

Energy Industry in Nigeria



General State of the Economy

Nigeria, the official name - Federal Republic of Nigeria, with its capital Abuja, is located in West Africa and borders Niger (in the north), Chad (in the northeast), Cameroon (in the east), and Benin (in the west).

In terms of its size, Nigeria is 33rd in the world, behind Angola, Niger, and South Africa; and in terms of population density, the country is ahead of most of the countries in the region, including South Africa, Benin, and Cameroon, and is 67th in the world, with an average den-

sity of 212 people per 1 km² [1,2]. The total length of the country's coastline is 853 km [3].

According to 2022 statistics, the country is home to around 225 million people [3].

Five out of ten indices characterizing the economic situation in the country are at the bottom part of the diagram shown in Figure 1.

Between 2000 and 2014, the country experienced rapid growth in GDP at purchasing power parity, but then it dropped, amounting to \$1.121 trillion in 2017 [3,4]. For



Sources:

1. GDP (purchasing power parity), 2020 est. / The World Factbook/Library/Central Intelligence Agency *228
 2. GDP - per capita (PPP), 2020 / The World Factbook/Library/Central Intelligence Agency *229
 3. Inflation rate (consumer prices), 2019 est. / The World Factbook/Library/Central Intelligence Agency *228
 4. Charges for the use of intellectual property, receipts (BoP, current US\$), 2020 / International Monetary Fund, Balance of Payments Statistics Yearbook, and data files. / License: CC BY-4.0 *88
 5. The Global Competitiveness Index 2019 / Rankings / Reports / World Economic Forum *141
 6. High-technology exports (current US\$) 2019-2020 / United Nations, Comtrade database through the WITS platform / License: CC BY-4.0 / Data *134
 7. 2021 Index of Economic Freedom / International Economies / The Heritage Foundation *178
 8. Reserves of foreign exchange and gold, 2017 est. / The World Factbook / Library / Central Intelligence Agency *195
 9. Annual average GDP growth in %, for the last 10 years (2011-2020) / World Bank national accounts data, and OECD National Accounts data files / License: CC BY-4.0 *206
 10. Public debt (% of GDP), 2017 est. / The World Factbook / Library / Central Intelligence Agency *210
- * Total number of countries participating in ranking

Figure 1. Economic indices of Nigeria

this indicator, Nigeria is 25th in the world, behind Saudi Arabia and Egypt [3].

According to GDP at purchasing power parity per capita, Nigeria shows a figure below world average - \$4 900 in 2020 [3]. The inflation rate in 2019 was 11.3%, compared to 16.5% in 2017 [3].

According to the Global Competitiveness Report, presented by the World Economic Forum in 2019, the country is 116th, out of an estimated total of 141 countries, behind Tunisia. This rating reflects the effectiveness of the use of the country's own resources for sustainable development. In addition to a number of economic indicators, this index also takes into account such variables as education, health, level of innovation, etc.

In the list of countries that export high-tech products in 2019-2020, the country was 77th out of 134 countries, behind Egypt. According to the Index of Economic Free-

dom, which is based on freedom of business, freedom from government action, property protection, and freedom from corruption, Nigeria was 105th in 2021, out of the 178 countries considered, behind Namibia. In terms of reserves of foreign exchange and gold Nigeria is 45th out of 195 countries, ahead of Morocco and Egypt.

According to the indicator for the average GDP growth in percentage over the last 10 years (2011–2020), in 2020 the country was 86th out of 206 countries. In terms of public debt, calculated as a percentage of the country's GDP, Nigeria was ranked 185th out of 202 countries considered in 2017.

For more information on the Nigerian economy click [here](#).

Energy resources

Nigeria has sufficiently large and varied reserves of fossil resources (Table 1), but the main resources of the country are oil and gas. These type of resources are represented by reserves of traditional oil, as well as oil sands and extra heavy oil, natural gas and associated petroleum gas.

In terms of tons of oil equivalent, in 2021 proved reserves of conventional hydrocarbons in Nigeria were: gas - 49.6%, oil - 48.1%, coal - 2.3% (Fig.5). The unconventional natural resource matrix looks much different: associated petroleum gas - 96.8%, oil sands and heavy oil - 3.2%(Fig. 5).

