

Energy Options for Sustainable Economic Growth in Nigeria: *Status, Issues and the Way Forward* *

By

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Environmental Protection and Sustainable Development

Outline

- **Introduction**
- **Energy & Economy in Nigeria**
- **Status of the Nigerian Energy System**
- **Energy Supply Options for Sustainable Development**
- **Challenges**
- **The Way Forward**
- **Conclusion**

SIGNIFICANCE OF PRESENTATION

1. Draft National Environmental (Energy Sector) Regulations 2013;
2. Application of up-to-date, Best Practicable Environmental Option, Cleaner Production and Green Technologies to reduce pollution;
3. Promotion of Sustainable Technologies, cleaner production processes to yield economic, social and environmental benefits

1. Introduction

- **Energy is central to the economic growth, national security and environmental protection of all nations.**
- **Nigeria, abundantly blessed with all energy types, has the challenges of supplying, transforming, delivering and effective use of energy services to achieve sustainable growth and development.**
- **Current patterns of energy production and consumption are unsustainable and threaten the environment at local, national and global levels.**
- **As long as the primary energy supply mix is biased towards fossil fuels, it would be difficult to achieve sustainable economic growth with the current fossil fuel-based energy technologies.**

1. Introduction...Contd

- **Given that the nation's economy is expected to double in size over the next twenty years, the nation's consumption of energy will also increase significantly even with its highly inefficient supply, conversion and use.**
- **It is therefore important to look closely into our energy system and accord priority attention to new and renewable energy systems, and increased end-use efficiency, while promoting clean fossil fuel technologies.**

2. Energy and Economy in Nigeria

Fossil and Nuclear Type Energy Resources

S/No	Resource Type	Reserves (Natural Units)	Production in 2008	Domestic utilization in 2008
1.	Crude Oil	36.2 billion barrels	0.723 billion barrels	0.164 billion barrels
2.	Natural Gas	187 Tscf	2.28Tscf	59.1% domestic utilization 26.8% flared 14.1% exported
3.	Coal and lignite	2.7 billion tonnes	0	0.0081million tonnes only
4	Tar sands	31 billion barrels of oil equipment	0	0.224million tonnes
5	Nuclear	Yet to be quantified	0	30kW research reactor

Source: CBN, 2008; NBS, 2009

2. Energy and Economy in Nigeria ...Cont'd

Renewable Energy Potentials

Resource	Potential	Remark
Large Hydropower	11,500 MW	1972 MW exploited
Small Hydropower	3,500 MW	64.2 MW exploited
Solar	4.0 kW/m/day – 6.5 kW/m ² /day	Refer to solar radiation map
Sunshine Hrs	(4-7.5)hrs/day	
Wind	2-4 m/s @ 10m height mainland	Electronic Wind Information system (WIS) available
Biomass	<ul style="list-style-type: none"> o Municipal Waste o Fuelwood 	<ul style="list-style-type: none"> o 18.5million tonnes produced in 2005 o 43.4 million tonnes/yr fuelwood consumption
	Animal Waste	245 million assorted in 2001
	<ul style="list-style-type: none"> o Agric Residue o Energy crops 	<ul style="list-style-type: none"> o 91.4millin tonnes /yr produced o 28.2 million hectares of arable land; 8.5% cultivated

2. Energy and Economy in Nigeria ...Cont'd

Energy Production

S/No	Type	2003	2004	2005	2006	2007	2008
1.	Coal (million tonnes)	0	0	0	0	0	0
2.	Oil (million barrels/ day)	2.3	2.5	2.5	2.2	2.2	2.0
3.	Natural Gas (billion m ³)	52.8	59.8	58.4	61.8	70.1	63.8
4.	Natural Gas flared (billion m ³)	23.3	24.2	23.0	22.3	21.8	17.1
5.	Electricity Generation (billion kWh)	22.03	23.9	24.22	23.8	23.3	21.27

Source: CBN, 2006 & 2008; NBS, 2007 & 2009

2. Energy and Economy in Nigeria ...Cont'd

Energy Consumption

S/No	Type	2003	2004	2005	2006	2007	2008
1.	Coal (%)	0.03	0.03	0.03	0.05	0.05	0.05
2.	Hydro (%)	14.20	17.39	12.02	17.03	23.90	19.05
3.	Natural gas (%)	1.90	4.54	5.50	7.52	8.72	15.20
4.	Petroleum Products (%)	83.87	78.04	82.45	75.45	68.33	65.70
5.	Total (Mtoe)	19.11	16.27	17.7	12.20	11.39	12.04

