

## COUNTRY CHAPTER: NIGERIA

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## ACRONYMS AND ABBREVIATIONS

## NIGERIA

AES	Applied Energy Services
CAC	Corporate Affairs Commission
CDM	Clean Development Mechanism
ECN	Energy Commission of Nigeria
ECOWAS	Economic Community of West African States
EPSR	Electric Power Sector Reforms
FDI	Foreign Direct Investment
FIIRO	Federal Institute of Industrial Research Oshodi
FOTE	Friends of the Environment
GDP	Gross Development Product
HIV/AIDS	Human Immunodeficiency Virus/Acquired Immune Deficiency Syndrome
IMF	International Monetary Fund
IPP	Independent Power Producer
IPPA	Investment Promotion and Protection Agreement
ITCZ	Inter-Tropical Convergence Zone
JV	Joint Venture
LGHQs	Local Government Headquaters
LPG	Liquefied Petroleum Gas
N	Nigerian Naira (currency of Nigeria, also NGN)
NAPEP	National Poverty Eradication Program
NBRI	Nigerian Building and Road Research Institute
NCC	National Coal Corporation
NDA	Niger Dam Authority
NEEDS	National Economic Empowerment and Development Strategy
NEPA	Nigerian Electricity Power Authority
NERC	Nigerian Electricity Regulatory Commission
NESCO	Nigeria Electricity Supply Company
NGC	Nigerian Gas Company
NGOs	Non Governmental Organizations
NIMET	Nigeria Meteorological Services
NIPC	Nigerian Investment Promotion Commission
NNPC	Nigerian National Petroleum Corporation
NNRA	Nigerian Nuclear Regulatory Authority
NREMP	National Renewable Energy Master Plan
PHCN	Power Holding Company of Nigeria
PRODA	Project Development Agency
R&D	Research and Development
REA	Rural Electrification Agency
REF	Rural Electrification Fund
REMP	Renewable Energy Master Plan
SESN	Solar Energy Society of Nigeria
SHP	Small Hydro Power
TCN	Transmission Company of Nigeria
UNIDO	United Nations Industrial Development Organization
USD	United States Dollars
VAT	Value Added Tax



## MEASUREMENTS

GWh	gigawatt hour
kg	kilogram
km	kilometer
kV	kilovolt ampere
kVA	kilovolt
kWh	kilowatt hour
kWp	kilowatt peak
m	meter
m <sup>2</sup>	square meter
/	meters per second
MJ	megajoule
MVA	megavolt ampere
MW	megawatt (1 MW = 1,000 kW)
MWh	megawatt hour
PJ	petajoule (1 PJ = ca. 277,778 million kWh)
scf	standard cubic feet
yr	year



## SUMMARY

The Country Study of Nigeria is to provide an overview of the country's energy market and to support decision-making for private investments for the Renewable Energy (RE) sector in Nigeria. The study is structured as follows:

Chapter one provides Background Information on Nigeria. This includes an overview of geographical and climatic conditions, as well as the most important facts in view of political, economic and socio-economic conditions of Nigeria.

Chapter two summarizes facts and figures of Nigeria's Energy Market including stakeholders and market actors and involved as well as related regulations.

Chapter three presents the currently existing Political Framework for Renewable Energies in Nigeria. This includes an overview of support mechanisms for photovoltaic (PV) as well as already existing regulations, incentives and legislative framework conditions, concerning other RE technologies.

Chapter four provides a brief overview of the Status Quo and Potential for Renewable Energies in Nigeria.

Chapter five summarizes the existing and potential Market Risks and Barriers in general with focus on RE.

Chapter six presents a compilation of the most relevant Renewable Energy Business Information and Contacts of Nigeria.

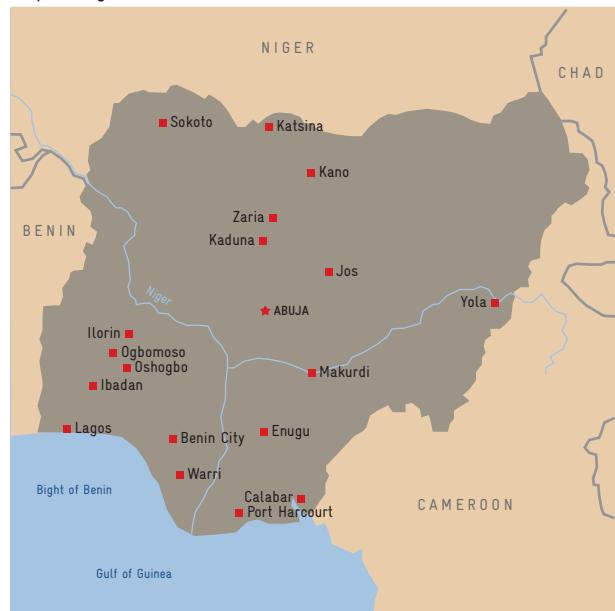


# 1 COUNTRY INTRODUCTION

## 1.1 GEOGRAPHY AND CLIMATIC CONDITIONS

Nigeria covers a total area of 923,768 km<sup>2</sup>. With over 140 million people (as of 2008), Nigeria is the most populated country in Africa and the ninth populated country in the world. About 45 % of the inhabitants live in urban areas; nearly 42 % of the population is under 14 years. The fertility rate in 2008 was 5.01 and the population growth rate about 2.03 %. Life expectancy rate in 2008 was estimated at 46.5 years, while adult literacy is 68%.<sup>1</sup> In 2003, 5.4 % of adults lived with HIV/AIDS. Infant mortality in 2008 remained very high with 95.78 deaths per thousand live births.<sup>2</sup> Nigeria is divided in the geographical regions North, South, the Central Region and the Guinea coastlands.

FIGURE 1  
Map of Nigeria



Because of its location just north of the equator, Nigeria enjoys a truly tropical climate characterized by the hot and wet conditions associated with the movement of the Inter-Tropical Convergence Zone (ITCZ) north and south of the equator. It is important to note that the climatic conditions of the country vary considerably due to its close proximity to the Equator and the Tropic of Cancer. There are two main seasons prevalent in Nigeria. One is the rainy season from May to September in the northern part of Nigeria and from March to November in the southern part. The dry season, also known the Harmattan season in Nigeria, lasts from December till January.

The country experiences consistently high temperatures all year round. The seasonal pattern of climatic conditions over Nigeria gives rise to four seasons in the South and two in the North. This is the result of annual total rainfall occurrence and distribution, which is more predominant in the South than in the North.

