

RENEWABLE ENERGY PROFILE AND CAPACITY IN NIGERIA



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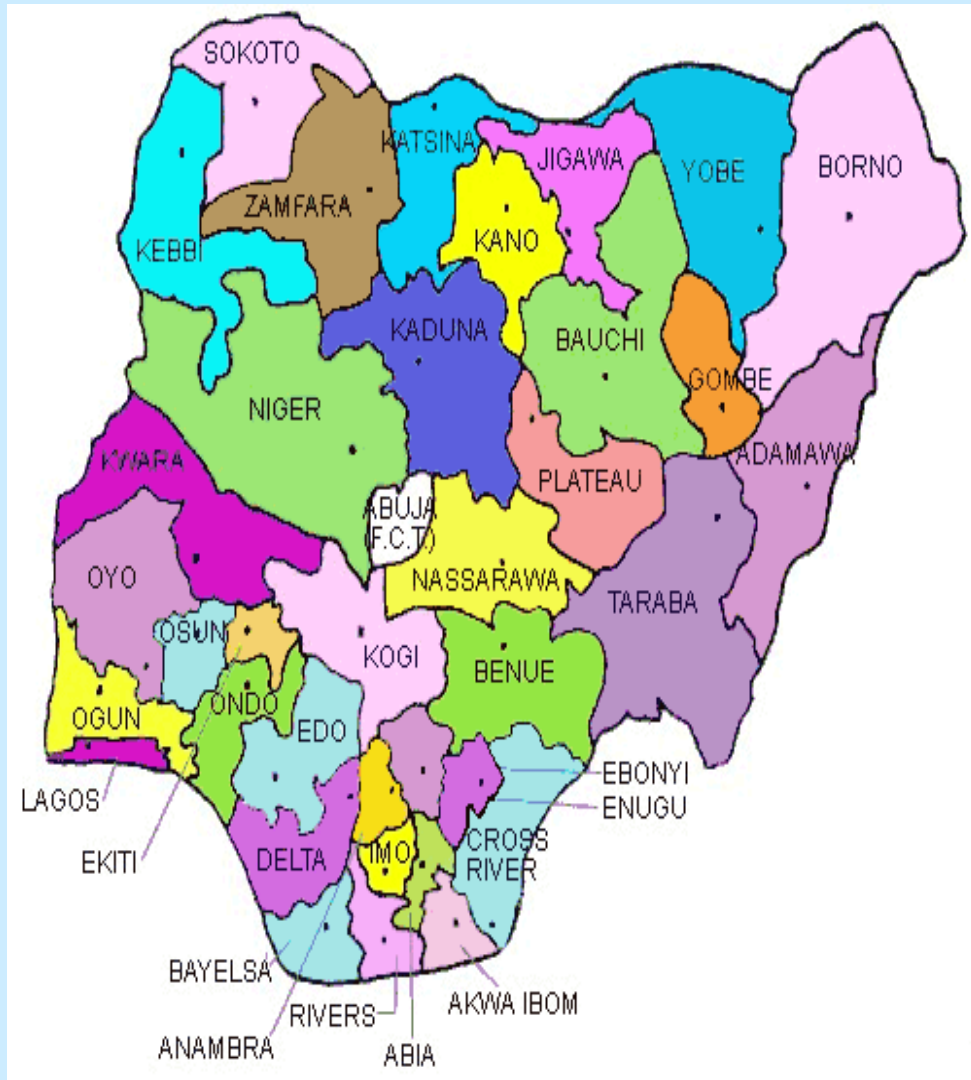
FEDERAL MINISTRY OF POWER, ABUJA NIGERIA

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1. COUNTRY PROFILE



a) Geography

- Nigeria is one of the 54 African countries situated in Sub-Saharan Africa. Nigeria lies within latitudes 4.32° N and 14° N and longitudes 2.72° E and 14.64° E with land area of about 924,000 sq km, which is about 3.1% of African land area.
- The population is about 140 million, which is about 15% of the continent's population.
- Nigeria is a Federal Republic, made up of 36 States and the Federal Capital Territory (FCT), which serves as the seat of the Federal Government.
- Government is operated through the presidential system, similar to that in North America.

