. Sectors such as power, iron and steel, aluminum, building, chemical processing and other heavy manufacturing will be adversely affected relative to other less energy consuming sectors because of higher costs. The high costs associated with adopting and operating clean coal technologies may also have more effect on countries like China, India and South Africa than Norway due to the latter's low dependence on coal for electricity and energy supply. Countries such as Australia and Indonesia whose economies to some extent depend on coal exports may also be affected. All these could have considerable impact on prices and on the competitiveness of these countries in the global market. As a result, some countries may be reluctant to adopt clean coal technologies if they perceive the cost is higher than the benefits compared to other countries.

One of the issues with clean coal technologies, particularly carbon capture and storage, is its storage capability. Carbon capture and storage is mainly transferring emission from one end to another. Besides, there is no concrete evidence on whether carbon can be stored underground indefinitely and safely, and whether storing of carbon underground has effect on the ozone layer and the environment. If carbon stored underground leaks, it would aggravate environmental challenges for future generations, raising concern about intergenerational equity and liability, and would undermine long term sustainable development.

The construction of new coal-fired plants will indirectly encourage coal mining, which is detrimental to nature. As more clean coal technologies are developed, power companies will construct more coal-fired power plants because they perceive that clean coal technologies are environmentally friendly as it reduces carbon emission from power generation. However, this practice will encourage more exploitation and mining of coal and undermine global initiatives to reduce coal consumption. Moreover, clean coal technologies do not consider the environmental impacts of coal mining. Coal mining is associated with environmental problems such as pollution, soil degradation and destruction of natural habitats.

Clean coal technology is a major distraction from renewable energy. Over the years, renewable energy is seen as an important policy option to reduce emissions and combat climate change. However, the increasing emphasis on the development of clean coal technologies is perceived as shifting of policy makers' attention from renewable energy. The financial resources expended on clean coal technologies would yield better long-term and sustainable impacts on the environment if they are invested in renewable energy.

Based on the above submissions, it is clear that clean coal technology may help to reduce emission in the present but would do little to significantly address greenhouse gas emissions and climate change. In fact, it may worsen environmental degradation in the longer term. Thus, policy makers need to collaborate with power producing companies, environmental scientists, coal miners, and other stakeholders in order to fashion a concrete solution to the clean coal phenomenon and sustainable development subject. Drastic measures need to be taken to ensure reduction in coal consumption in order to meet global CO<sub>2</sub> emission reduction target.

## Transitioning to a Low-Carbon Road Transport Sector: Where the Priorities should Lie for Lagos State?

Monica O.C. Maduekwe\*

\*Monica Maduekwe -  
ECOWAS Centre for  
Renewable Energy and  
Energy Efficiency  
is the corresponding author.  
She may be reached  
via email at:  
[monicamaduekwe@yahoo.com](mailto:monicamaduekwe@yahoo.com)  
or through phone with  
+2389899689

<sup>1</sup>According to the Lagos Bureau  
of Statistics, Public vehicles are  
those used for commercial  
purposes.

<sup>2</sup>Vehicles alone contribute about  
43 per cent to air pollution in  
Lagos State, according to a  
LAMATA presentation on Mass  
Transit and Climate Change, as  
it affects Lagos State.

<sup>3</sup>LAGOS Metropolitan Area  
Transport Authority  
(LAMATA)

<sup>4</sup>See 'Lagos State Road Energy  
Consumption: A roadmap for  
greening the road transport  
sector by 2030, by Monica O.C.  
Maduekwe. Presented at the 7<sup>th</sup>  
NAEE/IAEE International  
Conference on Energy Access  
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2014, Abuja, Nigeria.

In Lagos, Nigeria's most populous State, 259,473 motor vehicles and 73,411 motorcycles were newly registered in 2011, and from 1995 to 2011 the State has made close to 2 million new registrations for motor vehicles, excluding motorcycles (Lagos Bureau of Statistics, 2012). During this 16 year period, motor vehicle registration has grown at an annual average rate of 15 per cent with Saloon and Station wagon vehicles, private type vehicles, growing even faster at 16 per cent, bringing their total number, as at 2011, to 1.6 million (Lagos Bureau of Statistics, 2012).

In 2011, the total number of registered motor vehicles and motor cycles (new registration and renewals) was estimated at 1.1 million of which 79 per cent were private-owned, comprising of private, government, mission/school, and corporation, and 21 per cent public-owned<sup>1</sup> motor vehicles and motor cycles.

With a car ownership annual growth rate of 5 per cent and vehicle fleet comprised of 85 per cent gasoline driven engines, the sector is a primary source of air<sup>2</sup> and noise pollution in Lagos and is responsible for 50 per cent of the greenhouse gases emitted from the transport sector in Nigeria (LAMATA, 2013).

According to the Lagos Metropolitan Area Transport Authority (LAMATA), the sector is faced with four main challenges which impact severely the social, economic and environmental sustainability of the city, namely: an increasing level of air pollution, the absence of a regulatory framework, severe congestion and long travel distances particularly for the poor.

LAMATA was established with the mandate to address the transport challenges faced by the State specifically through the coordination of "transport policies, programmes and actions of all agencies at different tiers of government."<sup>3</sup> In fulfilment of its mandate, LAMATA developed the Strategic Transport Master Plan (STMP), a long-term plan expected to actualize the Lagos State 2030 Vision of providing "a modern integrated multi-modal public transport system that will make Lagos State a World Class city." The State transport regulator has drawn up twenty-five (25) strategic actions to work towards in the coming years with the objective of establishing an effective road transport system by 2020. These 25 actions are grouped into the following broad categories: transport choices for all users; introducing an integrated transport system; reducing urban transportation-induced emissions; optimising usage of current road network; integrating land use development and urban transport planning; and securing long term financing investment plan.

The ultimate goal is that these actions reduce emissions by 45 per cent in the year 2030 (LAMATA, 2013). The 25 actions under the STMP are no doubt ambitious and a tall order given the time-frame (the State has about five years to achieve what has been stated in the STMP). It is therefore imperative that the State goes for a Pareto Principle approach, where it prioritizes and focuses on a few but high-impact options that achieve the overall objective.

## The A-S-I approach and the STMP

The STMP aligns with the objectives of the Avoid-Shift-Improve (A-S-I) approach that promotes sustainable urban transportation through “the maximization of travel activity with minimal energy consumption through combinations of land-use planning, transport modal share, energy intensity and fuel type (IEA, 2013), by achieving system, trip and vehicle efficiency (GIZ, 2011).

“Avoid” policies aim at reducing the number of trips made and the distance travelled through the introduction of an integrated land-use planning and transport demand management (system efficiency).

“Shift” policies are targeted at facilitating a switch to more energy efficient modes of transport including non-motorized transport and public transport (bus and rail) thereby improving trip efficiency.

Policies for “Improve” concentrate on vehicle and fuel efficiency of all travel modes through the introduction of fuel-economy standards and other policies that lead to an uptake of clean vehicles and alternative fuels like compressed natural gas (CNG).

The implementation of A-S-I policies, through the STMP, in the Lagos road transport sector should ultimately bring about a reduction in road transport energy consumption and emissions. To cost-effectively implement the A-S-I approach, however, the following recommendations, based on a study using the Long Range Energy Alternative Planning (LEAP) modelling tool, for the case of Lagos, are made<sup>4</sup>:

1. In the short-term, the State should move fast to green the public transport system, as empirical analysis show that this sector is the major consumer of energy and major polluter. Improving vehicle and fuel efficiency of Heavy Duty Vehicles (HDVs) should be the priority for transition to a low-carbon road transport sector in the near-term. 'Fuel Economy Improvement' policies on HDVs, will have more impact on improving fuel and vehicle efficiency than on Light Duty Vehicles (LDVs), which already have better fuel economy status. Therefore, for HDVs the State should implement policies that encourage shift to advanced diesel HDVs and compressed natural gas (CNG) fired engines.
2. To reduce congestion, reducing private vehicle ownership and travel distance is a necessity; this however applies to LDVs on the private and public side. The LDVs are small unit vehicles and large in number, their features make them culprits for congestion and concentrated air and noise pollution, which impact negatively on the economic, social and environmental conditions of the residents. Therefore, although in general, LDVs may not consume as much energy as HDVs, or emit as much, curbing and shrinking their number is necessary for transforming Lagos into a world class livable city. Achieving this, however, depends much on how fast the State is able to transform the public transport into an attractive alternative; infrastructural development and fiscal incentives, to a lesser extent, are a must.

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## Emphasis on Remedial Approach to the Neglect of Penal Technique Method in the Enforcement of Environmental Laws in Nigeria

Suleiman Ikpechukwu Oji, Ph.D\*

### Introduction

Oil exploration involves labyrinth, intricate organization and sophisticated technology. The technology involved in extracting crude from oil wells, the process of refining, the myriad of pipes interlacing each other through which the refined oil are transported to various depots, the combustible nature of refined oil, the possibility of spill, are what make upstream and downstream activities hazardous to both animate and inanimate objects within a given environment. In this case a criminal negligence (where there are certainly evidence of impending environmental catastrophes) may be alleged where the oil prospecting company or even the supervisory authority remained docile and allowed such a spillage to fester thereby making the environment hazardous to the health of human beings and the environment.

A spill may be a natural occurrence or it may arise as a result of intentional activities of oil bunkers or sheer sabotage. In both circumstances, a criminal process should be activated where a criminal negligence can be framed against those who ought to have taken preventive steps to nip in the bud the resultant spillage from degenerating into a certainly life threatening hazard. In line with this proposition, this paper argues that in the enforcement of environmental laws in Nigeria there seems to be too much emphasis on remedial technique even where there exist a clear case of criminal negligence by those who ought to have taken urgent steps to prevent a spillage from degeneration and demands that the penal technique method should equally be employed in the enforcement of environmental laws in Nigeria.

### Exploration of Oil in Nigeria and the Indigenous People

Whereas oil exploration has yielded huge financial gains for the nation as the revenue from that sector accounts for about 90 per cent of the national income, the host communities of the oil prospecting companies have had one tale or the other to tell arising from pollution of water bodies in riverine areas where fishing is the primary occupation of the natives, to destruction of vast farmlands by oil spillage, and pollution of communities.

There is no gain saying that land formed an integral component of a peoples' economy. In the not too distant period, land in Nigeria was held in fee-simple. In that epoch, land belonged to the community, and not to a single individual. Landlessness was not a common feature in land ownership. It meant that land owners owned everything attached and beneath the land. The legal implication of this can be found in the Latin maxim, *quic quid plantatur solo solo cedit* (whatever is affixed to the soil belongs to the soil). This meant that land owners had the right to protect their land from any sort of degradation through civil action or criminal process or through street power.

As at 1956 when the first oil deposit in large commercial quantity was discovered in Oloribiri, a small town in the then Eastern Region, later Rivers State and, now Bayelsa State, the prevailed land tenure system was based on fee-simple. This period predated the United Nations General Assembly resolution on permanent sovereignty over natural resources. This resolution was actually intended to put to a stop the rapacious plunder of the economic resources of colonized nations by the colonial power. That resolution became the basis

\*Acting Head, Department of  
Public Law and Jurisprudence  
Faculty of Law  
Usmanu Danfodiyo University  
Sokoto

for nations to assume full and total control of resources within their territories. In effect, national governments were pitched against communities whose lands harbour mineral resources.