Source: CBN, 2006 & 2008

2. Energy and Economy in Nigeria ...Cont'd

Energy and the Economy

S/ N	Indicator	2003	2004	2005	2006	2007	2008
1	Real GDP Growth (%)	9.6	6.6	6.5	6.0	6.2	6.4
2	<ul style="list-style-type: none"> o Major Contributors to GPD @ 1990 Constant Prices: <ul style="list-style-type: none"> ▪Agriculture (%) ▪Crude Petroleum (%) o Major Contributor to Federal revenue (net) <ul style="list-style-type: none"> ▪Crude Petroleum (%) 	41.010 26.53	40.98 25.72	41.19 25.26	41.72 21.85	42.20 19.35	42.07 17.54
3	Energy Intensity (kgoe/\$) (Energy Consumption/GDP)	0.244	0.186	0.157	0.086	0.063	0.069
4	GPD/Capita (US\$)	620.9	673.2	847.4	1,036.2	1,256.6	1,176.1
5	Energy Consumption/Capita (kgoe/capita)	151.3	125.5	132.6	87.1	81.4	80.8
6	Electricity consumption/capita (kWh/capita)	174.6	176.4	181.4	167.6	161.2	142.9
7	Electricity Access (%)	55.2% from 40% in 1993					

Source: CBN, 2006& 2008; NBS, 2009

3. Status of the Nigerian Energy System

- **Nigeria currently has :**
 - **26 generating plants**
 - **22 thermal and 4 hydro plants**
 - **Over 5,500km of 330kV line**
 - **Over 6,500km of 132kV line**
 - **Over 6,500MVA transformer capacity at 330/132kV**
 - **Over 8,500MVA transformer capacity at 132/33kV**

INVENTORY OF POWER STATIONS IN NIGERIA.

S/N	NAME OF STATION	STATE	TECHNOLOGY	NAME PLATE CAPACITY	YEAR OF INSTALLATION
1.	AES Barge, Egin.	Lagos	Simple Cycle Gas Turbine.	270 MW	2001
2.	Aba Power Station.	Abia	Simple Cycle Gas Turbine.	140 MW	2012
3.	Afam IV - V Power Station.	Rivers	Simple Cycle Gas Turbine	726MW	1982 -2002
4.	Afam VI Power Station	Rivers	Combined Cycle Gas Turbine	624MW	2007 - 2010
5	Alaoji Power Station	Abia	Combined Cycle Gas Turbine	1074MW	2012 - 2015
6.	Calabar Power Station	Cross River	Simple Cycle Gas Turbine	561MW	2014
7.	Egbema Power Station	Imo State	Simple Cycle Gas Turbine	338MW	2012 - 2013
8.	Egbin Thermal Power Station	Lagos	Gas-Fired Steam Turbine	1320MW	1985 - 1986
9.	Geregu I Power Station	Kogi	Simple Cycle Gas Turbine	414MW	2007
10.	Geregu II Power Station	Kogi	Simple Cycle Gas Turbine	434MW	2012
11.	Ibom Power Station	Akwa Ibom	Simple Cycle Gas Turbine	190MW	2009

INVENTORY OF POWER STATIONS IN NIGERIA Contd.

S/N	NAME OF STATION	STATE	TECHNOLOGY	NAME PLATE CAPACITY	YEAR OF INSTALLATION
12.	Ihovbor Power Station	Edo	Simple Cycle Gas Turbine.	450 MW	2012 - 2013
13.	Okpai Power Station		Combined Cycle Gas Turbine.	480MW	2005
14.	Olorunsogo I Power Station	Ogun	Simple Cycle Gas Turbine	336MW	2007
15.	Olorunsogo II Power Station	Ogun	Combined Cycle Gas Turbine	675MW	2012
16.	Omoku I Power Station	Rivers	Simple Cycle Gas Turbine	150MW	2005
17.	Omoku II Power Station	Rivers	Simple Cycle Gas Turbine	225MW	2013
18.	Omotosho I Power Station	Ondo	Simple Cycle Gas Turbine	336MW	2005
19.	Omotosho II Power Station	Ondo	Simple Cycle Gas Turbine	450MW	2012
20.	Sapele I Power Station	Delta	Gas-Fired Steam Turbine	1020MW	1978 - 1981
21.	Sapele II Power Station (NIPP)	Delta	Simple Cycle Gas Turbine	450MW	2012
22.	Delta (Ughelli) Power Station	Delta	Simple Cycle Gas Turbine	900MW	1966 - 1990