Vegetation

Nigerian vegetation is mainly forests (salt water swamp and fresh water swamp) and savannah (Guinea, Sudan and Sahel)

1. Country Profile

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b) Economic Indicators

S/N	Indicator	2003	2004	2005	2006	2007
1.	Real GDP Growth (%)	9.6	6.6	6.5	6.0	6.2
2.	Inflation Rate (%)	23.8	10.0	11.6	8.5	6.6
3.	Monetary Policy Rate (%)	15.0	15.0	13.0	10.0	9.5
4.	Prime Lending Rate (%)	19.6	18.9	17.8	17.3	16.94
5.	a) Major Contributors to GDP @ 1990 Constant Basic Prices: ▪ Agriculture (%) ▪ Crude Petroleum (%)	41.010	40.98	41.19	41.72	42.20
	b) Major Contributor to foreign Exchange earnings ▪ Crude Petroleum (%)	26.53	25.72	25.26	21.85	19.35
		95.2	96.3	98.3	98.2	97.8
6.	Energy Intensity (kgoe/\$) [Energy Consumption/GDP]	0.244	0.186	0.157	0.086	0.063

Source: CBN (2007)

(c) Social Indicators

S/N	Indicator	2003	2004	2005	2006	2007
1.	GDP/Capita (US\$)	620.9	673.2	847.4	1,036.2	1,256.6
2.	Energy Consumption/capita (kgoe/capita)	151.3	125.5	132.6	87.1	81.4
3.	Electricity consumption/capita (kWh/capita)	174.6	176.4	181.4	167.6	-
4.	Electricity Access (%)				55.2% from 40% in 1993	
5.	Population growth rate (%)	2.8	2.8	2.8	3.2	3.2
6.	Adult literacy rate (%)	57.0	62.0	57.0	64.2	64.2
7.	Incidence of poverty (%)	-	54.4	54.4	54.0	54.0
8.	Life expectancy (yrs)	54.0	54.0	54.0	54.0	54.0