## 1.2 POLITICAL, ECONOMIC AND SOCIO-ECONOMIC CONDITIONS

Nigeria became an independent country on 1 October 1960 and a republic on 1 October 1963. The country operates as a federal system of governments, consisting of the Federal Government, 36 State Governments and 774 Local Governments. While the country has been governed by a succession of military and civilian governments, Nigeria is currently experiencing the longest period of democracy since becoming an independent nation. The Fourth Republic started on 29 May 1999 with the election of President Olusegun Obasanjo. Obasanjo was followed by the current President Umaru Musa Yar'Adua who was elected on 29 May 2007. While Nigeria operated a Parliamentary System of Government when it gained its independence, the country currently operates a Presidential System of Government with three tiers of Government, i.e. executive, legislative and judiciary.

Nigeria's population consists of about 250 ethnic groups speaking 500 indigenous languages and following two major religious, i.e. Islam and Christianity. The largest ethnic groups are the Hausa-Fulani, the Yorubas and the Igbos. Nigeria's economy is primarily driven by oil and gas. Oil and gas account for 25 % of the country's Gross Development Product of 115.4 billion USD (as of 2006) measured at current prices. Oil and gas account for over 80 % of governmental revenues and more than 95 % of total export earnings in 2006<sup>3</sup>. GDP per capita has recently risen considerably to 858 USD as opposed to 350 USD in 2000. The Nigerian economy is experiencing the fastest growth in over two decades due to the development in the energy sector, especially the oil and gas sub-sector. Growth averaged 5.7 per cent annually between 2000 and 2005, picking up across a broad range of sectors<sup>4</sup>. Nigeria's vision is to become one of the 20 largest economies by the year 2020.

However, in spite of the massive revenue from oil (estimated at over 600 billion USD since 1970), the standard of living is still very low, poverty is widespread and income distribution is highly skewed. Over 70 % of the population lives on less than 1 USD a day and 91 % live on less than 2 USD a day according to a 1990–2001 poverty study. Income distribution is highly skewed with the poorest 10 % of the population controlling just 1.6 % of the wealth, while the richest 10 % control 40.8 % of total wealth.<sup>5</sup> The Gini index stands at 50.6 %. Nigeria with a Human Development Index of 0.461 was classified among the countries with low human development by the United Nations. The International Monetary Fund (IMF) ranked Nigeria at 165 out of 179 countries in terms of per capita income in 2006. The major causes for poverty in Nigeria are bad governance, neglect of the agricultural sector, inadequate social and economic infrastructure and unstable policy environment.

<sup>1</sup> CIA, AS OF 2009

<sup>2</sup> CIA, AS OF 2009

<sup>3</sup> CBN, AS OF 2007

<sup>4</sup> KWAKWA ET AL., AS OF 2008

<sup>5</sup> NBS, AS OF 2005



## 2 ENERGY MARKET IN NIGERIA

### 2.1 OVERVIEW OF THE ENERGY SITUATION

Nearly 60% of the country's 140 million people have no reliable access to electricity from the national energy grid. Most people rely on lighting with kerosene lanterns, candles, torches etc. Nigeria has a National Energy Policy as well as a draft National Energy Master Plan and Renewable Energy Master Plan. The most important legislation guiding the power sector is contained in the Electric Power Sector Reforms (EPSR) Act of 2005. In 2008, the Government also approved of a new oil and gas policy.

### 2.2 ENERGY CAPACITIES, PRODUCTION, CONSUMPTION AND PRICES

Nigeria is fortunate to have huge energy resources enabling the country to transform its economy and the lives of its citizens. Nigeria sits astride of over 36 billion barrels of oil, 187 trillion cubic feet of gas, 4 billion metric tons of coal and lignite as well as huge reserves of tar sands, Hydro Power and solar radiation. An overview of Nigeria's energy reserves is presented in table 1.

**TABLE 1**  
Energy Reserves and Potential of Nigeria

Crude oil	35.2 billion barrels
Natural gas	187.44 trillion scf
Tar sands	30 billion barrels of oil equivalent
Coal & lignite	4 billion tons
Large Hydro Power	11,250 MW
Small Hydro Power	3,500 MW
Fuel wood	13,071,464 hectares
Animal waste	61 million tons/year
Crop residue	83 million tons/year
Solar radiation	3.5–7.0 kWh/m <sup>2</sup> /day
Wind	2–4 / at 10 m height

Source: Sambo, as of 2008

The energy mix of Nigeria is dominated by oil which accounts for about 57%, followed by natural gas (36%) and hydroelectricity (7%) as of 2005. Other energy sources such as coal, nuclear and renewable energies currently play no significant role in the country's energy consumption mix. Between 1980 and 2005, the share of oil in energy mix decreased from 82% to 56%. Natural gas consumption increased from 9% to 35%. Hydroelectricity experienced a slight increase from 6.6% to about 7%.

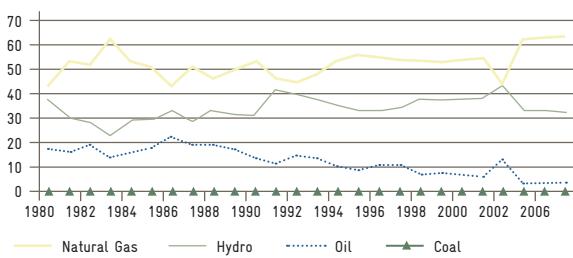
Over the period of 1989–2005, the share of non-commercial energy in total energy consumption fluctuated within the range of 30–40%. About 95% of total fuel wood consumption falls to households for cooking and domestic industrial activities, which are closely related to household activities. A smaller proportion of the fuel wood and charcoal consumed are used in the service sector.

### Electricity Sector

Electricity in Nigeria is supplied through large-scale thermal power and hydroelectric power plants and a 330 kV and 132 kV nationwide transmission network through the Power Holding Company of Nigeria (PHCN). Power demand developed from 3,233 MW in 2002 to 3,479 MW in 2003 and 3,403 MW in 2004. The maximum power demand in 2003 exceeded the available capacity of 3,477 MW in 2005. The Government has clearly fallen short of the national targets defined in the National Economic Empowerment and Development Strategy (NEEDS) in order to increase the generation capacity of power facilities to 10,000 MW, the transmission capacity to 9,340 MVA and the distribution capacities to 15,165 MVA by the year 2007. Most of the generating facilities are old and outdated, yet cannot be overhauled due to the lack of reserve capacity. This situation was caused by insufficient maintenance, the suspension of new investments and the high rate of auto-generation as a result of frequent large-scale blackouts.