Table 1. Fossil energy resources of Nigeria

Resource/explanations	Crude oil	Natural gas	Coal	Associated petroleum gas	Oil sands heavy oil*
Value	37.45	5.475	379	97.21	574
Unit	billion bbl	Tcm	million short tonnes	Tcf	million barrel
Year	2018	2018	2016	2015	2008
Source	[3]	[3]	[7]	[10]	[9]

*original reserves

According to information presented in [3], as of the beginning of 2018, oil reserves in the country amounted to 37.45 billion barrels, and gas reserves were 5.475 Tcm. According to the BP report, from 2000 to 2020, the total proved oil reserves increased from 29.0 to 36.9 billion barrels, and natural gas reserves grew from 3.9 Tcm to 5.5 Tcm in 2020 [6]. Coal reserves were estimated at 379 million short tons in 2016 [7].

Nigeria has small reserves of oil sands and heavy oil - about 574 million barrels [8]. There are also gas hydrate occurrences discovered to the south of Nigeria [9] (Fig.5). Resources of associated petroleum gas amounted to 97.21 Tcf in 2015 [10].

Nigeria has a significant potential for the development of renewable energy (Table 2).

Table 2. Renewable energy resources of Nigeria

Resource/ explanations	Solar Potential (GHI)*	Wind Potential (50 m)*	Hydro energy Potential**	Bio Potential Agricultural area	Bio Potential Forest Area	Municipal Solid Waste
Value	4.9 - 5.5	4.0 - 5.0	30	78	9.5	0.56
Unit	kWh/m ² /day	m/s	TWh/yr	% of land area	% of land area	Kg/per capita/day
Year	2018	2018	2008	2018	2018	2012
Source	[11]	[12]	[8]	[13]	[14]	[17]

*for most of the territory of the country

**economically exploitable hydropower potential

Due to its favorable geographical location, Nigeria has a significant potential for the development of solar energy. The most typical level of global horizontal irradiation is 4.9 - 5.5 kW / m² / day, and it can reach the level of over 6.0 kW / m² / day in the northern part of the country [11]. Wind speed in most parts of Nigeria is 4.0 - 5.0 m / s, and in the north of the country along the borderline with Niger, it can reach over 5.0 m / s [12]. Only 9.5% of the county is forested with around 78% covered by agricultural land [13,14].

Nigeria has a dense river network. Economically exploitable hydropower potential of the country is 30 TWh/yr, and small hydropower potential is 735 MW [8,15]. Potent-

tial for the use of ocean energy and sea wave energy in the south of the country can reach 10 kW/m [16].

This energy review of Nigeria would not be complete without mentioning municipal waste (0.56 kg per person per day), the disposal of which is the optimal solution from both an environmental and economic point of view [17]. However, the application of these technologies in the country has not received the necessary expansion.

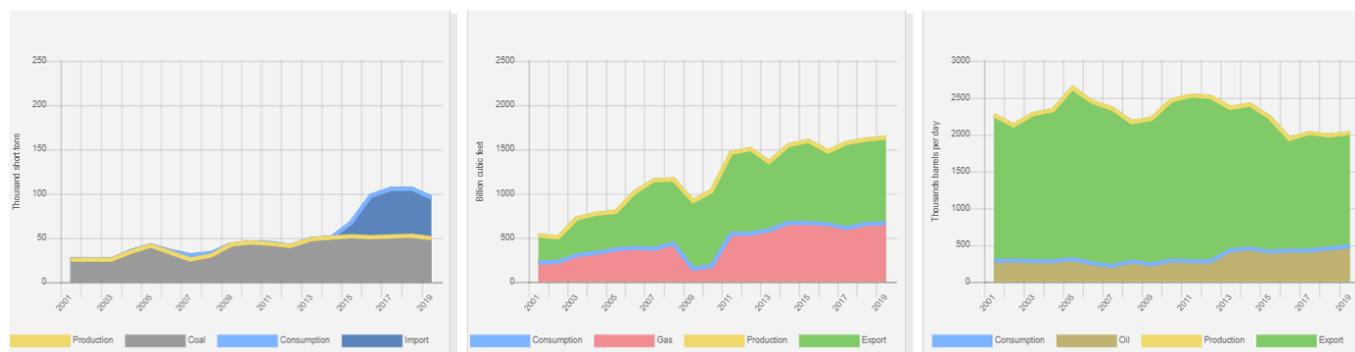
For more information about energy resources in Nigeria click [here](#).