INVENTORY OF POWER STATIONS IN NIGERIA (Hydro)

S/N	NAME OF STATION	STATE	TECHNOLOGY	NAME PLATE CAPACITY	YEAR OF INSTALLATION
23.	Kanji Power Station	Niger	Hydro-Electric Turbine.	760 MW	1968
24.	Jebba Power Station	Niger	Hydro-Electric Turbine.	540MW	1985
25.	Shiroro Power Station	Kaduna	Hydro-Electric Turbine	600MW	1990
26.	Zamfara Power Station	Zamfara	Hydro-Electric Turbine	100MW	2012
	HYDRO POWER STATIONS UNDER CONSTRUCTION				
1.	Kano Power Station	Kano	Hydro-Electric Turbine.	100	2015
2.	Kiri Power Station		Hydro-Electric Turbine.	35	2016
3.	Mambilla Power Station	Adama wa	Hydro-Electric Turbine	3050	2018

3. Status of the Nigerian Energy System.. Contd.

The current status of energy provision presents the following challenges:

- **Inadequate generation availability**
- **Inadequate refining capacity**
- **Inadequate and delayed maintenance of facilities**
- **Insufficient funding of power stations**
- **Obsolete equipment, tools and safety facilities**
- **Inadequate and obsolete communication equipment**
- **Low national energy mix**
- **Low staff morale**

3. Status of the Nigerian Energy System .. Contd



4. Energy Supply Options For Sustainable Development In Nigeria

The Nation's policy framework on sustainable energy supply should focus on:

- Expanded access to modern energy services,**
- Promotion of energy efficiency and conservation,**
- Development of renewable and alternative energy resources, and**
- Deployment of clean fossil fuel technologies.**

4. Energy Supply Options for Sustainable Development: Hydropower... Cont'd

Nigeria with a hydropower potential of about 15,000MW has about 2000MW only exploited. About 13,000MW needs to be developed fully. This is an option that needs to be pursued with all urgency and vigour



4. Energy Supply Options for Sustainable Development: SOLARCont'd

- **Nigeria is in the high solar radiation belt of the world, with annual average of about 3.5 kWh/m²-day in the coastal latitudes and about 7.0 kWh/m²-day in the far north of the country.**
- **The Energy Commission of Nigeria through its Energy Research Centres has developed various solar energy technologies that are ready for commercial production and adoption into the national economy. Some of which include: Solar PV applications, Solar water heaters, Solar Dryers, Solar Chicken Brooders, Water Distillers, and Solar thermal refrigerators.**



Solar PV mini-grid in a village in Sokoto, Sokoto State



Solar Street Lighting in Uyo, Cross River State



Solar Water Pumping for Students in Sokoto, Sokoto State



Solar PV at Itu.Mbuzo, Abia State

4. Energy Supply Options for Sustainable Development –WIND ENERGYCont'd

Wind energy speeds in the country at 10 m height shows that some sites have between 1.0 to 5.1 m/s.

Wind speeds range from a low 1.4 – 3.0 m/s in the Southern areas and 4.0 – 5.1 m/s in the extreme North.

Peak wind speeds generally occur between April and August for most sites.

Preliminary study shows that the total actual exploitable wind energy reserves at 10 m height, may vary from 8.0 MWh/yr in Yola to 51.0 MWh/yr in the mountain areas of Jos Plateau and its is as high as 97.0 MWh/yr in Sokoto