The ongoing crisis or conflicts in the Niger Delta region of Nigeria today can only be fully appreciated with the study of the nature, background and stages of the said crisis or conflicts. The foregoing is intended to demonstrate that the struggles which have characterized expropriation of mineral resources in the Niger Delta and the resistance by the ethnic nationalities of the region centred mainly on the economic survival of the people and, how this important indices in human existence can be guaranteed and protected.

### A Case for Penal Technique in the Enforcement of Environmental Law in Nigeria

As pointed out above, upstream activities are hazardous with great potentials of degrading the environment with its attendant consequences on the health and means of livelihood of the communities. It is not as if oil extracting companies in Nigeria are unmindful of the danger posed to host communities as a result of degradation and despoliation of the environment arising from oil exploration but it seems that their nonchalant attitude towards taking preventive measure to curtail pollution is because the consequence arising from spillage is centred mainly on remedial approach based on corporate social responsibilities of oil companies to the neglect of the penal technique method. Definitely, individuals would not mind where the proffered remedy is remedial to be borne by the corporation without any individual responsibility in terms of just deserts or retribution. For instance, following the *Ogoni* dispute, the then Nigerian President Olusegun Obasanjo appointed two peace envoys for the region - Fr. Mathew Kukah for the *Ogoni* dispute with Shell Petroleum Development Company of Nigeria (SPDC), and Ken Wiwa, the son to the slain *Ogoni* leader, Ken Saro Wiwa, for the region as a whole. The focus of these peace envoys was on how to open the region to socio-economic development. Also, about 65 Nobel Laureates composed with the Commission of Nobel Laureates on Peace, Equity and Development in the Niger Delta region of Nigeria in an effort to proffer solutions to the lingering crisis in the region focused on remedial approach of revenue and compensation. This is a clear indication that enforcement of environmental law in Nigeria has remained focused on non-criminal sanctions.

Currently, in international law there are few notable agreements that seek to protect the environment from serious degradation. Protocol I to the Geneva Conventions includes a prohibition on 'methods or means of warfare which are intended or may be expected to cause widespread, long-term, and severe damage to the natural environment.' This convention has remained in the front burner of any discussion on the natural environment. The convention is said to have provided the impetus for questioning the use of Agent Orange in Vietnam and the setting ablaze of oil wells in Iraq during the first Gulf War.

Though no one has been charged for violating the above Protocol, where conviction is sought, the Statute of International Criminal Court (ICC) can serve as basis for criminal responsibility. There are also other mandates of criminal sanctions for the violation of certain environmental norms, such as the International Convention for the Prevention of Pollution from Ships (Marpol) and the Convention on the Prevention of Marine Pollution by Dumping of Water and Other Matter (London Convention) 1972. Also the Convention on International Trade in Endangered Species (CITES) contains some criminal implementation provisions. There is also the Basel Convention on the Control of Trans-boundary Movements of Hazardous Wastes and their Disposal. Parties to the Basel Convention consider that illegal traffic in hazardous wastes or other wastes is criminal. The London Convention binds members individually and collectively and by virtue of Article 22, parties to the Convention are directed to promote the effective control of all sources of pollution of the marine environment and to take practical steps to prevent the pollution of the sea by dumping of harmful waste which may affect health, injure living resources and marine life or damage amenities. In addition, the Council of Europe adopted a convention on the protection of the environment through criminal law.

Apart from emphasis of corporate responsibility of environmental law violations in Nigeria, the penalty provided for enforcement of environmental laws in Nigeria can be described as a slap on the wrist. For instance, under the Environmental Impact Assessment Act (EIA), the punishment for failure to conduct proper assessment of the potential impacts whether positive or negative, of a proposed project on the natural environment in the case of individual is a fine of ₦ 200,000 or five years imprisonment and in the case of a firm or corporation to a fine of not less than ₦ 50,000 and not more than ₦ 1, 000,000. Also under the Oil in Navigable Water Regulation 1968, which objective is to protect Nigeria's waters from pollution, the Master of the Ship or Occupier has responsibility under Section 3 of the Act to prevent discharge of cruel oil into Nigerian waters. Sadly, the criminal sanction under the Act is only ₦ 200,000.

### Conclusion

Sanctions in terms of monetary compensation may be adequate if they are imposed before the degeneration of pollution into a life threatening hazard. Otherwise, it amounts to making mockery of enforcing preventive law when a pollution has actually caused huge damage to both humans and the eco-system of the people. It is hereby recommended that attitude towards enforcing environmental legislation in Nigeria should change from too much emphasis on monetary compensation to one of serious enforcement of retributive law.



**CENTRE FOR PETROLEUM, ENERGY ECONOMICS  
AND LAW (CPEEL),**  
University of Ibadan, Ibadan, Nigeria.



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#### **SUB-THEMES**

##### **Day 1**

- 1st Plenary Session: Keynote Address (The Transformations in the Global Energy Industry: Setting the Agenda for Gulf of Guinea)
- 2nd Plenary Session: Electricity Sector Reforms: Achievement and Challenges.
- 3rd Plenary Session: Developments in the Oil and Gas Sector.

##### **Day 2**

- 4th Plenary Session: New & Emerging Energy (Bio-Energy, Bioenergy, Hydrogen).
- 5th Plenary Session: Policy Round Table (Setting the Agenda for the Region in the Light of the Development Energy Industry).

#### **About CPEEL**

CPEEL, University of Ibadan was established in July 2011 as a John D and Catherine T. MacArthur Foundation funded Regional Centre of Excellence with the main goal of training highly skilled personnel and conducting research on energy. It is the first institution of its kind in Africa. CPEEL is in collaboration with the Department of Economics, Department of Petroleum Engineering and Faculty of Law at the University of Ibadan, Ibadan, Nigeria.

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Director, the Director,  
Centre for Petroleum,  
Energy Economics  
and Law (CPEEL)

**[www.cpeel.ui.edu.ng](http://www.cpeel.ui.edu.ng)**

**Contact:**  
7, Parry Road, University of Ibadan, Ibadan,  
Oyo State, Nigeria.  
Email: [cpeel@ui.edu.ng](mailto:cpeel@ui.edu.ng),  
Phone: +234 810 327 9807, +234 902 830 9734

# Framework for Building an Energy Demand Model for a Typical Nigerian University

Olusanya E. Olubusoye\*

## Introduction

The university system is a dynamic one with increasing physical expansion and population growth. New structures such as office complexes, hostels, etc., do spring up and new sites and extensions are created from time to time. In all of these, energy is vitally important and consideration for current and future energy demand is crucial. Most office and home appliances are powered by energy. Most laboratory equipment, medical devices, telecommunication equipment, security installations, etc., are powered by energy.

The need for a robust and comprehensive energy information system for the university is germane if the vision of becoming “a world-class institution” will be realisable. Also, analysing current energy consumption university-wide and building an empirical model for making future projections is worth considering by university administrators. Forecasting is important for many reasons. It will help the authority to develop sensible policies, formulate investment strategies in energy sector and attract both public and private funding support. Having better information about the structure of energy demand, future energy needs, underlying trends and impacts of the policies on energy consumption will enable the university administration to tackle the problems related with uncertainty about the future.

## Rationale

The recent report of the needs assessment of the public universities in Nigeria clearly acknowledges the importance of municipal/infrastructural facilities particularly power supply to a sustainable academic environment. These essential facilities make the university system a complete community and facilitate effective teaching, learning and research. But what is the current energy availability vis-a-vis demand by the different components of the university system and what are the future demand projections? What are the existing energy sources and contribution to the aggregate energy utilization? What is the structure of energy demand and use? What are the determinants or drivers of energy needs in the system? What are the underlying trends and patterns of these drivers? What are the shapes and directions of the underlying energy demand trends for the university's aggregate residential and office demand?

The operating environment of a university has been described as “highly complex” due partly to the deplorable power situation. The situation has led to closing down of some institutions and even adjustment of the academic calendar to allow for the power situation to be fixed (see U.I. Annual Report 2012, p4). In order to ensure a virile academic environment, it is important that energy demand (oil, gas, electricity) is analysed and examined carefully.

## Data Requirement

A combination of survey data and energy related administrative data will be needed to develop a comprehensive energy information system for the university. An exhaustive list of all residential buildings, office complexes, hostels, commercial centres, religious centres, sports and recreational centres, etc., must be generated. An energy survey instrument will then be used to capture detailed information on appliances, equipment, energy usage, energy sources, energy expenditure, etc. The following are the possible areas of coverage:

- academic units (departments, faculties, Centres, Schools, etc);

\*Department of Statistics  
University of Ibadan  
oe.olubusoye@mail.ui.edu.ng  
busoye2001@yahoo.com  
Tel.: +234 8058258883

- residential quarters (senior staff quarters and junior staff quarters);
- administrative units (central administration office, registry, finance, works, clinics, Security, Alumni centre, etc);
- hostels (undergraduate - male & female hostels, postgraduate hostels, privately owned hostels, etc);
- religious/worship centres (Muslim & Christian);
- Commercial centres (SUB, ventures, mini markets, Petrol stations, conference centres, etc); and
- Others, e.g. sport complex, farm areas, etc.

### Model

Generally, the literature aiming at modelling energy demand can be categorized into three main groups: (i) end-use modelling; (ii) input-output modelling; and (iii) econometric modelling. For the sake of brevity, we summarise the econometric modelling approach. The econometric modelling approach of energy demand is a quantitative approach that generally aims to analyse, statistically, relationships usually based on econometric theory or intuition between a dependent variable and independent variables using either historical data or observational data. The identified relationships can be used for analysing differences among cross-sectional units, estimating the effect of changes of the independent variables on the dependent variable and for prediction. In econometrics literature, several functional forms are plausible for energy demand modelling. These include the trans-log model (most often applied to a demand system) and the log-linear model (most often applied to a single equation model).

The latter is widely used. The model assumes energy demand is generated because of the demand for goods and services which needs energy in order to be utilized; such as heat, light, transport, etc, hence, demand for energy is not a final product. Therefore, the stock of appliances and its capacity usage are important factors that contribute to determining energy demand. This relationship is given as follows:

$$E_i = F(A_i, R_i) \quad (1)$$

Where;

$E_i$  = total demand for aggregated energy;

$A_i$  = stock of appliance for aggregated energy;

$R_i$  = capacity usage rate of the appliances; and

$i$  = Cross-sectional unit (e.g., residential, office, etc)

Studies such as Pesaran et al. (1998) confirm that the log-linear model of energy demand generally performs better than other specifications and is a more convenient specification for forecasting purposes.

### Forecasting and Simulation

Once the preferred energy demand models are determined for each category (residential, non-residential), forecast scenarios are constructed. Future energy demand depends upon a number of factors, such as the path of the key drivers; hence, the uncertainty of future projections produced will depend on the uncertainty of around the future paths of these drivers. Another uncertainty comes from the variation in the point estimates for the key parameters and elasticities (indicated by their standard errors) in the preferred energy demand models.