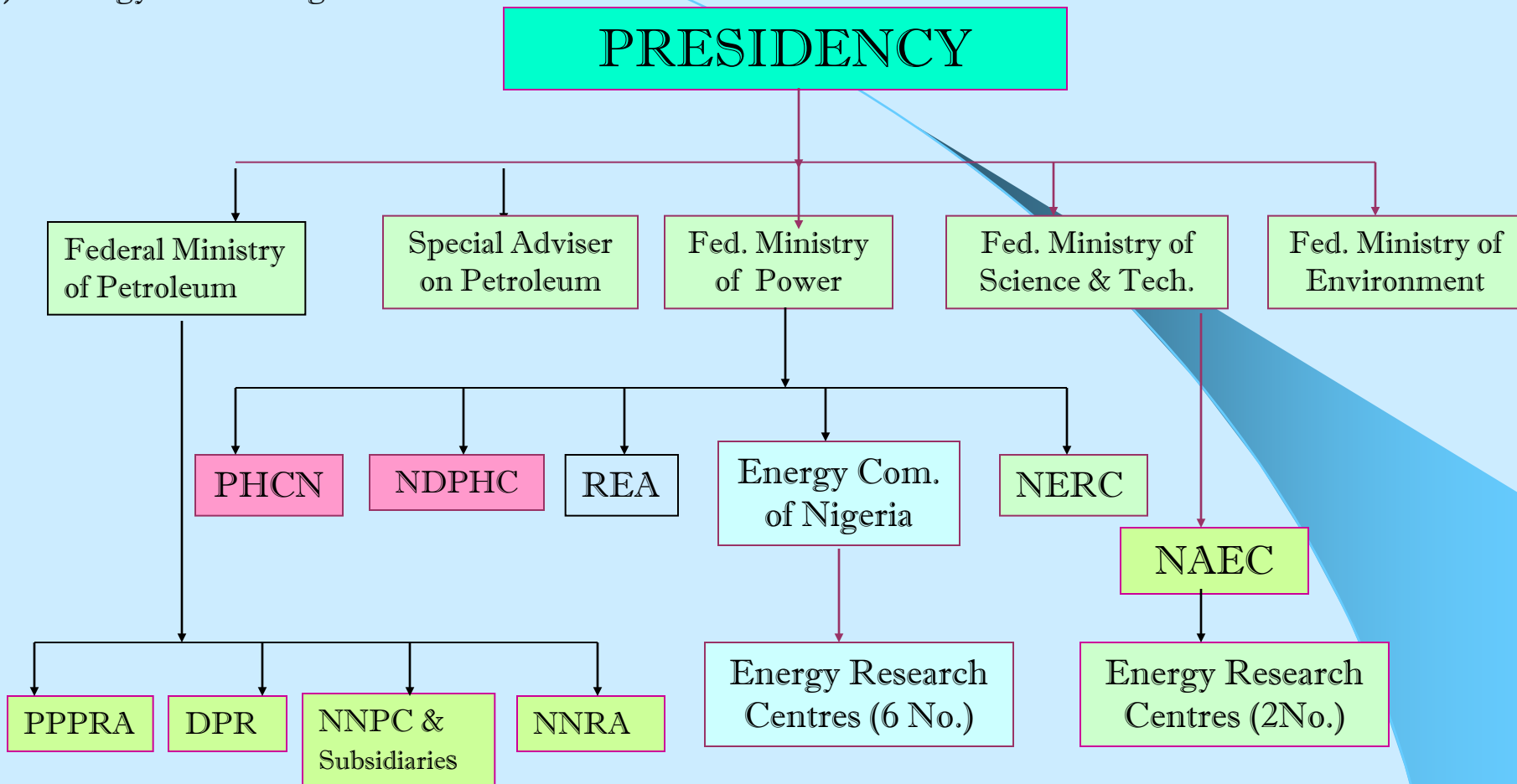
Source: Central Bank of Nigeria (CBN) (2007)
National Bureau of Statistics (NBS) (2007)

1. Country Profile

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d) Energy Sector Organization



KEY:

- PHCN Power Holding Company of Nigeria
- NDPHC Niger Delta Power Holding Company
- REA Rural Electrification Agency
- DPR Department of Petroleum Resources
- NERC Nigerian Electricity Regulatory Commission
- NAEC Nigerian Atomic Energy Commission
- NNRA Nigerian Nuclear Regulatory Agency
- PPPRA Petroleum Product Pricing Regulatory Agency
- NNPC Nigerian National Petroleum Corporation

2 ENERGY SUPPLY SITUATION

(a) Primary Energy Resources (2008)

S/No.	Resource Type		Reserves (Natural Units)
1.	Crude Oil		36.22 billion barrels
2.	Natural Gas		187 trillion SCF
3.	Coal and lignite		2.734 billion tonnes
4.	Tar Sands		31 billion barrels of oil equivalent
5.	Large Hydropower		11,250 MW
6.	Small Hydropower		3,500 MW
7.	Solar Radiation		3.5 - 7.0 kWh/m ² /day (485.1 million MWh/day using 0.1% Nigeria land area)
8.	Wind		(2-4) m/s at 10m height
9.	Biomass	Fuelwood	11 million hectares of forest and woodland
		Animal waste	245 million assorted in 2001
		Energy Crops and Agric Residue	72 million hectares of Agric. Land
10.	Nuclear Element		Not yet quantified