5kW aero generator in Sayya Gidan Gada, Sokoto State



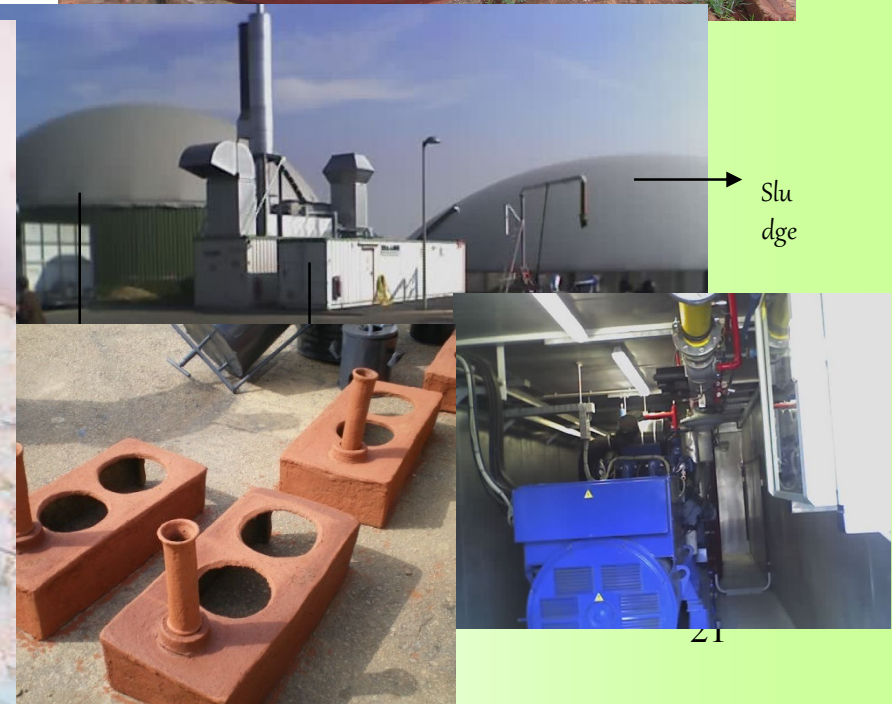
Harnessing Wind Energy for Electricity Generation in Brazil



305 MW Wind Farm at Zanfrana, along the Red Sea, Egypt

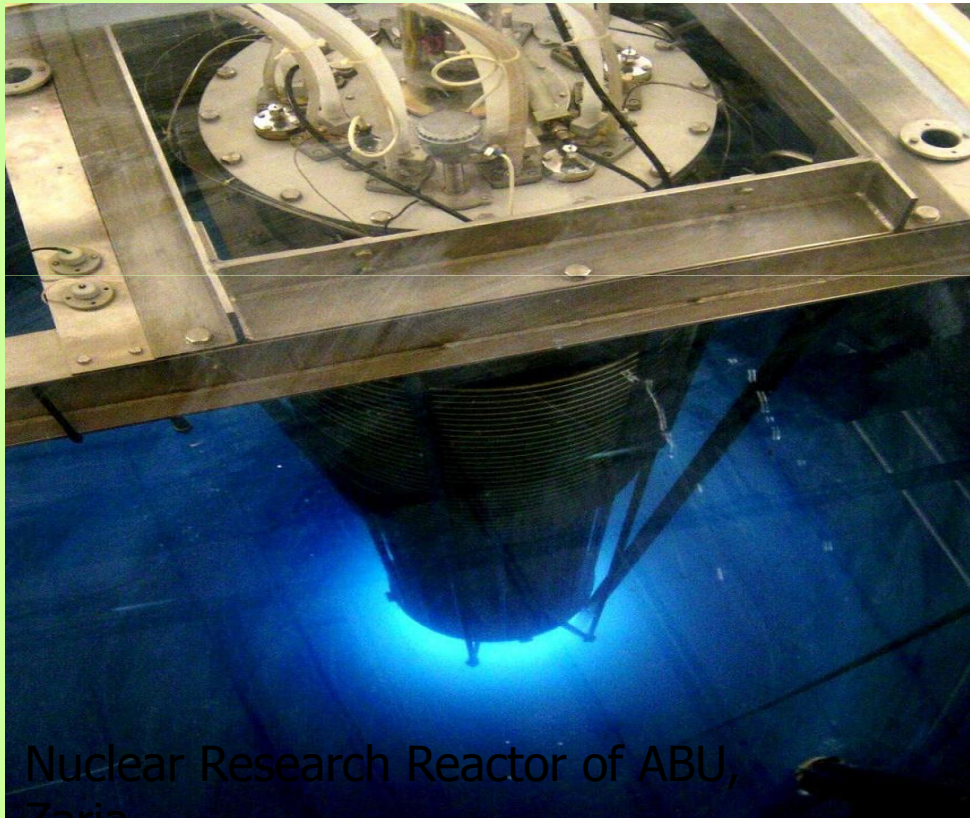
4. Energy Supply Options for Sustainable Development - BIOMASSCont'd

- Biomass refers to organic matter of non-fossil type. It may be gasified and used as a cleaner fuel for heating and power generation or liquefied to form biofuel for transportation
- Sustainable use of biomass in environmentally friendly manner could be used for increasing quality of life, combating CO₂ emissions and protecting the ecosystem.
- This requires converting the biomass and/or organic waste streams into an energy carrier such as cooking gas, electricity, methanol, hydrogen or bio-diesel.