### Conclusion

Modelling exercises of this nature are likely to suffer very serious challenges at the various stages of execution. The need to sustain the interest of the key stakeholders which are quite numerous is very fundamental. These include the staff, students, residents, non-residents but transacting business with the university, business operators, etc. Directly and indirectly, everyone who has anything to do with the university certainly has something to do with energy. The imperativeness of ensuring wide sensitization and creating awareness through the various university media is very crucial to the success of the project.

The most important aspect of modelling is the data collection. There is no best model but a model is as good as the data since empirical models are abstraction of the real-world. Obtaining high quality and reliable data will facilitate valid inferences and accurate forecast. Unfortunately, the general attitude to providing information willingly and truthfully is a culture that is hard to find even in the university community. The only solution to this is to guaranty confidentiality of information provided and protection of the giver's identity.

Finally, providing adequate institutional support with clear directive to relevant officers to fully cooperate whenever administrative data are required is needed. Sanctions may be applied where necessary to ensure compliance and total support.

# MSMEs in the Energy Space: A Case Study of Nigeria

Jean Balouga\*

## Introduction

Small businesses form a very diverse sector which is difficult to define and measure precisely (Goss, 1991). However, a Micro, Small or Medium Enterprise (MSME) can be defined as an innovation that leaves the technology incubation centre (Alawode, 2013c); or a business with a turnover below N100 million per annum and/or a staff strength below 300 employees (Anudu, 2013b).

Recent studies by the International Finance Corporation show that about 96 per cent of Nigerian businesses are SMEs. In comparison 53 per cent of the United States of America's (USA) businesses and 65 per cent of businesses in Europe are small (Alawode, 2013c). In Ghana, the contribution of SMEs to GDP is about 55 per cent, in Kenya it is 62 per cent, in South Africa it is more than 70 per cent, but in Nigeria it is only 27 per cent. Nigerians are perhaps the most enterprising people in the African continent; almost everybody knows how to run a successful business in Nigeria but there are prerequisites for SMEs to promote themselves (Obi, 2013).

## Background

Small Medium Enterprises (SMEs) began their revival in the USA in the 1960s. From the late 1960s, the creation of new jobs shifted from the country's largest organizations to SMEs, many of them new businesses. The growth in employment in the USA between the mid-1960s and mid-1980s was phenomenal. The total workforce grew from 71 million in 1965 to 106 million in 1985, a 50 per cent increase. The story was similar in England. After a period of relative decline and neglect, the SME sector is recognized today as a key element in national economic growth. In spite of the growth in number, SMEs remain a turbulent part of the economy, with large movements in and out of the sector each year (Goss, 1991).

## Challenges

Although many new enterprises are born every year and others expand, a large number disappears. Even in years when the economy is performing relatively well, many firms close as well as start up, as shown in Table 1 below:

Table 1: Business start-ups and closures in the UK (2000 – 2003)

	000s of businesses			
	2000	2001	2002	2003
Total business stock	3723	3746	3798	4021
Business starts	439	364	374	423
Starts to total stock	11.8%	9.7%	9.8%	10.5%
Business closures	393	410	434	392
Closures to total stock	10.5%	10.9%	11.4%	9.7%

\*Department of Economics,  
University of Lagos,  
Nigeria  
balougaje@live.com;  
jbalouga@unilag.edu.ng  
Tel. no: 08036006471

An entrepreneur who wants to succeed in business must have the mindset of creativity and not just money-making. He/she sees the gaps around him/her and seeks to fill them (Alawode, 2013b).

A huge infrastructural gap, lack of access to credit, poor financial support by government, multiple taxation, cumbersome regulatory pressures, high levels of unskilled workforce with inadequate employment rights and benefits (Rees, 2014) and low investment commitment to bring pilot plants to commercial sales are some of the great challenges facing SMEs in Nigeria. For example there are about 3.8 million potential micro-clients in Nigeria and so far all the microfinance banks combined have not covered up to 1 million clients. Consequently, Nigeria's SMEs survive mainly through informal financing (Moses-Ashike, 2013).

Finance for un-served and under-served SMEs is between US\$140 and US\$170 billion and unfortunately, commercial banks are not well suited to fund them. For instance, between 2003 and 2009, SME loans as a percentage of total credit decreased from 7.45 per cent to 0.18 per cent. The reasons for this are: the risk-reward structure of SMEs; their high mortality rate (90 per cent of new businesses die within 5 years); the source of bank deposits; the limited number of fundable business plans and the limited market knowledge of entrepreneurs. When commercial banks decide to risk funding, they particularly seek entrepreneurs that know their industry inside out and have robust business models. Yet by 2012, Nigeria had about 17.6 million MSMEs employing about 32.4 million people (Ede, 2013; Olushola, 2013c).

### Energy SMEs

Simple innovations can have a dramatic effect on the way businesses and markets operate in developing countries (Moscadelli, 2012). Renewable energy technologies such as affordable and fuel-efficient cook-stoves, biomass briquettes (cleaner alternative to charcoal and more economical than biomass), biogas, biochar, biomass cogeneration, pico- and micro-hydropower are readily available. Others are solar photovoltaic (PV) products and services, LED technology, siphon water filters; oil, gas and petrochemical products transportation, storage and distribution, as well as oil field services.

Energy MSMEs sit in a larger value chain but other service providers such as product developers, the media and individuals can contribute to favourable market conditions whether it is through improving product quality, increasing awareness and providing transportation and advertising services (Rai and Clough, 2010).

### Conclusion - The Way Forward

Throughout the developing world, there are probably very few development plans that have not paid homage to small industry (Gillis *et al.*, 1997). The case that small-scale industries can generate more employment than large factories is based on the observation that small firms generally use more labour and less capital per unit of output. Data gathered by the World Bank generally supports this conclusion. The reason for this may be that small-business enterprises tend to manufacture those products that are more labour-intensive, but use the same capital-output and labour-output ratios as large firms in the same industries. Dhar and Lyndall (1961) suggest that traditional industries of fewer than ten employees may be more labour-intensive than all modern firms, large and small. But among modern firms, economies of scale determine that larger firms use less of both capital and labour per unit of output.

If Dhar and Lyndall are right, then employment goals can be pursued through small industry only if traditional and informal sector, rather than small, modern, enterprises are encouraged; or small modern factories are encouraged, but are more likely to use both labour and capital. In either case, SMEs will generate more employment at the expense of modernization (and the widening consumer choice) or rising productivity and efficiency. This would be a serious indictment. But the issue is an empirical one: the available data give no clear answers and more research is needed before the SME approach is ruled out. Also, whether or not SMEs can promote equity without reducing growth hinges on the empirical issues of its productivity relative to large firms and to the additional costs of dispersed industry.

The recent response to financing SMEs in Africa by development finance institutions namely, the African Development Bank, ECOWAS Bank for Investment and Development, etc., is a step in the right direction. To prove successful, SMEs have to manage to break out of the marginal mindset and

have organizational confidence, a clear strategy and the drive to make things happen. Other challenges, which have to be overcome, are resource allocation, consistent financial growth, technical capabilities, corporate social responsibility, management skills development, crises management and the rule of law.

Micro, Small or Medium Enterprises (MSMEs) are the platform to address the high unemployment rate in Nigeria, and wealth creation. Government should therefore open the business space in order to strengthen the capacity of MSMEs by deliberately putting in place policies to assist them; provide infrastructure and platforms for networking between Nigeria SMEs and the big players in the hydrocarbon industry operating in Nigeria on the one hand, and on the other, Nigeria SMEs and their international counterparts.

The need arises for enterprise development culture to be inculcated right from secondary schools to tertiary institutions. Most importantly, rapid economic growth, technological change, constant competition and limited government intervention, are conditions for a perfect environment that supports 'entrepreneurial mythologies' (Garland, 2014).

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## Chairman's Remark

### Energy Access for Economic Development: Policy, Institutional Frameworks and Strategic Options

Soji Adelaja\*

It is my great pleasure to welcome you and our international visitors to the 2014 Annual NAEE/IAEE conference and to Abuja, the capital city of Nigeria, Africa's energy giant. In addition, I wish all of you a pleasurable stay in Abuja where every pleasure pleases. I hope that in addition to your activities at this conference, your chosen pleasure will please.

This annual event is the 7<sup>th</sup> NAEE/IAEE conference that features the work of global intellectuals in the field of energy economics. Also, the conference has become the focal point for the intellectual activities of energy economists in Nigeria and many around the globe, and it offers an opportunity for economists and others working on energy related issues to share new knowledge and ideas for the advancement of the profession and the energy sector.

This year's conference theme "Energy Access for Economic Development: Policy, Institutional Frameworks and Strategic Options" suggests that energy access is a major challenge facing the world this decade and Africa's principal challenge. Therefore, bringing energy access especially access to power, to the hundreds of millions of people in Africa and other parts of the world who have never have such access will unleash unimaginable job and income opportunities and tremendous increase in quality of life. For instance in Nigeria, millions of children have never known what it is like to read at home in the evenings. You have to imagine how much their competitiveness is impaired if not forever. Also, many of our rural farmers can triple their productivity and improve their quality of life through added incomes that energy access can bring.


The development of many communities has been stymied by the lack of energy opportunities, be it electricity or fossil fuel whereas the 21<sup>st</sup> Century has been labelled the Century of Africa. This dream will not be a reality until and unless we make huge strides in bringing energy access to millions of men, women, mothers, artisans, traders, students, farmers and others who have been energy abstinent.

With respect to electricity, energy access is constrained by inadequate and intermittent power supply even in on-grid areas. In Nigeria for example, it is estimated that the nation has as much as 90 per cent deficiency in electricity supply while in off-grid areas where some 50 per cent of Nigerians live, access to electricity is practically zero. As many have had to rely on fuel wood, the environmental impacts are staggering. We can only imagine the impact on health, disease management, employment, youth restiveness and ultimately some of the security challenges we face in Africa today.

Great opportunities exist today for paradigm shifts in energy access. These include renewable energy in off-grid areas, new biofuel opportunities, new energy storage devices, new distribution systems, and new energy transport modules for rural home etc. In addition, new market arrangement must be elements of our targets for energy access.

\*John A. Hannah  
Distinguished Professor in  
Land Policy,  
Michigan State.  
  
University Special Adviser  
on Economic Intelligence  
Office of the National  
Security Adviser, the  
Presidency, Abuja

Presented at  
The 7<sup>th</sup> NAEE/IAEE  
Annual Energy  
Conference, 16-18  
February 2014



The transformation I envision requires new policies, new institutional frameworks and clearly new strategic options. This is why the conference's theme is apt and requires productive efforts from different energy experts. Energy economists have an incredible role to play in connecting all these pivotal dots. Our profession has been the bedrock of policy and strategy in so many areas. Our market, institutional and production economists can help solve these problems but they must work with policymakers and engineers to find these solutions if such solutions are to be sustainable.