Sources: (i) Nigerian National Petroleum Corporation (NNPC) 2007
(ii) Renewable Energy Masterplan (REMP) 2005
(iii) Ministry of Mines and Steel Development (2008)

2 Energy Supply Situation Cont'd

(b) Energy Production in Nigeria

S/N	Type	2003	2004	2005	2006	2007
1.	Coal (million tonnes)	0	0	0	0	0
2.	Oil (million barrels/day)	2.3	2.5	2.5	2.2	2.2
3.	Natural gas (billionm ³) (% flared)	52.75 (44.1%)	59.76 (40.4%)	58.35 (39.4%)	61.80 (36.1%)	70.1 (31.1%)
4.	Electricity Generation (Twh)	22.03	22.92	24.22	23.47	16.94

Sources: (i) Central Bank of Nigeria (CBN) 2007
(ii) www.Opec.org/Library
(iii) National Bureau of Statistics (NBS) (2007)

- Though Nigeria has a resource of 2.7 billion tonnes of coal, production declined from a peak of 0.91 million tonnes in 1959 to no production in 2001, because of petroleum, which was discovered in commercial quantities in 1956

2 Energy Supply Situation Cont'd

(c) Energy Consumption by Type

Energy Consumption by Type and % of Total

S/N	Type	2003	2004	2005	2006	2007
1.	Coal (%)	0.03	0.03	0.03	0.05	0.05
2.	Hydro (%)	14.2	17.39	12.0	17.03	23.90
3.	Natural gas (%)	1.9	4.54	5.50	7.52	8.73
4.	Petroleum Products (%)	83.87	78.04	82.50	75.44	67.53
5.	Total (Mtoe)	19.11	16.27	17.7	12.20	11.39

Source: Central Bank of Nigeria (CBN) (2007)

- Petroleum products is the widely consumed energy type and the largest amount of that consumed is imported, despite the country's status as the largest oil producer in Africa.

2 Energy Supply Situation Cont'd

(d) Energy Consumption by Sector -

(i) Percentage Electricity Consumption by Sector

S/N	Sector	1988	1989	1990	1995	1999	2002
1.	Industrial (%)	30.2	30.2	25.7	21.9	21.7	24.1
2.	Commercial & Street Lighting (%)	12.8	12.8	23.8	25.6	26.8	25.9
3.	Residential (%)	57.0	57.0	50.5	52.5	51.5	50.0
	Total (million kWh)	7.865	8.854	7.944	9.435	8.576	12.118

Source: Central Bank of Nigeria (CBN) (1990), Federal Office of Statistics (FOS) (2002)

- Domestic or residential sector has been the largest consumer of electricity in the country.

2 Energy Supply Situation Cont'd

(ii) Projected Sectoral Energy Demand in Nigeria based on 7% Growth Rate

S/N	Sector	2005 (Base Yr)	2010	2015	2020	2025	2030
1.	Industry (%)	13.81	28.92	37.01	40.75	44.69	48.78
2.	Transport (%)	30.80	27.62	24.56	22.92	22.27	21.62
3.	Household (%)	49.23	38.16	33.05	30.62	27.27	24.12
4.	Services (%)	6.13	5.30	5.39	5.72	5.78	5.49
	Total (mtoe)	32.14	49.92	76.45	112.67	158.95	224.54

Source: Energy Commission of Nigeria (2008)

- These projections are based on the Model for the analysis of energy Demand (MAED) of the IAEA.
- The projections are also based on the preferred scenarios of development for the country, where industry would make the highest contribution to GDP.

2 Energy Supply Situation Cont'd

(iii) Projected Sectoral Energy Demand in Nigeria based on 13% Growth Rate

S/N	Sector	2005 (Base Yr)	2010	2015	2020	2025	2030
1.	Industry (%)	13.81	27.91	40.87	51.91	62.89	71.39
2.	Transport (%)	30.80	26.78	23.24	20.86	18.55	16.51
3.	Household (%)	49.23	38.46	28.84	21.26	14.08	8.95
4.	Services (%)	6.13	6.86	7.05	5.97	4.48	3.15
	Total (mtoe)	32.14	59.45	109.97	202.74	387.52	747.27

Source: Energy Commission of Nigeria (2008)

- This is the preferred economic growth rate by the Government to meet its aspirations.