Energy balance

Nigeria is one of the largest oil producers in Africa [18]. The production of oil remained stable since 2006, in 2017 it was 2015 thousand barrels / day, and 2020 thousand barrels/day in 2019 [19]. In 2020 it was at the level of 1798 thousand barrels / day according to [6], and 1989 thousand barrels / day in 2018 according to [3]. The volume of consumption of this resource also remained stable (Fig. 2), and in 2019 reached the level of 483 thousand barrels / day [19]. As reported in [3], the

volume of oil exports from Nigeria in 2015 amounted to 2.096 million bbl / d. The main importer of oil from Nigeria are the countries of the European Union [18].

Internal gas production in 2019 was 1635 Bcf, demonstrating a strong growth, compared to the previous years [19]. According to [3], gas production amounted to 44.48 billion m³ in 2017 and to 49.4 Bcm in 2020 [6]. Gas consumption in Nigeria has been slowly growing since 2001, and reached the level of 609 Bcf or 17.24 Bcm in 2017, and 663 Bcf in 2019 [3,6]. In 2017 Nigeria exported 27.21 Bcm of natural gas [3].



Source: U.S. Energy Information Administration (Dec 2021) / <https://www.eia.gov/>

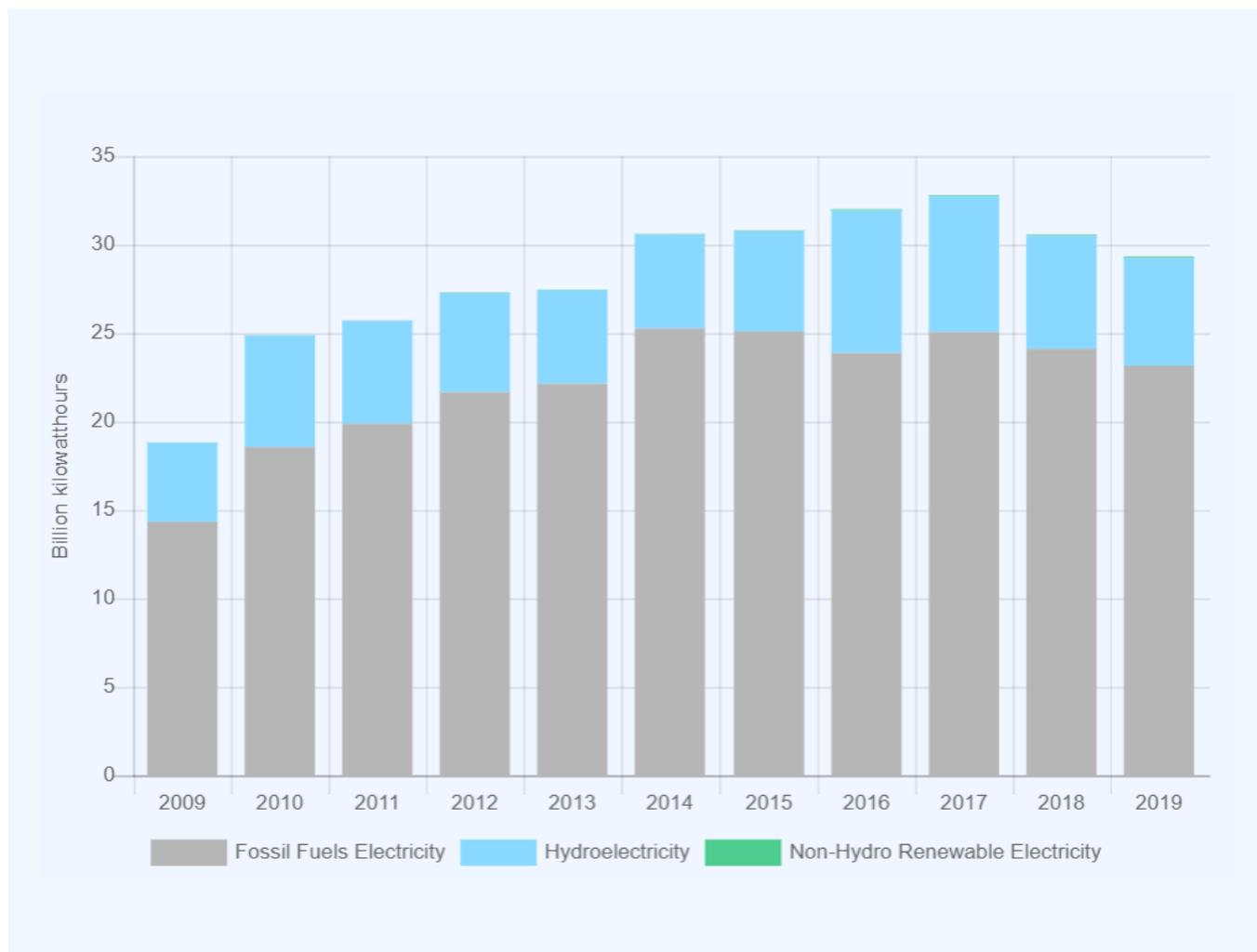
Figure 2. The production and consumption of fossil fuels in Nigeria (coal-left, gas-in the center, oil-right)