The 7<sup>th</sup> Annual conference planners have organized a rich agenda with presenters and speakers from various areas of the globe. The agenda ranges from theoretical and empirical issues, environmental linkages, sustainability, policy reform, public understanding, climate change, pricing, investment and finance, international comparisons, technology options, markets, efficiency issues, infrastructure issues, and appropriate legal frameworks. Obviously, again, our profession has a major role to play at this when a paradigm shift is needed in our economic thinking.

## LIST OF NAMES THAT JOIN NAEF FROM FEBRUARY 2014 - APRIL, 2015

1. AFOLABI BAMIDELE OJOSU  
Student  
Centre for Petroleum,  
Energy Economics & Law  
University of Ibadan,  
Ibadan, Oyo State.
2. LANIRAN TEMITOPE JOSEPH  
Student  
Centre for Petroleum,  
Energy Economics & Law  
University of Ibadan,  
Ibadan, Oyo State.
3. IYABO A. OLANRELE  
Student  
Nigerian Institute of Social  
and Economic Research  
Ibadan, Oyo State.
4. MILLICENT A. EZE  
Lecturer II  
Department of Economics,  
Faculty of Social Science,  
University of Abuja,  
Abuja.
5. REGINA OSUAGWU  
Principal Manager  
Nigerian Electricity Regulatory  
Commission,  
Adamawa Plaza,  
Plot 1099 First Avenue,  
Off Shehu Shagari Way, CBD.
6. OYEDEJI OLUWASANMI  
Lecturer  
Department of Business  
Administration & Management,  
Federal Polytechnic,  
Ado Ekiti, Ekiti
7. IHUOMA KANU  
Assistant Chief Regulatory Officer  
Petroleum Products Pricing  
Regulatory Agency, PPPRA  
P.M.B. 609 Garki, Abuja.
8. ROSEMARY OKUBANIYI  
Assistant Chief Regulatory Officer  
Petroleum Products Pricing  
Regulatory Agency, Garki, Abuja.
9. AKINYEMI OPEYEMI  
Assistant Lecturer  
Covenant University,  
Canaan Land, Ota, Ogun State
10. ANABUI P. IDAEWOR  
Ph.D Student  
Centre for Petroleum,  
Energy Economics & Law,  
University of Ibadan, Ibadan,  
Oyo State.
11. AMADI W.  
Law Ph.D Student  
Centre for Petroleum, Energy  
Economics & Law,  
7 Parry Road, University of Ibadan,  
Ibadan, Oyo State
12. VICTOR OSU  
Ph.D Student  
Institute for Innovation,  
Design and Sustainability  
(IDEAS)  
Robert Gordon University,  
Riverside East Garthdee Road,  
Aberdeen.
13. OLUWASOLA EMANNUEL OMOJU  
Student  
Department of Economics,  
China Center for Energy Economics  
Research (CCEER), Xiamen.
14. EGUABOR RICHARD ERAYANME  
Student  
Rufus Giwa Polytechnic,  
Owo, Ondo State.
15. ETENG IBANG ETEN  
CEPMLP ALUMNI, Abuja
16. OLUWAFISAYO ALABI  
Ph.D student  
Heriot Watt University,  
\*Department of Crop  
Protection, Faculty of  
Agriculture, Ahmadu Bello  
University, Samaru, Zaria,  
Kaduna State.
17. OLASUNKANMI OLABANJI  
MD/CEO  
Pannece Park Ltd, Ikeja,  
Lagos.
18. SANUSI M. OHIARE  
Ph.D  
De Monifort University,  
Abuja
19. JUMAI ADAJI  
Msc. Student  
University of Ibadan
20. GBENGA P. SANUSI  
Postgraduate Student  
Department of Economics,  
University of Ibadan, Oyo State
21. CHINEDU OKOYEAGU  
Msc. Student  
Emerald Energy Institute,  
University of Port Harcourt,  
River State.
22. ADEJOLA ADENIKE  
Student  
Emerald Energy Institute,  
University of Port Harcourt,  
River State.
23. BODUNRIN ORIADE  
Msc. Student  
Emerald Energy Institute,  
University of Port Harcourt,  
River State.
24. SULAIMAN A. HAKEEM  
Graduate Student  
Emerald Energy Institute,  
University of Port Harcourt,  
River State.
25. KINGSLEY I. WILLIAM  
M.Sc. Student  
Emerald Energy Institute,  
University of Port Harcourt,  
River State.
26. ANWUNAH IFUNANYA V.  
Student  
Emerald Energy Institute,  
University of Port Harcourt,  
River State.
27. OBEHI E. EBEWELE  
M.Sc. Student  
Emerald Energy Institute,  
University of Port Harcourt,  
River State.
28. EMMANUEL U. ASHIBEL  
M.Sc. Student  
Emerald Energy Institute,  
University of Port Harcourt,  
River State.
29. SUSAN A. FUBARA  
M.Sc. Student  
Emerald Energy Institute,  
University of Port Harcourt,  
River State.
30. ABDULLAHI AHMED NDA  
M.Sc. Student  
Emerald Energy Institute,  
University of Port Harcourt,  
River State.
31. ULOMA U. IWUJI  
M.Sc. Student  
Emerald Energy Institute,  
University of Port Harcourt,  
River State.
32. PATRICIA I. ARINZE  
M.Sc. Student  
Emerald Energy Institute,  
University of Port Harcourt,  
River State.
33. RICHARD U. INGWE  
Postgraduate Student  
Emerald Energy Institute,  
University of Port Harcourt,  
River State.
34. ONUOHA I. NNACHI  
M.Sc. Student  
Emerald Energy Institute,  
University of Port Harcourt,  
River State.
35. PARACLETE N. NNADILI  
M.Sc. Student  
Emerald Energy Institute,  
University of Port Harcourt,  
River State.
36. ISRAEL J. ONYIJ  
M.Sc. Student  
Emerald Energy Institute,  
University of Port Harcourt,  
River State.
37. OMOGBAI A. MARTINS  
M.Sc. Student  
Emerald Energy Institute,  
University of Port Harcourt,  
River State.
38. EMEKA F. OJIEGBU  
M.Sc. Student  
Emerald Energy Institute,  
University of Port Harcourt,  
River State
39. AMARACHI M. NWOKE  
M.Sc. Student  
Emerald Energy Institute,  
University of Port Harcourt,  
River State.
40. YOHANNA PANSIAK  
M.Sc. Student  
Plateau State University,  
Department of Economics,  
Plateau State University,  
Bokkos.
41. OLUMUYIWA L. MAKINDE  
Student  
Centre for Petroleum, Energy  
Economics & Law University  
of Ibadan, Ibadan,  
Oyo State.
42. ADEYEMI OLASUNBOMI A.  
Student  
Centre for Petroleum,  
Energy Economics & Law  
University of Ibadan,  
Ibadan, Oyo State.
43. ADEBULEHIN TOLULOPE I.  
Student  
Centre for Petroleum, Energy Economics  
& Law University of Ibadan, Ibadan,  
Oyo State.
44. TIDI MICHAEL  
Student  
Centre for Petroleum, Energy Economics  
& Law University of Ibadan, Ibadan,  
Oyo State.
45. JOEL OLUWABUSAYO IBUKUN  
Student  
Centre for Petroleum, Energy Economics  
& Law University of Ibadan, Ibadan,  
Oyo State.
46. FUNKE AYANDELE  
Student  
Centre for Petroleum, Energy Economics  
& Law University of Ibadan, Ibadan,  
Oyo State.
47. IYOFOR ANTHONY A.  
Student  
Centre for Petroleum, Energy Economics  
& Law University of Ibadan, Ibadan,  
Oyo State.
48. OGBONNAYA OKOGERI  
Student  
Centre for Petroleum, Energy Economics  
& Law University of Ibadan, Ibadan,  
Oyo State.
49. CHUKU FELICIA ONYINYECHI  
Student  
Centre for Petroleum, Energy Economics  
& Law University of Ibadan, Ibadan,  
Oyo State.
50. BICKERSTETH S. BABATOLA .S.  
Postgraduate Student  
Centre for Petroleum, Energy Economics  
& Law University of Ibadan, Ibadan,  
Oyo State.
51. ONYEMA JULIET UMEAGU  
M.Sc. Student  
Centre for Petroleum, Energy Economics  
& Law University of Ibadan, Ibadan,  
Oyo State.
52. LILIAN IDIAGHE  
Ph.D Student  
Centre for Petroleum, Energy Economics  
& Law University of Ibadan, Ibadan,  
Oyo State.
53. SOYOYE OREOLUWA  
M.Sc. Student  
Centre for Petroleum, Energy Economics  
& Law University of Ibadan, Ibadan,  
Oyo State.
54. DAHUNSI O. ADEWALE  
M.Sc. Student  
Centre for Petroleum, Energy Economics  
& Law University of Ibadan, Ibadan,  
Oyo State.
55. OGUNLOLU MODUPELOLA RAHMOT  
Student  
Redeemers University, Department of  
Economics, Redeemers University,  
Mowe, Ogun State.
56. OLOWOOKERE TOLULOPE OPEYEMI  
Student  
Redeemers University, Department of  
Economics, Redeemers University,  
Mowe, Ogun State.
57. ILESANMI OLUMIDUN  
Student  
Redeemers University, Department of  
Economics, Redeemers University,  
Mowe, Ogun State.