The residential sector accounted for 63% of the total electricity consumption in 2005, followed by the commercial sector (27%) and the industrial sector (10%). Natural gas dominates the electricity generation mix, accounting for an average of 63% of the total power generation. After natural gas, hydro is also a significant factor in power generation, though its contribution has decreased. Figure 2 presents the evolution of the total power generation shares by type of fuel.

**FIGURE 2**  
Share of Energy Sources in Total Power Generation (%)



Source: World Bank, as of 2006

Meanwhile, the contribution of oil, though marginal since 1980, has also drastically decreased contributing as little as 3% to the total power generation in 2004. In Nigeria, the problems in the Niger Delta have often affected the supply of gas to the power stations leading to major disruptions in electricity generation. Occasional low levels of water in the hydrostations together with the gas disruptions lead to blackouts in most parts of the country. Energy prices in Nigeria are very low compared to other countries and relative to the marginal cost of production. The average electricity tariff in Nigeria is about 6.75 N per kWh (approximately 5 €-Cents per kWh). It is estimated that the generation cost of electricity from wind power in Nigeria is about 8–10 Euro Cent per kWh. The current electricity prices (as of November 2008) vary between 3 and 5 €-Cents per kWh.

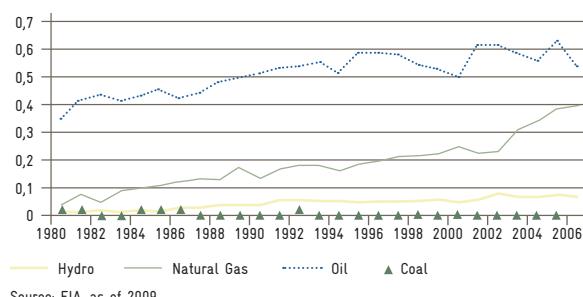


### Petroleum Sector

The commercial energy consumption mix in Nigeria is dominated by oil accounting for about 57 %, followed by natural gas (36 %). Besides hydroelectricity (7 %) and very little utilization of coal, other energy resources play no significant role in the country's energy consumption mix. Figure 3 presents an overview of the country's energy mix with main contributions from oil and natural gas.

Refined petroleum products can be classified into two categories, namely those whose prices are still regulated (i.e. gasoline and kerosene) and those whose prices are fully deregulated (i.e. diesel and LPG). Due to the poor state of local refineries, nearly 70 % of total consumption of refined products in Nigeria are imported. The current prices of petroleum products (as of November 2008) are presented in table 3.

**FIGURE 3**  
Evolution of the Energy Consumption Mix in Nigeria (1980–2006)  
(Quadrillion Btu)



Source: EIA, as of 2009

**TABLE 3**  
Overview of Prices for Selected Petroleum Products

TYPE OF FUEL	PRICE
Gasoline	0.46 Euro per liter
Diesel	0.92 Euro per liter
Kerosene	0.33 Euro per liter
LPG	17.71 Euro per 12.5 kg bottle

Source: market research conducted by the authors, as of November 2008

### 2.3 MARKET ACTORS AND REGULATION STRUCTURES

The Federal Ministry of Energy oversees the administration of the energy sector in Nigeria primarily through its two main executive bodies, namely the Nigerian National Petroleum Corporation (NNPC) and the PHCN. The NNPC's primary function is to oversee the regulation of the Nigerian oil industry while also being responsible for upstream and downstream developments. The Nigerian Electricity Power Authority (NEPA) was established in 1972 as a result of the merger of the former Electricity Company of Nigeria and the Niger Dam Authority (NDA). NEPA was structured as a vertically integrated monopoly with responsibility to generate, transmit and distribute electricity throughout the country. The NEPA Act was further amended in 1990 and 1998 to pave way for further liberalization of the electricity industry.

One of the major institutional and legislative reforms in the power sector in recent years was the Electric Power Sector Reform (EPSR) in 2005. The EPSR introduced important regulatory changes, which involve dismantling the monopoly of NEPA. It aimed at encouraging competition and efficiency through private participation, especially in the generation and distribution of electricity. The EPSR provided for the division of NEPA into 18 autonomous companies consisting of 6 generating companies, 1 transmission company and 11 distributing companies. The Act also provided for the creation of an independent regulatory agency, i.e. the Nigerian Electricity Regulatory Commission (NERC), and the Rural Electrification Agency (REA) to oversee the extension of electricity to rural and peri-urban areas. The REA is supervised by the Federal Ministry of Energy. The Act also provided for the establishment of a Rural Electrification Fund to promote access of rural dwellers to electricity. In some areas, electricity supply is provided by the REBs of state governments or through an Independent Power Producer (IPP) system such as NESCO (Nigeria Electricity Supply Company) or the AES Corporation.

There is, however, no agency with direct control of the RE sector in Nigeria. The responsibilities for RE objectives are shared between various Ministries, Departments and Agencies of the Government, e. g. the Energy Commission of Nigeria (ECN), REA, NNPC and the National Poverty Eradication Program (NAPEP). The ECN exercises jurisdiction over RE-related institutions in Nsukka and Sokoto, implements pilot projects on both, technology utilizing solar heat and PV generation, and promotes the introduction of these RE technologies. Silicon is mined in Nigeria and research and development on the domestic manufacturing of PV modules is being planned.

Other key actors in the energy sector are the Nigerian Gas Company (NGC), the Nigerian Nuclear Regulatory Authority (NNRA) and the National Coal Corporation (NCC). The Ministry of Science and Technology is responsible of planning and policy matters related to research and development in the field of science and technology including energy. Other agencies and NGOs also considering RE include the Federal Institute of Industrial Research Oshodi (FIIRO), the Project Development Agency (PRODA), Friends of the Environment (FOTE), the Solar Energy Society of Nigeria (SESN) to mention but a few.