Nigeria is also the fourth largest exporter of LNG in the world after Qatar, Malaysia and Australia. In 2014, the country exported about 900 Bcf. The largest importers of Nigerian LNG are the countries of South-East Asia - Japan, and South Korea [18].

Coal production has been steadily growing for the last decade, and in 2019 reached a level of 49.6 thousand short tons, while consumption rapidly grew between

2013 and 2019 reaching the level of 95 thousand short tons [19]. Production of associated petroleum gas between 2010-2015 remained fairly stable at between 1.74 -1.88 Tcf/day [10], 42% of which was re-injected to improve oil production.

Historically, Nigeria has a high share of fossil fuels in electricity production (Fig. 3).



Source: U.S. Energy Information Administration (Dec 2021) / <https://www.eia.gov/>

Figure 3. Electricity production in Nigeria

In 2019 Nigeria produced about 29.33 TWh of electricity, of which 79% was by fossil fuels, 20.8% by hydro power, and 0.2% by other renewable sources (Fig. 6).

Nigeria's position in the comparative diagram of energy index is shown in Fig. 4.

As mentioned previously, Nigeria has a potential of traditional fossil resources, which provides a high level of indices associated with crude oil and natural gas. At the same time, the country simultaneously shows high indicators of the production-consumption combination for these resources.

GDP per unit of energy use is above the world average—98th place out of 130 countries considered, while energy consumption per capita is lower - 100th out of 136 countries.

The share of renewable energy in electricity production is practically non-existent, and in the list of countries in 2017 the country has a zero value for this indicator.

In the Energy Architecture Performance Index 2017, which is based first on the level economic growth, environmental safety, and energy independence of the country, including access to energy, Nigeria lost 28 ran-



Sources:

1. Crude oil proved reserves, 2021 / International Energy Statistic/Geography / U.S. Energy Information Administration (Nov 2021) *98
 2. Natural gas proved reserves 2021 / International Energy Statistic / Geography / U.S. Energy Information Administration (Nov 2021) *99
 3. Total recoverable coal reserves 2019 / International Energy Statistic / Geography / U.S. Energy Information Administration (Nov 2021) *81
 4. Combination production-consumption for Crude oil 2018 / International Energy Statistic / Geography / U.S. Energy Information Administration (Nov 2021) *219
 5. Combination production-consumption for Natural gas 2019 / International Energy Statistic / Geography / U.S. Energy Information Administration (Nov 2021) *123
 6. Combination production-consumption for Coal 2019 / International Energy Statistic / Geography / U.S. Energy Information Administration (Nov 2021) *128
 7. Electricity – from other renewable sources (% of total installed capacity), 2017 est. / The World Factbook / Library / Central Intelligence Agency *170
 8. GDP per unit of energy use (constant 2017 PPP \$ per kg of oil equivalent), 2014 *130
The World Bank
 9. Energy use (kg of oil equivalent per capita), 2014 *136
The World Bank
 10. The Global Energy Architecture Performance Index Report (EAPI) 2017 / Rankings / Reports / World Economic Forum
 11. Electric power consumption (kWh per capita), 2016 *217
Electricity Consumption - The World Factbook / Library / Central Intelligence Agency; Population - United Nations, Department of Economic and Social Affairs, Population Division (2019). World Population Prospects 2019, custom data acquired via website. Retrieved 15 November 2021
 12. Combination of electricity production-consumption (kWh)/The World Factbook/Library/Central Intelligence Agency *216
- * Total number of countries participating in ranking

Figure 4. Energy indices of Nigeria

king positions over the previous year, and is 110th in the world, behind Libya and Egypt.