3. Renewable Energy Development in Nigeria

- The country now has three (3) large hydropower stations as follows:

S/N	Name of Hydro Power Plant	Year Established	Installed Capacity (MW)
1.	Kainji	1968	760
2.	Jebba	1986	578
3.	Shiroro	1990	600
Total			1,938 MW

3. Renewable Energy Development in Nigeria Cont'd

(b) Policy Framework

- In 2003, the Federal Government approved a National Energy Policy, which encourages the optimum utilization of the country's energy resources, including renewable, for sustainable national development with the active participation of the private sector. For example, the following policies are articulated for solar energy, biomass and wind:

Solar Energy :

- Abundant solar radiation 4kWhr/m² to 6kWhr/m²
 - The nation shall aggressively pursue the integration of solar energy into the nation's energy mix
 - The nation shall keep abreast with worldwide developments in solar energy technology.

3. Renewable Energy Development in Nigeria Cont'd

(b) Policy Framework Cont'd

- Biomass:

- The nation shall effectively harness non-fuelwood biomass energy resources and integrate them with other energy resources
- The nation shall promote the use of efficient biomass conversion technologies.

- Wind:

- The nation shall commercially develop its wind energy resource and integrate this with other energy resource.
- The nation shall take necessary measures to ensure that this form of energy is harnessed at sustainable costs to both suppliers and consumers in the rural areas.

3. Renewable Energy Development in Nigeria Cont'd

(b) Policy Framework Cont'd

- In 2005, the Energy Commission of Nigeria in collaboration with the United Nations Development Programme (UNDP) drafted a Renewable Energy Masterplan from the National Energy Policy strategies. The masterplan provides a roadmap or activities that will enable the implementation of the policies on renewable energy, with targets/milestones and timelines in the short, medium and long terms.
- In 2007, a biofuel policy initiated by the country's National Petroleum Corporation (NNPC), was approved by the Federal Government. The policy articulates amongst other things, a seeding, programme within which up to 10% mixture of ethanol in premium motor spirit (E10) and 20% of biodiesel in petro-diesel (B20) by volume are to be imported and used as automotive fuels in the country.

3. Renewable Energy Development in Nigeria Cont'd

(c) Regulation and Legislature

- Major renewable energy applications in Nigeria are in the areas of:
 - Electricity production
 - Biofuel for transportation
 - Other thermal applications (cooking, drying, heating, etc.)
- The coordination of the national policies on energy in all its ramifications rests on the Energy Commission of Nigeria, established by law in 1979.
- Generally, the Nigerian electricity sector was liberalised by the Electric Power Sector Reform Act of 2005, and a strong regulatory institution, the Nigerian Electricity Regulatory Commission (NERC) was thereafter established.
- NERC has the general mandate to regulate the entire electricity sector in the country with regards to tariff setting and regulation, supervision of market rules, performance monitoring, and overseeing the orderly transformation of the power sector to a more competitive environment. Licenses are required for generation of 1MW aggregate and above at a site; and distribution of power of capacity greater than 100kW in aggregate at a site.

3. Renewable Energy Development in Nigeria Cont'd

(c) Regulation and Legislature Cont'd

- Generally, automotive fuels in Nigeria are regulated by the Department of Petroleum Resources (DPR). Automotive fuels include both mineral fuels and biofuels.
- Other relevant regulatory institution to renewable energy is the Standard Organization of Nigeria (SON), charged with responsibility of setting and enforcing standards of goods and services in Nigeria. Therefore, the quality standards of solar PV modules, inverters, batteries, solar cookers, improved woodstoves, biogas digesters etc. should be enforced by SON; after the standards have been set in conjunction with relevant bodies like the Energy Commission of Nigeria, Manufacturers Association of Nigeria, Nigeria Society of Engineers, NERC, etc
- The National energy Masterplan, which includes renewable energy, as well as the masterplan are yet to be passed into law through an Act of National Assembly.
- The National Assembly is, however, being sensitized to facilitate the consideration of an energy bill that would enable the enactment of the National Energy Policy and Masterplan into law.