## 3 POLICY FRAMEWORK FOR RENEWABLE ENERGIES

### 3.1 POLICIES, STRATEGIES AND PROGRAMS FOR RENEWABLE ENERGY PROMOTION

The NEP was drafted in 1993 by the ECN and represents a comprehensive energy policy that covers all energy sectors. The key objectives and targets for the power sector are:

- To expand electricity access to 75 % of the population by 2020
- To provide electricity supply for all 774 local government headquarters and other cities by 2010
  - (only 660 LGHQs have been electrified so far)
- To promote private sector participation
- The key elements in the national policy position on the development and application of RE and its technologies are:
  - To develop and promote the country's RE resources and include all viable ones into the national energy mix
  - To promote decentralized energy supply, especially in rural areas, based on RE resources
  - To discourage the use of wood as fuel
  - To promote efficient methods in the use of biomass energy resources
  - To keep abreast of international developments in RE technologies and applications

At present, there are no special incentives for distributors, manufacturers and users of RE systems, also due to the huge subsidies granted for conventional energy, in particular conventionally generated electricity and petroleum products. The country is also yet to provide a PPA for developers of RE based electricity projects. The only RE sector that attracts special incentives is the biofuel industry. These incentives include (i) the granting of a pioneer status to all registered businesses engaged in activities related to the production of biofuels or the production of feed stocks for biofuel production and co-generation, (ii) exemptions from withholding tax and capital gains tax; (iii) exemptions from the payment of customs duties, taxes and other charges of similar nature on biofuels imports and exports, imports of inputs and machineries, (iv) waivers on VAT payments on all products and services consumed by biofuel companies and (v) access to preferential loan arrangements with the Bank of Industry, the Nigerian Export and Import Bank, commercial banks, agriculture banks and other development finance agencies.

### 3.2 REGULATIONS, INCENTIVES AND LEGISLATIVE FRAMEWORK CONDITIONS

Most RE technologies are imported, as there is virtually no manufacturing capacity in the country. In Nigeria, customs tariffs for ordinary electrical products are applied for PV-related equipment resulting in high tariffs which are lacking any incentives and are discouraging the country's PV business. ECN has submitted an "Importation of Renewable Energy Equipment" bill to the Nigerian Senate in 2002, asking for tax exemptions for the import duty of PV equipment.

The Nigerian Government allows for 100 % foreign ownership or joint ventures (JV) with Nigerian partners in all sectors of the economy including the PV sub-sector. The Government has also effected an Investment Promotion and Protection Agreement (IPPA) which guarantees investors adequate and prompt payments in the event of expropriation, free transfer of funds as well as provisions for international arbitration in the event of disputes. This agreement is to facilitate the attraction of Foreign Direct Investment (FDI) to the economy and protect investments in all sectors including the RE sub-sector. Additional incentives to encourage industrialists and investors in all sectors of the economy including the RE sub-sector provide:

- Five years tax holiday for pioneer products and industries
- Tax-free dividend for a period of three years
- 95 % capital allowance for replacement investment
- Elimination of double taxation
- Abolition of excise duty

All excise duties were abolished with effect from 1 January 1999. It should also be mentioned that any investments in the energy sector are rated as pioneer initiatives entitled to a tax holiday of 5–7 year.

The EPSR Act provided for the establishment of the Rural Electrification Agency. The Federal Government has set a target for increasing electricity access in rural areas from currently 40 % to 75 % by 2015. The rural electrification strategy and plan aim at the expansion of the main grid, the development of isolated and mini-grid systems, the creation of an enabling environment to promote investments in RE power generation and the fostering of public and private sectors partnerships designed to supply electricity for the rural population. The targets against which these policies will be measured are: (i) ensuring that 75 % of the rural population has electricity by 2010, (ii) providing electricity to all the 774 local government headquarters and other strategic towns by 2010 and (iii) reducing cost per connection of rural electricity schemes on a sustainable basis. The strategies being contemplated by REA for expanding energy access comprise two elements: pilot projects aimed at testing innovative approaches to expanding rural electricity and activities related to implementation support for the National Renewable Energy Master Plan (NREMP).

To encourage the private sector for investing in rural electrification, governmental subsidy is set at a 304.5 N/month flat rate. The REA and the Rural Electrification Fund (REF) were established in March 2006. Any organization intending to start a rural electrification project can do so by obtaining a business license from the REA without providing or being related to an existing distribution company in the relevant area. The REA will approve of the proposed site for a rural electrification project and allot funds for the REF in accordance with fair and transparent rules. The REA will also formulate and establish minimum safety regulations, technical standards and criteria for the services level.

The NERC is a regulatory and supervisory organ for electric power entities (including private companies) working in power generation, transmission and distribution projects in



general. Although rural electrification projects fall under the authority of NERC, projects with less than 1 MW generating facilities and 100 kW distribution facilities are not subject to their regulation, so off-grid rural electrification projects are not included for the time being.

In general there is no restriction for foreign companies and investors doing business in Nigeria. They must, however, incorporate a local vehicle before commencing business. All companies are approved and regulated by the Corporate Affairs Commission (CAC). Decree No. 16 pf (as of 1995) of the Nigerian Investment Promotion Commission (NIPC) allows for 100 % foreign participation in Nigerian businesses. It also allows for repatriation of capital and dividend without any inhibition from the Government. The NIPC is a one-stop office for dealing with all requirements for investments in the country. The Companies and Allied Matters Act 1990 (The Companies Act) is the principal law regulating the incorporation of businesses in Nigeria.

The approval procedures for foreign investors in Nigeria can be stated as follows: The first port of call is the NIPC office for enquiries about investment opportunities and procedures in Nigeria. Second step is the registration of the company with the CAC. Third is to notify the Industrial Inspectorate Department of the Federal Ministry of Industries of the intended capital expenditure. Next step is to ask for approval of location with the Federal Ministry of Industries. Moreover, approval or a proper business permit with or without expatriate quota allocation must be sought in writing from the Ministry of Internal Affairs. Finally, to know whether the company will obtain pioneer status, it must apply to the Federal Ministry of Industry. The same Ministry also approves the user licenses.

There is an opportunity in the Nigerian power sector to leverage carbon finance from the energy loss reduction and efficiency program embarked upon recently with the assistance of the World Bank. The Transmission Company of Nigeria (TCN) is currently finalizing the Emission Reduction Purchase Agreement. The conversion to a High Voltage Distribution System lead to technical loss and therefore a substantial reduction of carbon emissions due to avoided generation. This represents the first step for the Nigerian power sector in accessing the benefits of Clean Development Mechanism (CDM) under the Kyoto Protocol.

## 4 STATUS AND POTENTIAL FOR RENEWABLE ENERGIES

An overview of the status (as of 2005) and future potential (outlook by 2025) for RE is presented in Table 4.

The Renewable Energy Master Plan (REMP) envisages to aggregate the electrification demand of 14,000 MW by 2015 of which RE will constitute about 5 % (701 MW). In 2025, the electricity demand is projected to increase to 29,000 MW with new RE satisfying up 10 % of the country's overall energy demand. The mix of RE making up the 10 % is projected as follows: small Hydro Power 66 %, PV 17 %, biomass 14 %, wind 1.3 % and solar thermal 0.7 %. The REMP estimated the cost of REMP implementation up to 2025 at 4.8 billion USD. Table 5 presents the targets for electricity generation in Nigeria.