In terms of electricity consumption per capita, the country is 191st in the world, however, for the indicator of combination of electricity production-consumption, Nige-

ria is 54th in the ranked list of 216 countries.

More information about the energy balance of Nigeria can be found in the documents from our reference library [here](#).

Energy Infrastructure

A territorial map of the distribution of the largest infrastructure projects of the fossil fuel sector in Nigeria is shown in Figure 5.

As mentioned previously, oil reserves account for 48.1%, and gas reserves account for 49.6%, of the energy potential of fossil resources. The main oil and gas fields are concentrated in the south of the country (Fig.5).

Three types of pipelines connect the fields with refineries and consumers: crude oil pipelines with a total length of 4 441 km, pipelines for transporting oil products with a total length 3 940 km, and liquefied natural gas with a total length of 164 km. The length of the gas pipeline is 4045 km and the length of the condensate is 124 km [3]. The total installed capacity of Nigeria's oil refining industry is 445 thousand barrels/day (Fig. 5). The Nigerian

National Petroleum Corporation manages three oil refineries, the largest of which is Port Harcourt Refinery (210 thousand barrels/day) [20].

The most important oil storage facility is Qua Iboe Oil Terminal, which is located in the south of the country, in close proximity to the fields and has a capacity of 8 520 thousand barrels/day [21]. The largest FPSO (Floating Production, Storage and Offloading) terminal is Erha, with a capacity of 2 355 335 barrels [22].

Bonny LNG Export Terminal is located on the coast in the south of the country, in the Port Harcourt area, and has a capacity of 1.1 Bcf/year [23]. The largest importers of Nigerian LNG are the countries of South-East Asia - Japan, and South Korea [18].

The natural gas processing infrastructure is located in close proximity to the fields - Soku plant owned by Shell has an installed capacity of 1 100 MMscfd [24].