58. ADEBIYI BOLUWATIFE .C.  
Student  
Redeemers University, Department of Economics, Redeemers University, Mowe, Ogun State.
59. OGBON JOSHUA .U.  
Student  
Redeemers University, Department of Economics, Redeemers University, Mowe, Ogun State.
60. ALABI OLUSOLA .S.  
Student  
Redeemers University, Department of Economics, Redeemers University, Mowe, Ogun State.
61. OLA BURAIMO ADETUTU  
Student  
Redeemers University, Department of Economics, Redeemers University, Mowe, Ogun State.
62. OMOROGIEVA MARIAN  
Student  
Redeemers University, Department of Economics, Redeemers University, Mowe, Ogun State.
63. ANIYI OLUWATOBI  
Student  
Redeemers University, Department of Economics, Redeemers University, Mowe, Ogun State.
64. OLAJIDE OLAMIDE  
Student  
Redeemers University, Mowe, Ogun State.
65. OYEDEPO OYETUNDE  
Student  
Redeemers University, Department of Economics, Redeemers University, Mowe, Ogun State.
66. EKUNDAYO OLUWADAMILOLA  
Student  
Redeemers University, Department of Economics, Redeemers University, Mowe, Ogun State.
67. OLUBUKOLA O. SOGBOLU  
Student  
Redeemers University, Department of Economics, Redeemers University, Mowe, Ogun State.
68. AGAGU T. MUREWA  
Student  
Redeemers University, Department of Economics, Redeemers University, Mowe, Ogun State.
69. ODULATE OLUWATOFUNMI E.  
Student  
Redeemers University, Department of Economics, Redeemers University, Mowe, Ogun State.
70. SENBORE OREOLUWA O.  
Student  
Redeemers University, Department of Economics, Redeemers University, Mowe, Ogun State.
71. DAMILOLA T. ADETOMIWA  
Student  
Redeemers University, Department of Economics, Redeemers University, Mowe, Ogun State.
72. JEFF-ZANNI MEDINA CHEH  
Student  
Redeemers University, Department of Economics, Redeemers University, Mowe, Ogun State.
73. OLUWAYOMI O. OLANREWAJU  
Student  
Redeemers University, Department of Economics, Redeemers University, Mowe, Ogun State.
74. TITILAYOMI L. BABALOLA  
Student  
Redeemers University, Department of Economics, Redeemers University, Mowe, Ogun State.
75. FATIMA DALHATU  
Nigerian National Petroleum Corporation, Abuja.
76. NKESE UMOREN  
Nigerian National Petroleum Corporation, Abuja.
77. ADEWOLE AYOOLUWA OLUSOLA  
Marketing Manager  
Reachout Marketing Limited  
Constitution Av. Gaduwa, Abuja.
78. OLALEKAN A. BANKOLE  
Budget Officer  
Nigerian Petroleum Development Co. Ltd.  
62/64 Sapele Road, Benin, Edo State.
79. BERNARD O. ANTHONY  
Lecturer  
Kogi State University,  
Department of Economics,  
Anyingba.
80. PIUS EGBUNU OKEH  
Director  
Finance & Accounts,  
Kogi SUBEB,  
Lokoja.
81. LADI M. OROKPO  
Assistant Admin. Officer  
Federal Ministry of Power,  
Garki, Abuja.
82. SULU B. FULANI IBRAHIM  
Chief Scientific Officer  
Energy Commission of Nigeria,  
Abuja.
83. AMIEYE-OFORI FELIX  
Managing Director  
Energia Limited, Ikoyi,  
Lagos.
84. JUBRIL OLANREWAJU LAWAL  
Managing Director  
Ubrill Integrated Limited,  
Akowonjo, Lagos.
85. ISMAILA MAMBO  
Budget Office of The Federation,  
Garki Abuja.
86. OLUKEMI A. ARODUDU  
Deputy Director  
Budget Office of The Federation,  
Garki Abuja.
87. PETER E. AUDU  
Assistant Chief Admin Officer  
Budget Office Of The Federation,  
Garki Abuja.
88. MRS. STELLA B. TOLUWASE  
Director  
Budget Office of The Federation,  
Garki Abuja.
89. FADARE MARY OLADUNNI  
Customer Service Officer  
Ibadan Electricity Distribution  
Company, Ibadan.  
Electricity Distribution Zone,  
Dugbe Ibadan, Oyo State.
90. YEMI ADETUNJI  
General Manager Transformation  
Nigerian National Petroleum  
Corporation (NNPC),  
Garki, Abuja.
91. OLUMUYIWA ONADEKO  
Deputy Manager Assets Evaluation  
and Economics  
Nigerian National Petroleum  
Corporation (NNPC),  
Garki, Abuja.
92. ISA ISMAILA  
DM Strategy Development  
Nigerian National Petroleum  
Corporation (NNPC),  
Garki, Abuja.
93. ALIYU AHMED LAWAL  
Transformation Officer  
Nigerian National Petroleum  
Corporation (NNPC),  
Garki, Abuja.
94. OGBU ADAH VINCENT  
Energy Analyst  
Nigerian National Petroleum  
Corporation (NNPC),  
Garki, Abuja.
95. ATIAT OLABUNMI SHEIDU  
Commercial Analyst  
Nigerian National Petroleum  
Corporation (NNPC),  
Garki, Abuja.
96. NWIGWE IJEOMA  
Commercial Analyst  
Nigerian National Petroleum  
Corporation (NNPC),  
Garki, Abuja.
97. PREYE EDIH  
Graduate Trainee  
Nigerian National Petroleum  
Corporation (NNPC),  
Garki, Abuja.
98. OLUSOLA OLUDIRAN  
Transformation Officer  
Nigerian National Petroleum  
Corporation (NNPC),  
Garki, Abuja.
99. RAPHAEL ZINGAK WALBE  
Transformation Officer  
Nigerian National Petroleum  
Corporation (NNPC),  
Garki, Abuja.
100. SALISU IBRAHIM MUKHTAR  
Transformation Officer  
Nigerian National Petroleum  
Corporation (NNPC),  
Garki, Abuja.
101. ARINZE OKAFOR  
Transformation Officer  
Nigerian National Petroleum  
Corporation (NNPC),  
Garki, Abuja.
102. UMAR GBOBE AMINU  
Dm Communication and Change  
Management Nigerian National  
Petroleum Corporation (NNPC),  
Garki, Abuja.
103. ARSITOTLE JOHN-EMEZI  
Transformation Officer  
Nigerian National Petroleum  
Corporation (NNPC),  
Garki, Abuja.
104. AYOTOMIDE OLUGBENGA  
OLUMOYEGUN  
Chief Accountant  
Office of the Head of Civil Service  
of Federation., Abuja
105. ARIGBABUWO TAOFEQ OLAYEMI  
MABAYOJE  
Finance Controller, IHS Nigeria Plc  
Mende Maryland Lagos.
106. MARCELLINA E. ABANG  
Assistant Gen. Manager  
Nig. Electricity Regulatory  
Commission, Garki, Abuja.
107. AMB (DR) GODKNOWS BOLADEI  
IGALI  
Permanent Secretary  
Federal Ministry of Power,  
Garki, Abuja.
108. SUNDAY IDOWU  
SA to Permanent Secretary  
Federal Ministry of Power  
Federal Ministry of Power,  
Garki, Abuja.
109. NWAKEGO CHINEYEMBA  
Marketer  
Fidelity Bank, Delta State.
110. ANIEBUE NNEKA CLARA ENUMA  
Tax Inspector  
Federal Inland Revenue Service,  
F.I.R.S. Office, Ikoyi, Lagos State.
111. EGORERUA .O. SYLVESTER  
Chief Technician  
W.R.PC EKPAN-WARRI, Effurun,  
Delta State.
112. BARBARA U. ADUDA  
Nigerian Bulk Electricity Trading  
PLC., Utako, Abuja.
113. FATIMA SHEHU HABIB  
Nigerian Bulk Electricity Trading  
PLC., Utako, Abuja.
114. ECHETA DESMOND .O.  
Head of Department  
Imo State Polytechnic, Department  
of Banking and Finance, Imo State  
Polytechnic, Umuagwo.
115. EGOR F. EGBE  
Deputy Manager, Human Capacity  
NNPC Human Resource Division  
Nigerian National Petroleum  
Corporation, NNPC Towers, Central  
Business District, Herbert  
Macaulay Way, P.M.B 190,  
Garki, Abuja.
116. TIJANI RAFIU YINKA  
Assistant Chief Planning Officer  
Lagos State Ministry of Economic  
Planning and Budget, Alausa-  
Ikeja, Lagos State.
117. LAWRENCE U. EKE  
Field Operations  
Total E & P, Trans Amadi, Port  
Harcourt, River State.
118. AZUONYE A. CHIDIEBERE  
District Planning Engineer  
Total E & P, Trans Amadi, Port  
Harcourt, River State.
119. BIODUN ADELEGN  
Lecturer  
Department of Economics &  
Development Studies, Federal  
University, Otuoke, Yenagoa
120. EREPAGAMOYE IYALLA  
Assistant Chief Officer Projects  
Petroleum Technology Dev. Fund,  
Garki Abuja.

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**NAEE INSTITUTIONAL MEMBERS**

- Centre for Petroleum, Energy Economics and Law  
University of Ibadan, Nigeria.
- Emerald Energy Institute,  
University of PortHarcourt.
- Ibadan Electricity Distribution  
Company.



**PAST CONFERENCES OF THE ASSOCIATION HAVE ADDRESSED PERTINENT NATIONAL ISSUES IN NIGERIA AND HAVE BEEN GRACED WITH THE PRESENCE OF DISTINGUISHED NIGERIANS AS CAN BE SEEN IN THE TABLE BELOW:**

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. Osten Olorunsola, former Vice President, Gas, Shell Africa, former Director, DPR	Engr. Chima Ibenechie, former Managing Director, NLNG	28th – 29th April 2011, Sheraton Hotel & Towers, Abuja.
5th Annual Conference	ENERGY TECHNOLOGY AND INFRASTRUCTURE FOR SUSTAINABLE DEVELOPMENT.	Professor Einar Hope, 2010 IAAE President	Prof. A.S. Sambo, FNAEE, Director General, Energy Commission of Nigeria and Special Adviser to the President on Energy	23rd – 24th April, 2012, 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 Soji Adelaja, John. A. Hannah Professor of Land Economics, MSU, & Special Adviser on Economic Intelligence	16th -18th, February 2014, Sheraton Hotel & Towers, Abuja.

## IAEE Presidential Message at the 7th NAEF Conference, Abuja, Nigeria

Wumi Iledare, Ph.D., FNAEF\*

Honorable Minister of Power, Professor Chinedu Nebo, the Honorable Special Adviser to the President of Nigeria on Economic Security and Intelligence and the Chairman of this occasion, Professor Soji Adelaja, Former Special Adviser, Petroleum Matters, Dr. Emmanuel Egbogah, ably represented by Dr. Jude Ahmaful, the CEO and Vice Chairman of Emerald Energy Resources Limited, Special Guests of Honour, Mr. Reginald Stanley, the ES of PPRA, the Key Note Speaker, Professor Yinka Omoroghe, Ladies and Gentlemen.

It is with a great pleasure to welcome you to the 7<sup>th</sup> IAEE/NAEF meeting. NAEF started as an affiliate of IAEE in 2007 and held its first international conference in 2008. The 2007 and 2008 IAEE Presidents, the USAEE President and the Executive Director of IAEE attended this inaugural conference in 2008. I was present at the conference as the USAEE president then. Subsequently NAEF had the privilege to host nearly every IAEE President since then. In fact, the 2010 IAEE President was the key note speaker in 2010. Thus, I consider it a great honour to follow the tradition of IAEE presidents on this matter. So I am here with you at the 7<sup>th</sup> NAEF conference. Being in your midst at the 7<sup>th</sup> NAEF conference in my capacity as the 2014 IAEE President, is gratifying and I am thankful to God. The only difference this time, of course, is the fact that this is home coming for me because I am one of you. It is “omowale” indeed!

The theme of this 7<sup>th</sup> NAEF conference is interesting to me. Everything in life is really about having access to something. So a discussion on access to energy within the context of the Nigerian economy is quite relevant more so now than ever before. The first plenary session is also organized to set the stage for our conversation right after the opening session. Nearly 100 papers will be presented at this conference on this subject matter.

Thus, it is appropriate to make a quick remark on the key anchors of energy access. The first anchor is energy *availability* which requires massive investments from the private sector with a well articulated public policy to attract investments. You cannot have access to what is not available. There is no way government can be solely responsible for providing access to energy. Public education is necessary to facilitate the basic understanding of the fact that energy in whatever form is an economic good and not a public good. Thus, energy can only be made available only at an appropriate price.

Next is the basic fact that energy must be affordable. While the industry needs liberalization and restructuring to make energy available, it must be regulated at the end-users market to ensure *affordability*. An unregulated utility market can be disastrous to a national economy. There must be a functioning regulatory agency to guaranteed equitable pricing of energy to end-users and distributors.