**TABLE 4**  
Technical Potential for Renewable Energy in Nigeria

ENERGY SOURCE	ESTIMATED POTENTIAL	CURRENT UTILIZATION	SHARE OF ELECTRICITY SUPPLY (%) UP TO 2005	SHARE OF ELECTRICITY SUPPLY BY 2025 (%)
Large Hydro Power	14,750 MW	1,930 MW	29.30	25.00
Small Hydro Power	734 MW	30 MW	0.46	9.90
Fuel wood, animal waste and crop residue	144 million tons/		0	0.41
Solar radiation	3.5–7.0 kWh/m <sup>2</sup> /day	marginal	0	0.26
Wind	2–4 /	marginal	0	0.02

Sources: ECN, Renewable Energy Master Plan, as of 2005/ECN, Energy Demand Projection Document, as of 2004

**TABLE 5**  
Targets for Electricity Generation (MW)

RESOURCE	SHORT-TERM (2005–2007)	MEDIUM-TERM (2008–2015)	LONG-TERM (2016–2025)
Large Hydro Power	1,930	5,230	48,000
Small Hydro Power	100	3,500	19,000
Solar PV	5	120	500
Solar thermal	–	1	5
Biomass	1	100	800
Wind	1	20	40
All renewables	2,036	6,905	68,345
All energy resources	15,920	30,210	192,000
% of renewables	13 %	23 %	36 %

Source: Energy Commission of Nigeria, as of 2007



#### 4.1 BIOMASS/BIOGAS

The biomass resources of Nigeria consist of wood, forage, grass and shrubs, animal wastes arising from forestry, agricultural, municipal and industrial activities as well as aquatic biomass. Biomass remains a leading source of energy for Nigeria contributing an estimated 37% of total energy demand and being the energy of choice for the vast majority of rural dwellers and the urban poor. The country's biomass energy resources are estimated at 144 million tons per year. Nigeria currently consumes 43.4 billion kg (equivalent 43.4\* 109 kg) of fuel wood annually. The average daily consumption is about 0.5–1.0 kg of dry fuel wood per person. The rate of consumption hardly matches the rate of reforestation.

#### 4.2 SOLAR ENERGY

Nigeria is situated in a belt of high sunshine. The solar radiation is fairly well distributed throughout the country. The annual average of total solar radiation varies from about 12.6 MJ/m<sup>2</sup>/day (equivalent 3.5 kWh/m<sup>2</sup>/day) in the coastal latitudes to about 25.2 MJ/m<sup>2</sup>/day (equivalent 7.0 kWh/m<sup>2</sup>/day) in the far North. This equals an average annual solar energy intensity of 1,934.5 kWh/m<sup>2</sup>. Thus, over a whole year, an average of 6,372,613 PJ/year (1,770 thousand TWh/year) of solar energy falls on the entire land area of Nigeria. The national average is 5.5 kWh/m<sup>2</sup>/day and the average solar radiation time is 6 hours/day, which are favorable conditions for PV power generation.

The only survey on the business units dealing with solar business in Nigeria shows that a total of 44 companies and 2 research centers were active in the importation and/or installation of PV systems. 30 of them were located in Lagos (68%) and 14 in the rest of the country (32%). Among the 27 respondents in the survey, 22 (81%) were involved in solar business. The bulk of the companies were either consultants, vendors or contractors. Many of the existing companies claimed to be distributors for one foreign company or the other. The survey identified only one manufacturer of solar PV components or systems, namely Solar Electric systems, based in Jos. It assembled solar-PV refrigerators and manufactured solar cookers and solar heaters.

The PV components which are marketed in the country include modules, batteries, inverters, converters, charge controllers, bulb/tubes, refrigerators, lighting systems, solar lanterns, solar lamps, and junction boxes. The total module installation for 1999 was estimated at 264 kWp. The REMP estimated the PV modules installation in 2005 at 800 kWp. Most of the distributors of solar PV components and systems in Nigeria obtain their products from America (49%), Germany (13.7%) and Britain (21.5%). Recently, the Asian countries of India and China have taken over increasing shares of the market. One of the emerging issues in the Nigerian solar market, however, is product quality. The country is yet to establish product standards. Presently, there are no capacities to actually test the products that are brought into the country.

Solar PV technologies are being more and more accepted in Nigeria. Despite improvements in local R&D efforts, however, the knowledge of these technologies and their market potentials is considerably inadequate. Presently, all the

PV modules in the Nigerian market are imported. Solar PV systems are being extensively used for a wide range of electrical energy requirements including solar home systems, water pumping, refrigeration and telecommunication.

#### 4.3 WIND POWER

Wind speeds in Nigeria range from 1.4 to 3.0 m/s in the southern areas and 4.0 to 5.12 / in the extreme North. Wind speeds in Nigeria are generally weak in the South except for the coastal regions and offshore locations. In Nigeria, peak wind speeds generally occur between April and August on most sites. Initial studies show that the actual total exploitable wind energy reserve at a height of 10 m may vary from 8 MWh/ in Yola to 51 MWh/ in the mountainous areas of Jos plateau and rise to 97 MWh/ in Sokoto. Hence, Nigeria has poor to moderate wind conditions.

Wind energy utilization in Nigeria is practically minimal. The hundreds of wind pumps scattered all over the country are badly maintained and some have been abandoned altogether. Some state governments like Jigawa and Kano are making an effort to install new wind pumps. There is one pilot wind electricity project in operation, namely the 5 kWp Sayya Gidan Gada wind electricity project at Sokoto. Moreover, a 0.75 kWp wind electricity project in the center of the town is being run on an experimental basis to prove the viability of wind farming in the area.

#### 4.4 HYDRO POWER

According to NEPA's most recent estimate, the country's gross hydro potential is approximately 14,750 MW. On the basis of a 1980 survey of 12 of the old states of the federation, it was assessed that some 734 MW of small Hydro Power (SHP) could be harnessed from 277 sites. Unfortunately, the database on SHP in Nigeria is limited, incomplete and substantially obsolete. No new surveys have been conducted since those undertaken in only three states over 20 years ago to confirm or verify the data. The REMP, however, estimates that SHP potential is about 3,500 MW. More detailed information can be found in the Annex of this report.