Energy Supply Options for Sustainable Development - Nuclear

- It is obvious that the use of nuclear energy does not contribute to the emission of CO₂; hence, generating electricity from radioactive materials can be a very good step towards mitigating GHGs emissions/climate change



Nuclear Research Reactor of ABU,
Zaria



Tandem Accelerator of
OAU, Ife

4. Other Energy Supply Options for Sustainable Development in NigeriaCont'd

- **Hydrogen/Fuel cells:**

Hydrogen is a fuel that is produced through reforming of organic compounds or electrolysis of water, since it does not occur naturally as a gas. This is still at the R & D stage.

- **Clean Coal Technologies:**

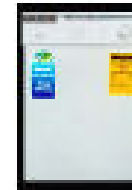
Between 1916 and 1958/59 coal was the main source of energy for rail transportation, power generation and domestic heat production. But, coal has since been abandoned with the emergence of commercial crude oil. Efforts are on to reverse this scenario

Sustainable Energy Systems – Energy Efficiency

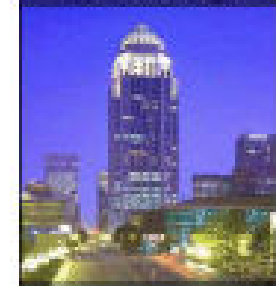
■ Energy efficiency improvement is an important CO2 mitigation strategy;

■ Manufacturing Energy-Efficient appliances and equipment is essential for sustainable development;

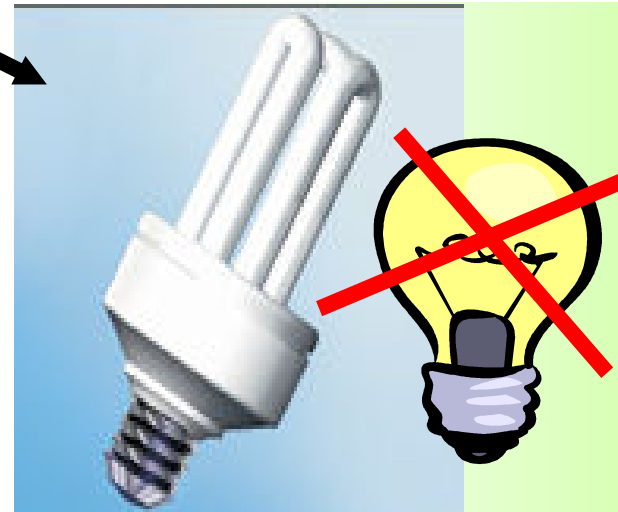
products



buildings



homes



**ENERGY EFFICIENCY AND CONSERVATION
FOR SUSTAINABLE DEVELOPMENT**

5. Challenges Of Sustainable Energy Supply Options

- **High initial investment costs of sustainable energy supply systems**
- **Inadequate human capacity to support introduction and development of new sustainable energy supply systems**
- **Slow and inconsistent implementation of reforms in the energy sector**
- **Inadequate financial support for new sustainable energy supply systems**
- **Lack of legal instrument that supports introduction and development of new sustainable energy supply systems.**

6. Way Forward

- **The National Energy Policy (NEP) of 2003 and its master plan referred to as the National Energy Master Plan (NEMP) need to be reviewed and passed into an Energy Law.**
- **The on-going reforms in the oil, gas, and power sub-sectors of the country should be pursued with vigour.**
- **Existing under utilized energy infrastructure in the country should be rehabilitated and upgraded to operate at optimum conditions.**
- **New energy infrastructure should be put in place in the country at a faster rate.**
- **The energy supply mix into the economy should be diversified to include nuclear, coal, solar, wind, biomass and biofuels.**

6. Way Forward ... Cont'd

- **Energy conservation and efficiency technologies should be encouraged as a means of effective management of available energy.**
- **Continuous capacity building in the entire spectrum of energy development should be pursued with all seriousness.**
- **Adequate and appropriate incentives to be established to attract private funds in the development of the energy sector.**
- **Continued constructive engagement with the Niger-Delta communities.**

Thank You