3. Renewable Energy Development in Nigeria Cont'd

(d) On-going Projects and Programmes

- 2,000 MW hydropower plant in Mambilla, Taraba State
- 30 MW hydropower plant in Gurara, Niger State
- 33 MW hydropower plant in Dadin Kowa, Gombe State
- 10 MW wind farm at Rimi, Katsina State
- Isolated solar water pumping and street lighting schemes for rural communities
- Research and training in our six (6) Renewable Energy Research Centres:
 - Centre for Energy Conservation and Energy Efficiency, Lagos
 - Centre for Hydropower Research, Ilorin
 - Centre for Energy Environment Research, Benin City
 - National Centre for Energy Research and Development (NCERD), Nsukka
 - Sokoto Energy Research Centre, (SERC), Sokoto.

Progress of Solar Energy Development

There is abundant solar radiation and fairly well distributed Nationwide that has not been adequately tapped to date. However some efforts have been put up as follows:

- i. A lot of solar powered home and street lightening systems have been demonstrated in most parts of the country.
- ii. A number of pilot rural electrifications access powered by solar systems have been demonstrated in some parts of the country - OGD farms solar based rural electrification project at OGD farm Ogun State, Gaza village in Bauchi, Katsina State and Esham Cross Rivers State e.t.c
- iii. There are many ongoing solar powered street lightening projects Nationwide.
- iv. In recent times a lot of private investors have shown interest in using solar Energy to generate electricity for ON and OFF- grid connections

4. CONCLUSIONS

- Nigeria is endowed with appreciable RE sources of solar, wind, biomass and hydro.
- National Energy Policy exists that encourages the exploitation of RE resources and its integration into the nation's energy supply mix for sustainable national development, through private sector participation.
- A National Renewable Energy Masterplan also exists to fast track RE development in the country
- Energy Commission of Nigeria, Nigerian Electricity Regulatory Commission, Department of Petroleum Resources and Standard Organisation of Nigeria, established by law, constitute the institutional framework for the regulation and standardization of renewable energy and its systems in Nigeria.
- Efforts are being made to get the energy policy and masterplan passed into an energy law.

CONCLUSION CONT:

- The Roadmap for Power Sector reform recently unveiled by His Excellency, Goodluck Ebele Jonathan, the President of the Federal Republic of Nigeria adequately recognised Renewable Energy development in its long term objective for improved Power generation in Nigeria.
- The prospect for Solar Energy development for Power(electricity) generation in Nigeria is quite very bright especially for rural community electrification access(for electrifying remote communities far from the National Grid access).
- It is obvious that some private investors seeking to use Solar Energy to generate electricity may soon commence construction of privately owned Solar Energy Power plants in Nigeria considering that some of such proposals have reached advanced stages of development.

REFERENCES

1. Central Bank of Nigeria (CBN) (2007): “Annual Report and Statement of Accounts”
2. David Sweet (2009): “Decentralized Energy - A Local Solution for Global Problems” Paper Presented at WEC and NNC-WEC Workshop on Cleaner Fossil Fuels Technologies, Transcorp Hilton Hotel, Abuja, 6th -7th April 2009.
3. Federal Office of Statistics (FOS)) (2002): “Annual Abstract of Statistics”
4. National Bureau of Statistics (NBS)(2007): “Annual Abstract of Statistics.
5. Federal Ministry of Power annual project reports 2008/2009 and 2010 progress report