Finally energy access must be *sustainable*. This requires massive investment in human capacity to manage the industry, its regulatory institutions and agencies effectively. This is where NAEF becomes an important stakeholder in terms of providing intellectual forum to discuss policy issues and ideas for sustainable energy access for all. No nation can grow its economy in a sustainable manner without a dynamic intellectual community. Energy sector reform is premised on skilled manpower to manage investment flow into the sector. And for a better tomorrow for any nation, its intellectual growth must be faster than its economic growth. I believe NAEF offers a unique forum for our energy professionals to grow



\*2014 IAEE President  
Emeritus Professor,  
LSU Center for  
Energy Studies, USA  
Chirota & Emmanuel Egbogah  
Distinguished Professor  
Director, Emerald Energy  
Institute, UNIPORT,  
Nigeria.

intellectually and to facilitate good understanding of the importance of energy to economic growth and development. Let me therefore invite you to make the NAEF and by extension IAEE your association of choice as energy professionals. The association offers a forum for dialogue on all aspects of energy. It is a one of a kind association because hardly can you find a group of professionals with many diverse occupations dialoguing on the same product-energy. The association is international in its governance structure and membership distribution.

International Association for Energy Economics, IAEE currently has over 4,000 direct and affiliate members from over 100 countries, including 26 affiliates worldwide. Secondly, membership privilege is available to every professional and graduate student interested in the economics of energy and willing to claim ownership of the association as a stakeholder. Thirdly, the founding leaders of IAEE certainly had a great insight, when they changed the name of the association from International Association of Energy Economists to International Association for Energy Economics. Subsequently, at every regional and/or international meeting of the IAEE, professionals—engineers, geoscientists, economists, lawyers, geographers, scientists—interested in the economics of the energy industries and energy policy issues and problems come from the industry/business sector, academic and government institutions. Let me say, without mincing words, that it is very unlikely to find another association on this planet earth with the type of professional diversity as in IAEE and NAEF.

In conclusion, I sincerely appreciate the opportunity to be your IAEE president and I look forward to expanding IAEE membership worldwide into areas where we are yet to be fully entrenched. It was 28 years ago that I attended my first IAEE conference as a graduate student at West Virginia University. I became the USAEE president about six years ago and now the IAEE President. So, I am so very thrilled to see the efforts NAEF has deliberately made since inception to encourage graduate students to join NAEF. The future of NAEF lies with today's graduate students. But I want to encourage you to work with us and not to just grow the individual membership of NAEF and by extension IAEE; I want us to work together as a team to also grow our institutional membership. Currently, NAEF has no institutional members, but IAEE has about 30 institutional members worldwide. Perhaps, we can work together to get ten in 2014, one at a time for NAEF. It is my hope that some of our invited guests will consider persuading their employers to become institutional members of NAEF this year. I have already persuaded my employer to be an institutional member of NAEF with immediate effect.

Finally, I would want to bring to your attention the forthcoming IAEE conferences in 2014. The 37<sup>th</sup> IAEE International Conference to be held in New York on June 16-18, 2014, exactly four months from today. The conference has been fashioned to facilitate a good understanding of the international implications of U.S. reemergence as a key global energy producer. The geopolitical and economic implications of the U.S. becoming an exporter of oil and gas, in the not too distant future, will be momentous. For example, African light oil export to the U.S. will be in trouble as a result of discounted pricing of light tight oil from shale in the U.S. So, would this affect OPEC significantly in terms of its output strategy? Further, because of gas abundance in the U.S. and the likelihood of gas export to Europe, would the clamor for subsidy incentives for renewable energy be significantly affected? Well, as I mentioned earlier, here lies the uniqueness of our IAEE. The organization is fashioned to provide a thorough analysis of the issues the new energy landscape brings with it in its conferences.

Please note also that the 4<sup>th</sup> IAEE Asian conference will be held in Beijing, China on Sept 19-21, 2014, The theme of the conference is 'Economic Growth and Energy Security: Competition and Cooperation.' Finally, the 14<sup>th</sup> IAEE European conference is slated to be held on October 28-31 in Rome, Italy. The theme of the conference is 'Sustainable Energy Strategies for Europe.' In fact the planning for the 38<sup>th</sup> IAEE International Conference in Antalya, Turkey on May 24-27, 2015 is in full gear. Please visit [www.IAEE.org](http://www.IAEE.org) for more information on these conferences.

Please enjoy your stay in Abuja and I hope you will find the 7<sup>th</sup> NAEF conference informative, educative and enjoyable. I sincerely look forward to seeing you at the next IAEE conference in New York, June 16-18, 2014.

## Keynote Address

# Energy Access and Economic Development: Policies, Institutional Frameworks and Strategic Options

Yinka Omorogbe, FNAEE\*



### Introduction

First, I must express my appreciation to the Nigerian Association of Energy Economics for honouring me with this invitation to deliver a Keynote Address at this very distinguished gathering, on a topic that I am passionate about. This is an association that has proved a spiritual principle that I believe in and regularly preach; that which you honour and esteem will always come near you. As an energy lawyer and specialist, if there is a discipline that I honour and which I regard as one of the most important in this area (apologies to engineers, I hope you'll understand my position before I am finished) it is the discipline of economics, particularly energy economics. Without a doubt, if as a nation we had honoured this specialization, I believe that the Nigerian Petroleum Industry would not be in its present position. It is therefore gratifying that NAEF has been in existence for the last few years, and that during its short life span, it is now becoming a voice of substance in the Nigerian petroleum industry. We really need to listen to, and heed the advice of energy economists.

The conference theme is topical, as Nigeria remains plagued with a comatose electricity system, characterized by blackouts for the fifty per cent of the population connected to the electricity grid; and no electricity at all for the other half that lives outside the grid areas all around the country. Again, Nigeria has the unenviable status of having both one of the world's largest producers of crude oil and largest importers of petroleum products. It also has an opaque kerosene 'subsidy' regime that is in the process of being exposed to the general public, resulting in kerosene prices lying outside the reach of the ordinary person; this is particular tragedy since the large majority of Nigerians rely on primitive biomass-leaves, wood and waste- as their primary energy source.

There is nothing as important as energy. It is the driving force of life, in every sense of the word, and that is why it is a word that is used all the time, in varying contexts that all somehow end up conveying the imperative of the word. For a few minutes, I am going to talk about energy and economic development, and to show why, as a nation, we have little or no energy, so to speak<sup>1</sup>. What precisely do we mean when talking about energy, considering, as I have said, that the word is used in so many ways? Why is it so critical for a country and its people to have energy?

From an energy perspective, it must be recognized that a great gulf exists between the poor and those who are not. The poor live in a different energy world; that is the way it is primarily because of the amount of energy at their disposal. With no other alternative to biomass in its crudest form (wood and animal dung) they live at subsistence levels, with women and children suffering additional disadvantages because they are primarily responsible for the gathering of this biomass. The factors outlined above and others mean that these communities have greatly reduced productivity, with fewer opportunities for growth and to break away from the prevailing poverty, all of which further perpetuate the existing conditions of underdevelopment, and 'help trap the user in poverty'<sup>2</sup>.

To lift people out of poverty, they have first to be lifted out of energy poverty. It is now recognized that this is not possible if they do not have access to energy services. This therefore

\*Nabo Graham Douglas  
Distinguished Professor  
of Law, Nigerian Institute  
of Advanced Legal Studies,  
Abuja.

<sup>1</sup>A play on my University  
lecture title, delivered in 2008  
at the University of Ibadan:  
Yinka Omorogbe,  
*Why We Have No Energy*,  
University of Ibadan Press,  
2008.

<sup>2</sup>Meeting the Challenge for Rural Energy and Development, [www.worldbank.org](http://www.worldbank.org).

<sup>3</sup>See Yinka Omorogbe, 'Policy, Law and the Actualisation of the Right of Access to Energy Services,' Kim Talus (Ed.) *International Energy Law Handbook*, Edward Elgar Press, 2014, Chapter 14 (in press).

<sup>4</sup>United National General Assembly declares 2014-2024 Decade of Sustainable Energy for All, General Assembly GA/11333 EN/274, December 21, 2012, available at [www.un.org/News/Press/docs/2012/ga11333.doc.htm](http://www.un.org/News/Press/docs/2012/ga11333.doc.htm)

<sup>5</sup>See 'Energy Access Database', available at [www.worldenergyoutlook.org/resources/energydevelopment/energyaccessdatabase/](http://www.worldenergyoutlook.org/resources/energydevelopment/energyaccessdatabase/). According to the *World Economic Outlook 2010*, which focused on the right of access to energy services, residential electricity consumption in that region (with the exception of South Africa) is roughly equivalent to consumption in New York. This means that the 19.5 million residents of New York use about the same amount of electricity as the 791 million people of sub-Saharan Africa.

<sup>6</sup>Countries with the largest populations without access to electricity in 2010: Congo, Pakistan, Tanzania, Kenya and Uganda.

Countries with the largest population relying on tradition biomass in 2010: India, China, Bangladesh, Indonesia, Nigeria, Pakistan, Ethiopia, Democratic Republic of the Congo, Vietnam and the Philippines. 'Measuring Progress towards Energy for All: Power to the People?' in *World Energy Outlook 2012*, 533-4, available at [www.worldenergyoutlook.org](http://www.worldenergyoutlook.org).

has to be a major plank of any development strategy, which in the first place should be geared towards sustainable development, and not to economic development, which mean two different things. Economic development is, in my opinion, a sterile concept, which can often occur without appreciable impacts on the people. The outcomes of both are often very different. Therefore, it is possible for the generality of the people to suffer from abject poverty and deprivation, even as economic development indicators are posting impressive growth percentages. I need to discuss 'energy services,' economic development, and sustainable development, clarifying why as will be seen, my concern is more about sustainable development, and not the clinical term 'economic development' which, in my opinion, allows for empty and lop-sided growth unaccompanied by little or no improvements in national development indicators.

### Access to Energy<sup>3</sup>

Energy access, or the lack of it, can be said to be one of the most pressing problems of the twenty-first century, because it is now a widely recognized fact that sustainable development, or development in real terms, is an impossibility in the absence of access to energy services. In recognition of this fact, the United Nations system designated 2012 as the year of Sustainable Energy for All (SEFA), and has followed this up with the designation of the decade 2014-2024 as the Decade of Sustainable Energy for All<sup>4</sup>.

Energy access does not refer to access to a source of energy. It refers to access to the benefits derived from that source of energy-to the services that it provides, referred to as energy services. Energy services include household access to electricity, to clean cooking facilities, and to energy that empowers work, making life easier, healthier, and safer. The benefits of 'energy services' are derived from the use of efficient energy sources, over and above that derived from basic biomass, which is the fuel of the poor in developing countries, such as Nigeria. These benefits make fundamental differences to peoples' lives and standards of living. With efficient energy for work, grinding foodstuff is done in a fraction of the time that would otherwise have been spent to do it manually. Efficient energy services provide lighting for reading and greater productivity at night; cooking safely and without the stress of having to regularly source firewood or other basic biomass; refrigeration so that one is free from having to buy food daily, or have needed food rotting away; telecommunications so that there is no longer the need to embark on costly and long journeys in pursuit of transactions that can easily be concluded over the phone; and transportation, without which the people will have to walk long distances, or travel by donkey, camel, horseback, or bicycles. Firewood, crop waste, dung, and wood shavings as well as other energy sources used by the poor, cannot provide these and many other services.