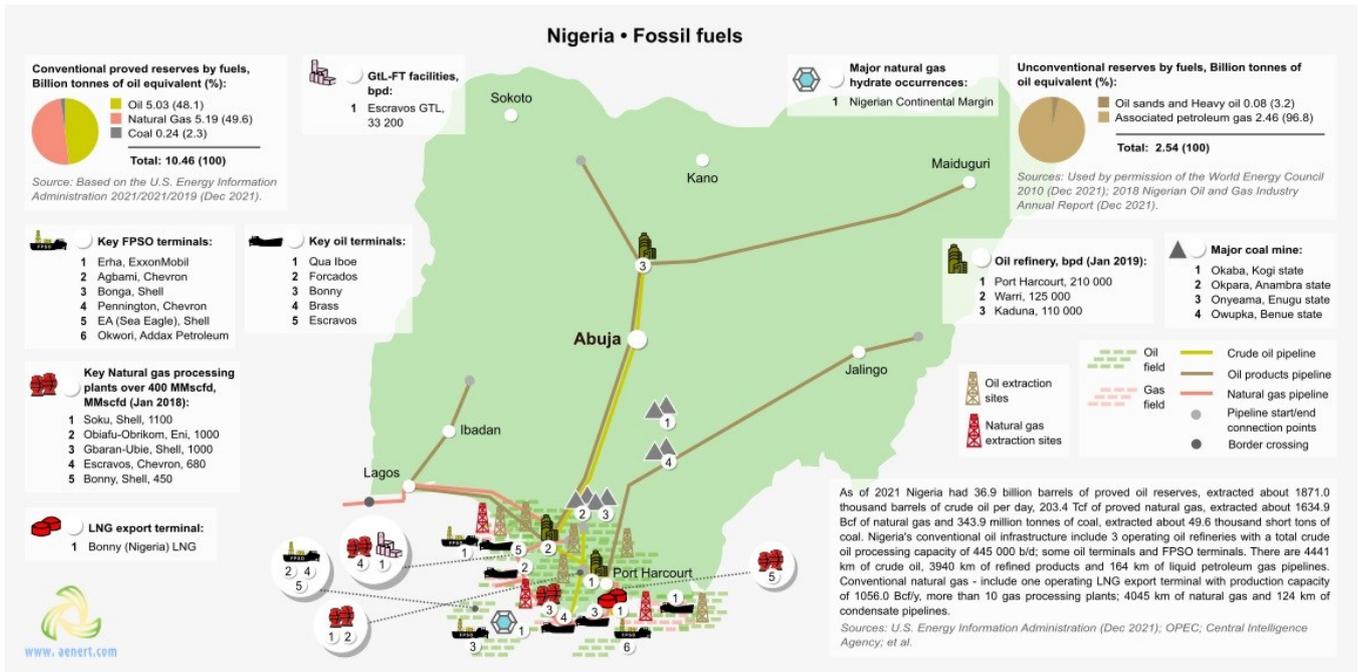


Figure 5. Basic infrastructural facilities of the fossil fuel sector in Nigeria

Escravos GTL, with a capacity of 33 200 barrels/day, operated by Chevron and NNPC, began production of liquid hydrocarbons in 2014 using Sasol Chevron's Fischer-Tropsch and isocracking technologies that allow to reduce volumes of combustible gas [18]. The largest coal deposit in Nigeria is Okaba Coal Mine in Kogi state with proven reserves of 73 million tons [25].

In Figure 6, you can see the main facilities of the Nigerian infrastructure for the production of energy from traditional and renewable sources.

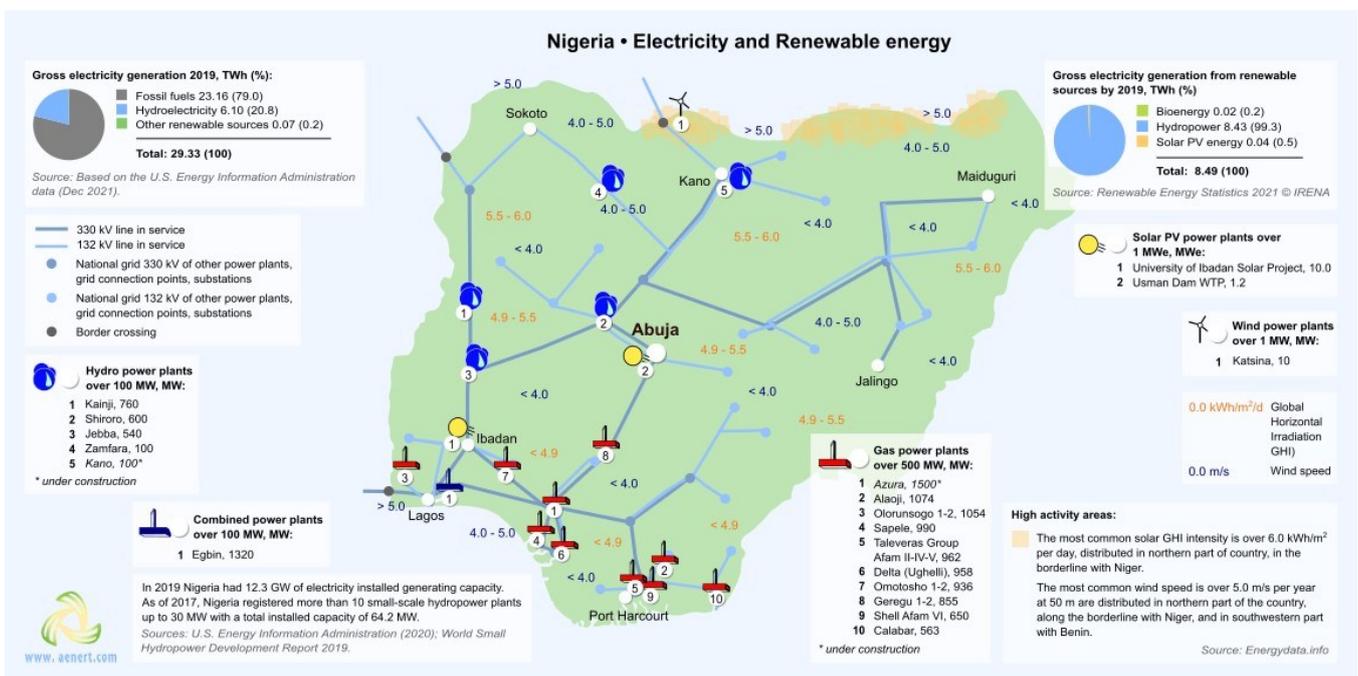


Figure 6. Renewable energy and Electricity in Nigeria

In 2019 Nigeria produced about 29.33 TWh of electricity, of which 79% was by fossil fuels, 20.8% by hydro power, and 0.2% by other renewable sources.