#### Hydrogen, Marine, Ocean and Geothermal Energy

Hydrogen, marine, ocean and geothermal energy are important in the long-term vision of providing secure, abundant, cost effective and clean sources of energy for Nigeria. Their impact, however, is still negligible at present. The Nigerian Energy Policy seeks to promote capacities to enable Nigeria to include these new energy sources in the country's future energy mix. Nigeria has an Atlantic Ocean coastline stretching over 800 km from Badagry to Bakassi. Tides in the coastal areas have a height range of 100–300 cm and an incursion of 30–40 km on the average. With respect to geothermal energy, there are two known geothermal resources in Nigeria: Ikogosi Warm Springs in Ondo State and the Wikki Warm Spring in Bauchi. Moreover, high geothermal gradient trends have been identified in the Lagos sub-basin, the Okitipupa ridge, the Auchi-Agbede within the Benin flank/hinge line as well as in the Abakaliki anticlinorium.



## 5 MARKET RISKS AND BARRIERS

Price distortions, poor regulatory environment and inadequate infrastructure define the current energy market conditions in Nigeria reducing the scope for competition, growth and innovation in the market. The Nigerian business environment is characterized by weak infrastructure, poorly implemented incentives (especially fiscal and tariff regimes), massive smuggling, counterfeiting and dumping of products, lack of standardization required for international competitiveness, unfavorable international trade rules, a national trade policy stance which is endemically unpredictable (especially in the application of tariffs and exemptions), high transaction costs at ports, complicated customs clearance procedures, tariffs and non-tariff barriers which on the average exceed those of other ECOWAS countries and high level of official corruption.

The 2009 Report on “Doing Business Index” jointly authored by the World Bank and the International Finance Corporation shows that Nigeria dropped from position 108 out of 178 in 2008 to position 118 out of 181 in 2009. Nigeria slides down on most of the scales used to measure efficiency of business transactions. While the number of procedures required for obtaining licenses reduced from 18 to 16, the number of the days required in concluding the process increased from 350 to 360 days. Similarly, while the number of payments in business taxes reduced from 35 to 32, the percentage of the tax (related to the company profit) rose from 29.9 % to 32.2 %. Nigeria, however, recorded some improvements such as the reduction of the number of procedures for registering a business from 9 to 8 or the reduction of the number of days required for the process from 34 to 31. The costs for registering a new business in Nigeria however raised from 56.6 % in the 2008 Report to 90.1 % in the 2009 Report (indicated as percentage of per capita income). Employers have high flexibility to hire and fire employees.

Moreover, there are no clear and consistent institutional structures helping to overcome barriers and create expanded opportunities for RE. Some of the current initiatives of various actors are rather spontaneous and lacking systematic approaches. The Government’s Agencies and Ministries active in the RE sector include the Energy Commission of Nigeria (through two of its renewable energy centers located at Sokoto and Nsukka), the Nigeria Meteorological Services (NIMET), the Nigerian Building and Road Research Institute (NBRI), the Project Development Institute (PRODA), the Federal Institute of Industrial Research Oshodi (FIIRO), REA, the Federal Ministry of Environment, the Federal Ministry of Science and Technology, the Federal Ministry of Energy as well as some of Nigeria’s universities and polytechnics.

There is a need to create a level playing field in the energy market by removing all price distortions, by granting special incentives to market operators for the introduction of RE technology systems and by encouraging consumers to access RE products.



## 6 RENEWABLE ENERGY BUSINESS INFORMATION AND CONTACTS

TABLE 6

## Local Business Partners

NAME	ADDRESS	BUSINESS FOCUS
Jon Paca Investments Ltd.	Suite 38, Kogi Street, Garki, Abuja Phone: +234 803 703 490 6	Solar water pumping systems, solar street lighting
Aero Systems & Tech Nig. Ltd.	Plot 7, Durban Street Wuse 2, Abuja Phone: +234 806 602 033 3	PV systems, batteries, inverters, solar charge controllers, solar water pumping systems
Solarec Engineering Ltd.	2nd Floor, 6A Ahmadu Bello Way, Kaduna Phone: +234 301 568 05	PV modules, inverters, DC lighting, charge controllers, solar water pumping systems
Afri-Asia Global Services Ltd.	1, Ilesanmi Idowu, Ogudu GRA, Ogudu, Ojota, Lagos Phone: +224 806 008 651 2 <a href="http://www.afasglobal.com">www.afasglobal.com</a>	Hydroenergy system components, solar street lighting, solar water pumping systems, wind energy system components
EastWind Laboratories	8, Lagere Road, Ile-ifé, Osun State Phone: +234 803 455 154 6 Web: <a href="http://www.eastwindlabs.com">www.eastwindlabs.com</a>	Solar electric power systems, battery charge controllers, PV module components, inverters
Pamtronics Nigeria Ltd.	Suite C3 Royal Plaza, Area 3 Junction, Garki, Abuja Phone: +234 803 701 270 3 Web: <a href="http://www.pamtronics.com">www.pamtronics.com</a>	Solar electric power systems, batteries deep cycle, DC to AC power inverters sine wave, DC lighting, modules
Borodo & Co. Ltd.	P.O. Box 7328, Kano Phone: +234 803 587 005 8	Solar electric power systems, lead acid batteries, solar modules, inverters
Cedicon Ltd.	13th Floor, Zenon House, No.2 Ajose Adeogun St, Victoria Island, Lagos Phone: +234 806 572 208 5	Solar electric power systems, wind power plants, inverters
Rubitec Nigeria Ltd.	72 Adeniyi Jones Avenue, Ikeja, Lagos Phone: +234 803 449 967 0	Solar lighting systems, solar water pumping systems, power inverters, water filtering and purification systems, wind systems and small Hydro Power
Royal Power and Energy Ltd.	Plot 10b, 2 Ashabi Adewale Close, Off Chief Harmann St, Lekki Phase 1, Lagos Phone: +234 176 096 83 <a href="http://www.rpe ltd.com">www.rpe ltd.com</a>	Solar and wind power batteries, UPS and surge protectors
Solar Energy Services Ltd.	No. 14, Muri Okunola St., Suite 2, Victoria Island, Lagos Phone: +234 146 133 56	Solar streetlights, park lights, solar lighting
KXN Nig, Ltd.	3B, Ribadu Road, Ikorodu, Lagos Phone: +234 177 478 87 <a href="mailto:kxn@solarsolve.com">kxn@solarsolve.com</a>	Solar PV modules, refrigeration, batteries, controllers, water pumping, small home systems
OEIE Nig. Ltd.	14 Woji Road, Eugene Plaza, Rumuogba, Port Harcourt Phone: +234 846 100 452	Solar water borehole system, refrigeration, solar panels, streetlight billboards
Berekotry Detergents Ltd.	KM 1, Oremojo Rd, Iseyin, Oyo State Phone: +234 803 422 244 8	Biodiesel, bioplastics, cooking stoves