Whilst millions of people now have access to modern energy services, one fifth of the world's population lacks access to electricity. Twice as many still rely on traditional uses of biomass for cooking<sup>5</sup>. Cumulatively, more than 95 per cent of those without modern energy access live in the developing countries of Asia, and of sub-Saharan Africa, with the great majority residing in the rural areas. More than half of the populations in developing Asia and 80 per cent of the population in sub-Saharan Africa exist without clean cooking facilities. In sub-Saharan Africa, the electrification rate is 31 per cent and the number of people relying on biomass is 80 per cent<sup>6</sup>.

Out of a sub-Saharan population of 600 million without access to electricity, 84 million are Nigerians. Worldwide, this represents the largest number of people without electricity, after India, which has 306 million, or 25% of its population. It should be remembered that those regarded as having access to electricity are the people connected to the electricity grid, such as you and I. As we know, invariably no day passes without connections being disrupted, often several times a day, and sometimes, in some areas, for days at a time. So, even those with electricity are deprived people, with- at the most, partial connections. Generators provide the backup for all who can afford them, at the levels that they can afford. So, in reality, the whole of Nigeria has limited access to electricity.

Regarding the use of traditional biomass, 122 million Nigerians, representing 75 per cent of the population of this country, rely on traditional biomass for cooking. Nigeria ranks 4th on the worldwide list, after India, China and Bangladesh. For sub-Saharan Africa, it tops the list, representing nearly 20 per cent of the 696 million people cooking with traditional biomass in 2011. Again, it should be remembered that amongst the 25 per cent of the Nigerian population that does not use biomass, there are millions, mainly in urban areas, who rely primarily on kerosene, which is less efficient than either LPG or natural gas, and which has negative health effects. Nigeria can therefore be described strongly but aptly as a country in the throes of an energy famine.

It is now recognized that improved access to modern energy services for as many people as possible, is the single most important component of any development strategy, and that none of the Millennium Development Goals (MDGs) are capable of realization without the use of efficient energy within the very poor communities of the world. Everyone needs access to energy services, which must be provided by a source of primary energy or an energy carrier that is capable of providing necessary benefits.

## Economic Development

This Conference is about energy access and economic growth. In fact, energy access has a positive impact on growth, but is primarily about sustainable development. Therefore, by linking an economic development, which is primarily measured in terms of aggregated figures; with energy access, measured in terms of its impact on people and their livelihoods, the Conference is highlighting sustainable development and its importance to meaningful growth.

Economic growth is concerned with aggregated figures, whilst development is concerned with discernible and measureable impacts on as much of the population as possible. A few decades ago, economic development was seen as synonymous with development. Now, no informed person would make that statement. Now, it is a clearly recognized fact that economic growth and development are not one and the same thing and therefore increased growth does not imply greater development. In fact, growth often exists in places where there are great disparities in income distribution and which suffer from fundamental development deficiencies. This is the situation in several developing countries, including most of the sub-Saharan African countries, which have been experiencing rapid economic growth. In most of these countries, growth has been driven by events and activities in the international economic and financial systems, and is occurring irrespective of the internal policies and actions of many of the countries concerned, which in fact are not pro-poor, and which do not encourage growth. This has given rise to a false optimism, premised on the equally false assumption that economic growth and development are one and the same thing. They are not. Great inequalities are prevalent in many of these economies, many of which have low and stagnating development indicators, clearly showing that the economic growth experienced has not led to improvement in living standards for most of the people, but has only benefitted a small percentage of the population. Ironically, as shown above, the majority of the world's energy poor are found in these fastest growing countries. Nigeria provides a perfect example of this, with generally poor development indicators. It is common knowledge that we have been consistently ranked as a low human development country for years. In the Human Development Report 2013, we are 153<sup>rd</sup> out of the world's 190 plus countries, behind many African countries, such as Ghana (135) and the Congo (142). According to UNICEF, the deaths of newborn babies in Nigeria represent a quarter of the total number of deaths of children under-five.

According to Save the Children, 14 out of 1000 newborns die the same day they were born, with the majority occurring within the first week of life, mainly due to complications during pregnancy and delivery reflecting the intimate link between newborn survival and the quality of maternal care. Main causes of neonatal deaths are birth asphyxia, severe infection including tetanus and premature birth. Similarly, a woman's chance of dying from pregnancy and childbirth in Nigeria is 1 in 13. Although many of these deaths are preventable, the coverage and quality of health care services in Nigeria are substandard, with less than 20 per cent of health facilities offering emergency obstetric care and only 35 per cent of deliveries attended by skilled birth attendants. UNICEF therefore states:

*Every single day, Nigeria loses about 2,300 under-five year olds and 145 women of childbearing age. This makes the country the second largest contributor to the under-five and maternal mortality rate in the world.*

Depressingly, the youth unemployment rate is 54 per cent. By any standard, that is extremely alarming. Surely this is a sign that economic growth in Nigeria has not impacted on the economy as one would have expected it would? If it had, there would be more jobs, and less unemployment. These and other depressing non-achievements have led to our being described as the worst place in the world to be born in, by the Economist<sup>7</sup>.

The typical elitist Nigerian reaction to this is uninformed disbelief. Do your own research; check out the facts for yourself, and then decide on the veracity or otherwise of the assertions

made in this presentation. Of what use is growth that fails to address severe problems of planning and underdevelopment such as these?

For economic development to be meaningful, it must be accompanied by interventions that impact on the disadvantaged and that make a difference to the poorest of the poor, none of whom are in this room. Percentage points in growth are not only meaningless, they can be quite irritating, if there are no signs that the increased revenues being touted are accompanied by policies or strategies that positively impact on the disadvantaged Nigerian.

Since it is clear that we are gripped by an energy famine, and that the present economic growth cannot lead to development in the real sense, if it remains unaccompanied by activities that positively impact on the people, how does one address this problem? In a nutshell, the solution lies in development planning that is actually adhered to, with ordinary people as the central focus. It also means that the entire energy sector must be developed strategically, in such a way as to benefit the ordinary man or woman.

### The State of the Nigerian Energy Sector

The energy sector in any country is concerned with the frameworks and institutions of the various sources of energy that are utilized within that country, for the provision of energy services. In Nigeria, we should be referring to petroleum, hydropower, coal, renewable energy, and electricity, which uses one or more of the previously mentioned sources as feedstock for the electricity generation. These sectors are the concern of Nigeria's Energy Policy, which is currently undergoing revision after a decade of operation. However, it is safe to say that energy has never been driven as a whole. Instead, the various energy subsectors have developed independently and sometimes at variance with each other, resulting in the present situation of energy poverty. It is my opinion that this is the major reason for the current state of the Nigerian energy industry.

This is a conference where many learned persons will offer their prescriptions for identified problems. I hope that it will highlight one pressing problem, which is that of coordination and cooperation in the sector. This problem occurs at institutional and professional levels, a typical example being the various policies relating to the energy sector that have emanated from different ministries and institutions over the years from the Energy Commission of Nigeria, and the Ministries of Petroleum and Power. It is also evidenced by low levels of collaboration between the essential disciplines of the energy sector.

### The Collaboration of Disciplines

The role of other disciplines in the energy sector has had a mixed reception. Using petroleum as an example, whilst geologists and engineers are necessary to know of the existence of petroleum deposits, and to get them out of the ground, what one does, and how one goes about developing the discovered resources, is now the province of other specializations, notably the accountants, economists and lawyers. All of them will however not get anywhere in the absence of seasoned managers and administrators, operating in line with the frameworks created by the law, based on the advice of the geologists, engineers, accountants, and economists. The same applies to renewable or other forms of energy, - solar, wind, coal, biofuels etc., which require scientific knowledge and activity before exploitation is possible, but which then require the input of other complementary disciplines for the emergence of functional and development-oriented industries. Therefore, the energy industry is one where collaboration of disciplines is vital, if a conducive and develop-prone environment is to emerge. This is yet to be the case in Nigeria, although we have come a long way. For example, until recently, the role of the energy lawyer was barely acknowledged, not to talk of respected. The energy field remained dominated by engineers and geologists who I have earlier described as operating as jacks-of-all-trades, - as accountants, lawyers, and petroleum economists. Committees established to deal with purely legal issues would often be headed by an engineer or geologist. The Memorandum of Understanding is the product of an engineer, which is why Nigeria ended up being in the peculiar position of having fiscal regulations within a private contract that was shrouded in secrecy, and not in legislation, as is the practice practically everywhere else in the world. For the legal profession that jinx was broken with the emergence of the Oil and Gas Sector Implementation Committees established by Presidents Obasanjo and Yar-Adua in 2000 and 2007 respectively.

For both of them, the legal profession played a prominent role. Currently, legal documents

<sup>7</sup>The Lottery of Life:  
Where to be Born in 2013,  
November 12, 2012',  
[www.economist.com/news/21566430-where-be-born-2013-lottery-life](http://www.economist.com/news/21566430-where-be-born-2013-lottery-life)

continue to be drafted by technical persons, but the input of the lawyer is appreciated, and the feel that the law is for the purpose of rubberstamping anything written is, hopefully, receding. Whilst it is important to know how to get a precious resource out of the ground, that is just the beginning. The framework for the optimal exploitation of the resource in question now assumes the utmost importance. For that resource to be useful, and for maximum benefits to be derived, other specializations are necessary, or the structures that will allow for optimal development will never emanate. There have to be laws that govern the use of the resources, and that lay down rights and duties, privileges, incentives and benefits, so that investors, community dwellers and other interested parties will understand and know what may or may not be done. Without clearly laid down laws and regulations showing fiscal requirements, and other matters that make up the investment climate, no serious investor will put in substantial money, irrespective of how many road shows that are undertaken (at taxpayers' expense). Again, no meaningful laws can emerge without input from petroleum accountants and petroleum economists. We can draft the finest laws in the land, but if the fiscals are wrong, they will not achieve their purpose. For the fiscals to derive their ideal purpose of ensuring that as much economic rent as possible accrues to the sovereign state, without dis-incentivizing the investor, you need the energy economist to bring her knowledge to bear, through analyses that examine the resource under different scenarios, nationally and internationally.

It is critically important to understand the economics of that resource, and how to utilize it, even as it is important to appreciate how to derive maximum monetary and other benefits for the people. Unfortunately, in Nigeria, the imperative of these disciplines is yet to fully catch on, which is why, in Nigeria, we have recently been regaled with engineers attempting to state that numbers relating to the use and sales of petroleum and petroleum products are technical matters, further underscoring how the hegemony of the engineering profession has led to the present mess that Nigeria is in, as a resource country characterized by an inability to husband petroleum for the good of its people.