TABLE 7

## Local Business Institutions

NAME	ADDRESS	BUSINESS FOCUS
Lagos Chamber of Commerce and Industry	1 Idowu Taylor St., Victoria Island Phone: +234 177 466 17 Fax: +234 127 010 09 <a href="http://www.lagoschamberng.com">www.lagoschamberng.com</a>	Pioneer Chamber of Commerce and Industry in Nigeria
Manufacturers Association of Nigeria	MAN House, Ikeja, P.O. Box 3835, Lagos Phone: +234 149 742 403 Fax: +234 149 742 47 <a href="http://www.manufacturersnigeria.org">www.manufacturersnigeria.org</a>	Umbrella body for all local manufacturers in Nigeria
Kaduna Chamber of Commerce and Industry	Kaduna International Trade and Investment Centre, Km 4, Kaduna-Zaria Rd., P.O. Box 728, Kaduna Phone: +234 623 187 94 Fax: +234 623 187 94 <a href="http://www.kadunachamberofcommerce.org">www.kadunachamberofcommerce.org</a>	One of the leading chambers of commerce and industry in the North
Kano Chamber of Commerce and Industry	Trade Fair Complex, Zoo Road, P.O. Box 10, Kano City, Kano Phone: +234 646 671 38 Fax: +234 646 671 38 <a href="mailto:kaccima@hotmail.com">kaccima@hotmail.com</a>	One of the leading chambers of commerce and industry in the North
Enugu Chamber of Commerce, Industry, Mines and Agriculture	Trade Fair Complex, Abakaliki Road, P.O. Box 734, Enugu Phone: +234 422 505 75 Fax: +234 422 521 86 <a href="http://www.enuguchambers.net">www.enuguchambers.net</a>	One of the leading chambers of Commerce and Industry in the South East
Onitsha Chamber of Commerce and Industry	Achike House, 38, Ogota Road, P.O. Box 2578, Onitsha, Anambra State Phone: +234 464 141 40 Fax: +234 462 511 34 <a href="mailto:oniccima02@yahoo.co.uk">oniccima02@yahoo.co.uk</a>	One of the leading chambers of Commerce and Industry in the South East
Abuja Chambers of Commerce and Industry	Abuja International Trade Fair Complex, Km8, Airport Road, P.M.B 86, Garki, Abuja Phone: +234 967 072 18	Leading chamber of commerce and industry in the Federal Capital



TABLE 8

## Relevant Governmental Institutions and Agencies

NAME	ADDRESS	AREA OF FOCUS
Energy Commission of Nigeria (ECN)	Plot 701C, 358, Garki, Abuja, Nigeria dg@energy.gov.ng <a href="http://www.energy.gov.ng">www.energy.gov.ng</a>	Strategic energy planning, coordination and performance, laying down guidelines on the utilization of energy types for specific purposes
Sokoto Energy Research Centre, Sokoto	Uthman Dan Fodio University, Sokoto <a href="http://www.edusok.edu.ng">www.edusok.edu.ng</a>	Mandate for research of RE and implementation of relevant pilot programs
National Centre for Energy Research and Development	University of Nigeria, Nsukka, Enugu State	Mandate for research in renewable energy with a number of completed pilot projects
Rural Electrification Agency (REA)	No. 16, Gwani Street, off IBB Way, Wuse Zone 4, PMB, 5072, Wuse, Abuja <a href="http://www.reang.ng">www.reang.ng</a>	Provision of reliable and affordable electricity supply to all rural dwellers using both grid and non-grid options
UNIDO Regional Center for Small Hydro Power	WAEC Building, Plot 10 (2nd Floor), Zambezi Crescent, Maitama, PMB 175, Garki, Abuja <a href="http://www.unidorc.org/nigerian">www.unidorc.org/nigerian</a>	Established in Abuja for the promotion and acceleration of SHP in the region; development of cost effective technologies, capacity building and training
Renewable Energy Section (NNPC)	Block B, NNPC Towers, Central Business District, P.M.B. 190, Garki, Abuja <a href="http://www.nnpcgroup.com">www.nnpcgroup.com</a>	National secretariat for biofuel policies and implementation



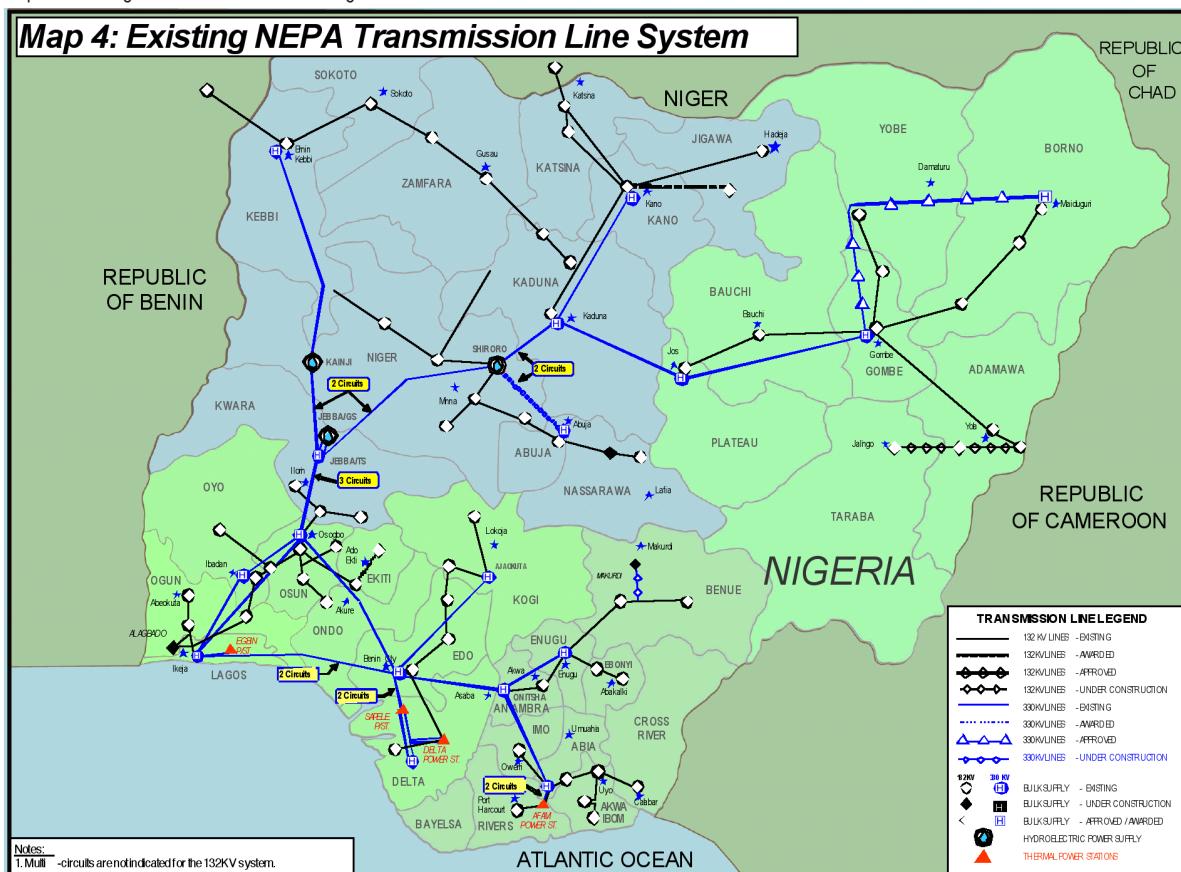
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8 ANNEX

**FIGURE 4**

## Map of Existing Transmission Lines in Nigeria



Source: Oke, as of 2008

TABLE 9

## Installed Power Generating Capacity on the Nigerian Grid (2006)

TYPE	INSTALLED CAPACITY (MW)	%
Hydro		
Kanji	760	28.9
Jebba	540	
Shiroro	600	
Gas turbines		
Sapele	300	40.0
Afam	920	
Delta	840	
AES	270	
AGIP	300	
Steam turbines		
Egbin	1,320	31.1
Sapele	720	
Total capacity	6,570	100

Source: Oke, as of 2008



**TABLE 10**  
**Electricity Tariffs in Nigeria**

RESIDENTIAL CLASS						
Class	Demand Level	Demand Charge/KVA	Max. Charge/Month	Fixed Charge	Meter Maintenance Charge/Month	Energy Charge/KWH
R1	< 5 kVA	-	-	20	100.00	1.2
R2	< 5–15 kVA	-	-	30	100.00	4.0
R3	< 15–45 kVA	-	-	120	500.00	6.0
R4(MD)	LV: < 45–500 kVA	-	5,000.00	120	1,600.00	8.5
R5(MD)	HV: < 500 kVA – 20 MVA	-	31,250.00	-	2,200.00	8.5

COMMERCIAL CLASS						
Class	Demand Level	Demand Charge/KVA	Max. Charge/Month	Fixed Charge	Meter Main Charge/Month	Energy Charge/KWH
C1	< 5–15 kVA			90	500.00	8.5
C2	< 15–45 kVA			120	1,600.00	8.5
C3(MD)	LV:<45–500 kVA	230,00	5,000.00	240	2,200.00	8.5
C4(MD)	HV: < 500 kVA – 20 MVA	230,00	31,250.00			

INDUSTRIAL CLASS						
Class	Demand Level	Demand Charge/KVA	Max Charge /Month	Fixed Charge	Meter Main Charge/Month	Energy Charge /KWH
D1	< 5–15 kVA	-	-	90	100.00	6.5
D2	< 15–45 kVA	-	-	120	500.00	8.5
D3	LV: < 45–500 kVA	230	5,000.00	240	1,600.00	8.5
D4	HV: < 500 kVA – 20 MVA	250	31,250.00		2,200.00	8.5
D5	> 20 MVA	270	-	1.5 M	2,200.00	8.5

PREPAYMENT CLASS						
Tariff Index	Rate	Meter Maintenance Fee		Fixed Charge		
Residential 3 phase (R3) index 2	6.0	500		120		
Commercial 3 phase (C2) index 5	8.5	500		120		
Commercial 3 phase (C3) index 6	8.5	1,600		240		
Residential single phase (R2) index 1	4.0	100		30		
Commercial single phase (C1) index 4	6.5	100		90		

Source: PHCN, as of 2008



## NIGERIA

**TABLE 11**

NEPA Estimate of Current Exploitable Hydro Power Sites in Nigeria

LOCATION	RIVER	POTENTIAL CAPACITY (MW)
Donka	Niger	225
Zungeru II	Kaduna	450
Zungery I	Kaduna	500
Zurubu	Kaduna	20
Gwaram	Jamaare	30
Izom	Gurara	10
Gudi	Mada	40
Kafanchan	Kongum	5
Kurra II	Sanga	25
Kurra I	Sanga	15
Richa II	Daffo	25
Richa I	Mosari	35
Mistakuku	Kurra	20
Korubo	Gongola	35
Kiri	Gongola	40
Yola	Benue	360
Karamti	Kam	115
Beli	Taraba	240
Garin Dali	Taraba	135
Sarkin Danko	Suntai	45
Gembu	Dongu	130
Kasimbila	Kasina Ala	30
Katsina Ala	Katsina Ala	260
Makurdi	Benue	1,060
Lokoja	Niger	1,950
Onitsha	Niger	1,050
Ifon	Osse	30
Ikrom	Cross	730
Afokpo	Cross	180
Atan	Cross	180
Gurara	Gurara	300
Mambilla	Danga	3,960
Total		12,220

Source: ECN, Renewable Energy Master Plan, as of 2005

**TABLE 12**

Small Hydro Potential in Surveyed States of Nigeria

STATE (PRE 1980)	RIVER BASIN	TOTAL SITES	TOTAL CAPACITY (MW)
Sokoto	Sokoto-Rima	22	30.6
Katsina	Sokoto-Rima	11	8.0
Niger	Niger	30	117.6
Kaduna	Niger	19	59.2
Kwara	Niger	12	38.8
Kano	Hadeija-Jamaare	28	46.2
Borno	Chad	28	20.8
Bauchi	Upper Benue	20	42.6
Gongola	Upper Benue	38	162.7
Plateau	Lower Benue	32	110.4
Benue	Lower Benue	19	69.2
Rivers	Cross River	18	258.1
Total		277	734.2

Source: ECN, Renewable Energy Master Plan, as of 2005

**TABLE 13**

Existing Small Hydro Schemes in Nigeria

RIVER	STATE	INSTALLED CAPACITY (MW)
Bagel I	Plateau	1
Bagel II	Plateau	2
Ouree	Plateau	2
Kurra	Plateau	8
Lere I	Plateau	4
Lere II	Plateau	4
Bakalori	Sokoto	3
Tiga	Kano	6

Source: ECN, Renewable Energy Master Plan, as of 2005