It is time to recognize and give voices and credence to the other disciplines that are vital for the growth and maximum impact of any sector to national development. All plans and strategies must incorporate input from all energy specializations, and those with expertise in management and administration. Were it to be considered as a whole, the pertinent question should arise such as: What is the ideal energy mix for Nigeria, if every Nigerian is to have access to energy services?

### **Petroleum and Nigeria's Energy Mix**

We have an electricity sector that is dominated by reliance on the natural gas industry, which currently lacks structure and coherence due to the absence of a legal and regulatory framework that will provide the framework for development and implementation. The natural gas sector, which forms part of the petroleum industry, is itself hampered by the inertia in the area of petroleum industry reform.

The commencement of reform has remained an illusion for many years. The Petroleum Industry Bill has been drafted and redrafted. Not only has the constant drafting been to no avail, but also there is clearly deterioration, as can be seen from a reading of the present draft. To put it simply, motionless motion is the best description of the current state of petroleum industry reform, with constant talk and allusions to the PIB. There are even pole banners on Bill Clinton Drive, apparently placed by some government entity, advocating the passage of the PIB. What exact purposes do these banners serve? The saddest part of the constant noise and present perceptions about petroleum industry reform and the PIB is that the passage of the Bill is only the beginning.

If the PIB is passed in its present state today, the natural gas industry will be no better, because the provisions of the present draft before the National Assembly do not adequately cater for gas. However, let us assume that it contained excellent provisions that allowed for natural gas use and development. That would be a significant milestone, but would not in any way change the sector significantly in the absence of implementation. A law that has not been implemented is the same as no law at all. This is something that the electricity sector bears witness to. The Power Sector Reform Act 2005 spent several years being totally disregarded and unimplemented. Implementation only commenced a couple of years ago, and is still work in progress. Why is the country so slow to realize that an electricity sector that is dependent on natural gas will continue to function at substandard levels until the emergence of an appropriate

framework for downstream natural gas? I am aware that there is talk of developing a framework for natural gas, and leaving the rest of the petroleum sector to continue to function as it is presently doing. Simply put, that will be extremely difficult, and the result of any effectors in that direction will be just another variant of dysfunctional. Simply put, under present conditions in Nigeria, it is impossible to develop a framework for natural gas alone, and not for crude oil. The entire petroleum sector is in need of reform and there is no alternative to that. Recent revelations should have made that plain. Also, constant vandalisms of gas pipelines provide further evidence. The circumstances that allow constant pipeline damage cannot be addressed through any ring-fenced approach.

If Nigeria chooses not to create a functional and optimal petroleum industry, that does not mean the continuation of the present low levels of generation. There are options. We do not have to use natural gas as the primary feedstock for electricity. Before we became a mono oil economy, Nigerian relied on hydropower. Several countries generate electricity from several other sources, such as coal, hydropower, nuclear, wind and solar energy. To give an example, Norway, notwithstanding its gas reserves, as a matter of policy, exports large volumes of crude oil and natural gas, and relies on an energy mix that includes substantial amounts of hydropower and to a growing extent, wind power. Several countries use coal-fired plants, such as the very different countries of Denmark and China. Furthermore, the inaccessible communities in off-grid locations in Nigeria may never have electricity in the absence of an energy mix that utilizes renewable such as solar and wind energy. The present challenges are how to surmount the present obstacles resulting from poor natural gas supply, which has come about because of the continued failure to reform the petroleum industry; how to ensure that, within the decade of Sustainable Energy for All (SEFA), Nigerians are liberated from the present tyranny of self-generation; and that as many Nigerians as possible have access to energy services.

However, we are an oil-rich country, with abundant resources that have so far, not benefitted the generality of Nigerians. That should make the attainment of sustainable development much easier. The present legal and institutional frameworks have locked in the treasures of petroleum. Until we rebuild those frameworks, it will continue to benefit an infinitesimal few members of the influential and rentier classes, and to impoverish the average Nigerian. Petroleum industry reform is the key to unlock development for the entire country, because energy access is the most fundamental requirement for the development of Nigeria and Nigerians. It is hoped that Nigeria will, at last, recognize and wake up to this fact. As a Nigerian proverb says, it is when you wake up that it is morning. Surely our morning is overdue. The Nigerian Association of Energy Economics has a very relevant role in ensuring that dawn emerges in the energy sector presently one of the darkest areas of our economy, and one that is impeding our sustainable development.

I pray for successful deliberations and pivotal conclusions that will positively impact on decisions pertaining to Nigeria and the energy sector, and that will stimulate sustainable energy for all Nigerians within the decade of SEFA.

Once again, thank you very much for this great honour.

God bless Nigeria.

## ABOUT NIGERIAN ASSOCIATION FOR ENERGY ECONOMICS (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 100 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.

### MISSION STATEMENT

The Association is a nation-wide 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 consideration.

### 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;
- \* Fosters an improved understanding of energy economics and energy related issues by all interested parties, and;
- \* Provides a forum for contribution to national discourse on energy policy issues in Nigeria.

### Activities of the NAEE

The NAEE will achieve its objectives through the following activities:

- \* Publication of Professional Journal, Books, Newsletter and Press release.
- \* Organizing seminars, Conferences, Workshops, Public Lectures and other similar fora.
- \* Meeting 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
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11. IAEE Website
12. IAEE membership
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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.

### NAEE ACCOUNT DETAILS

**Bank Name:** Guaranty Trust Bank Plc.  
**Account Name:** Nigerian Association for Energy Economics  
**Account Number:** 0110538168  
**Sort Code:** 058152052  
**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](http://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](http://www.iaee.org). Payment can be made online, Membership form can be downloaded from these websites.

**Contact:** for more information you can write directly to:

Nigerian Association for Energy Economics (NAEE)

**c/o Professor Adeola Adenikinju**

Department of Economics

University of Ibadan

Ibadan

Tel: +2348053527260, +2348023440018

Email: [president@naee.org.ng](mailto:president@naee.org.ng)

[af.adenikinju@ui.edu.ng](mailto:af.adenikinju@ui.edu.ng)

[adeola.adenikinju@naee.org.ng](mailto:adeola.adenikinju@naee.org.ng)

### Programme Officer

Nigerian Association for Energy Economics (NAEE)

Email: [admin@naee.org.ng](mailto:admin@naee.org.ng)

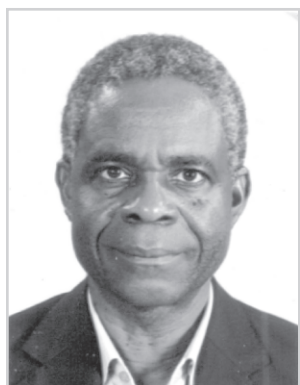
### Nigerian Association for Energy Economics (NAEE) PUBLICATIONS

1. Energy, Environment & Economic growth (2010) Price: N1,500.
2. Green Energy and Energy Security: Options for Africa (2011) Price: N1,500.
3. Energy Technology and Infrastructure for Development (2012) Price: N2,000.
4. Energy Resource Management in a Federal System (2013) Price: N2,500
5. Energy Access and Economic Development: Policies, Institutional Framework and Strategic Options (2014) Price: N3,000
6. Solving Nigeria's Energy Puzzle: Why Economic Analysis Matters : N200

**NOTE: These prices are only available at the conference.**

## Distinguished Personality

### Professor Akin Iwayemi, FNAEE



Akin Iwayemi graduated with B.Sc. (Economics), First Class degree from the University of Ibadan in 1969. He got the Ph.D degree in Economics from the Johns Hopkins University, Baltimore, U.S.A. in 1975. He joined the University of Ibadan in 1975 and rose to become a Professor of Economics in the Department of Economics. While on leave of absence from the University, he served as Petroleum Industry Financial Analyst in OPEC between 1983 and 1988. He returned to his teaching and research position at the University of Ibadan in November 1988. He retired in October 1, 2011. He is currently involved in teaching and research at the Centre for Petroleum Energy Economics and Law (CPEEL), University of Ibadan.

His research and teaching interests include energy, environmental and development economics as well as political economy and game theory. He has published extensively in these areas in international and national journals, monographs and books. He has consulted widely for government, private sector and international organizations on energy, environment, and other development issues affecting Nigeria and the Africa region.

Professor Iwayemi is the immediate past President of the Nigerian Economic Society (2011-2013), a past President of the African Econometric Society (2007-2009) and the immediate past President of the Nigerian Association for Energy Economics (2007-2011). Professor Iwayemi is also a member of the Nigerian Economics Society, International Association for Energy Economics, the Nigerian Association for Energy Economics and African Econometric Society. He is currently an Associate Editor of the African Development Review. He was a founding member of Editorial Board of the Journal "Economics of Energy and Environmental Policy" published by IAEE.



# Glimpses from the 7th Annual NAEE/IAEE International Conference

16-18 February, 2014, Sheraton Hotel, Abuja



Dignitaries at the Conference



Dignitaries at the Conference



Cultural Dance



Student Delegates



Registration



Registration in progress



Cross section of participants



Cross section of participants



Cross section of participants



NAEE President with ABU Students



Student Participants



Student Delegates



Participants at a Session



IAEE & NAEE President with UI Students



IAEE President with Emerald Energy Institute Students



Cross section of participants



Prof. Adeola Adenikinju, NAEF President



Keynote Speaker Professor Yinka Omorogbe, (NIALS), Abuja



Chairman, Professor Soji Adelaja, Special Adviser on Economic Intelligence



Delegates



Dignitaries at the Dinner



Dignitaries at the Conference



NAEF President with CPEL Students



NAEF President with Bowen Students



Cross section of participants



NAEF President with Prof. Chinedu Nedo, Min. of Power at Cpeel Exhibition during the 7th NAEF Conference, Abuja.



Registration Desk



Participants



Cross section of participants



Cross section of participants

**ENERGY PROFESSIONALS**

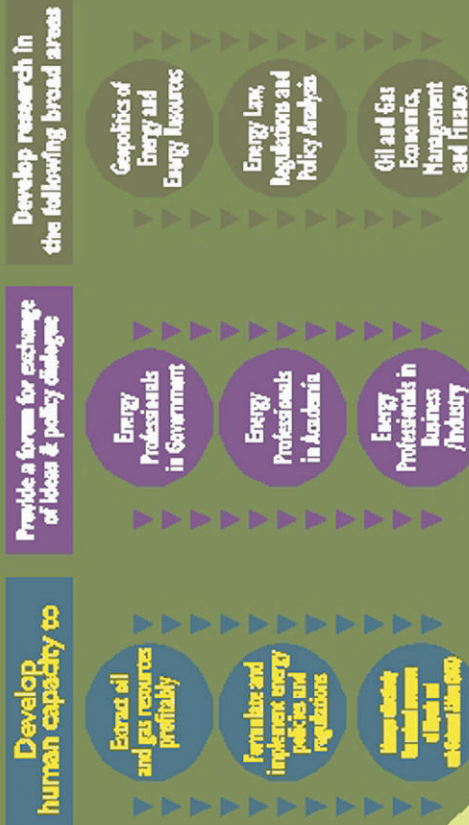
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