Nigeria has considerable capacities for power generation from fossil fuels, including 10 large gas power stations with a capacity of more than 500 MW and one station of combined cycle Egbin [26], with installed capacity of 1 320 MW (Fig. 6).

The leader in electricity generation among power plants operating on gas is Azura, with a capacity of 1 500 MW. [27].

As noted above, renewable energy in Nigeria, including hydropower, does not have a decisive influence on electricity generation.

In 2019, around 6.10 TWh of electricity was generated by means of hydropower (Fig. 6). The country's largest hydroelectric power plant Kainji, has an installed capacity of 760 MW [28].

Education and Innovation

The set of indices reflecting the position of Nigeria among other countries in the field of education and innovation can be seen in Figure 7.

In 2019, the total electricity production from renewable sources, excluding hydropower, was 0.07 TWh (Fig. 6).

As mentioned earlier, the level of global horizontal solar radiation can reach over 6 kWh/m² per day, and the level of wind speed can reach more than 5 m/sec, which is a good resource for the production of energy [10,11]. However, as already mentioned, this resource has not been actively capitalized. Several solar stations and one wind farm Katsina Wind Power Plant with a capacity of 10 MW [29] operate on the territory of the country (Fig.6). The largest solar power plant is the University of Ibadan PV Solar Plant Project, with an installed capacity of 10 MW [30].

Detailed information about energy infrastructure of Nigeria can be found [here](#).

In the country ranking in accordance with The Global Innovation Index in 2021, Nigeria was 118th, behind Egypt and Algeria.



Sources:

1. The Global Innovation Index 2021, Rankings / Knowledge / World Intellectual Property Organization / Cornell University, INSEAD, and WIPO (2021): Energizing the World with Innovation. Ithaca, Fontainebleau, and Geneva *132
 2. Patent Grants 2011-2020, resident & abroad / Statistical country profiles / World Intellectual Property Organization *185
 3. Patents in Force 2020 / Statistical country profiles / World Intellectual Property Organization *109
 4. QS World University Rankings 2022 *97
 5. SCImago Country Rankings (1996-2020) / Country rankings / SCImago, (n.d.). SIR-SCImago Journal & Country Rank [Portal]. Retrieved 17 Nov 2021 *240
 6. Internet users in 2018 / The World Factbook / Central Intelligence Agency *229
 7. Internet users in 2018 (% Population) / The World Factbook / Central Intelligence Agency *229
 8. Government expenditure on education, total (% of GDP), 2019 / United Nations Educational, Scientific, and Cultural Organization (UNESCO) Institute for Statistics. License: CCBY-4.0 / Data as of September 2021*177
 9. Research and development expenditure (% of GDP), 2018 / UNESCO Institute for Statistics. License: CCBY-4.0 / Data *119
 10. Scientific and technical journal articles, 2018 / National Science Foundation, Science and Engineering Indicators. License: CCBY-4.0 / Data *197
- * Total number of countries participating in ranking

Figure 7. The indices of education and innovation in Nigeria

According to the number of patents granted to Nigerian residents, both inside the country and abroad, the country ranks 86th in the world.

Nigeria is well positioned when considering the number of publications of specialists in scientific and technological journals – 48th place out of 197 countries considered. It is also regarded highly by the Scimago Journal and Country Rank (51st place).

Federal University of Technology, the University of Ibadan, the University of Port Harcourt and Obafemi Awolowo University are actively involved in the research in the field of associated petroleum gas. The university of Benin, Abubakar Tafawa Balewa University and Ekiti State University, Obafemi Awolowo University publish scientific papers in the field of extraction and processing of unconventional oil. Nigerian Institute for Oceanography and Marine Research (NIOMR) are involved in the research in the field of gas hydrates. Federal University of Technology, the University of Ibadan, the University of Port Harcourt publish research paper on the subject of

hydrocarbon production from low permeability reservoirs.

In the field of synthetic fuel development – the university of Port Harcourt, Abubakar Tafawa Balewa University and Ahmadu Bello University, and in the field of coal seam methane – Covenant University.

Research and development in the field of bioenergy is being carried out by the University of Ibadan, federal University of Technology and Landmark University.

A large number of Nigerian universities conduct research in the field of energy production from renewable sources. Umaru Musa Yar’adua University, Covenant University and the University of Ilorin have the largest number of scientific publications in the field of concentrated solar power,

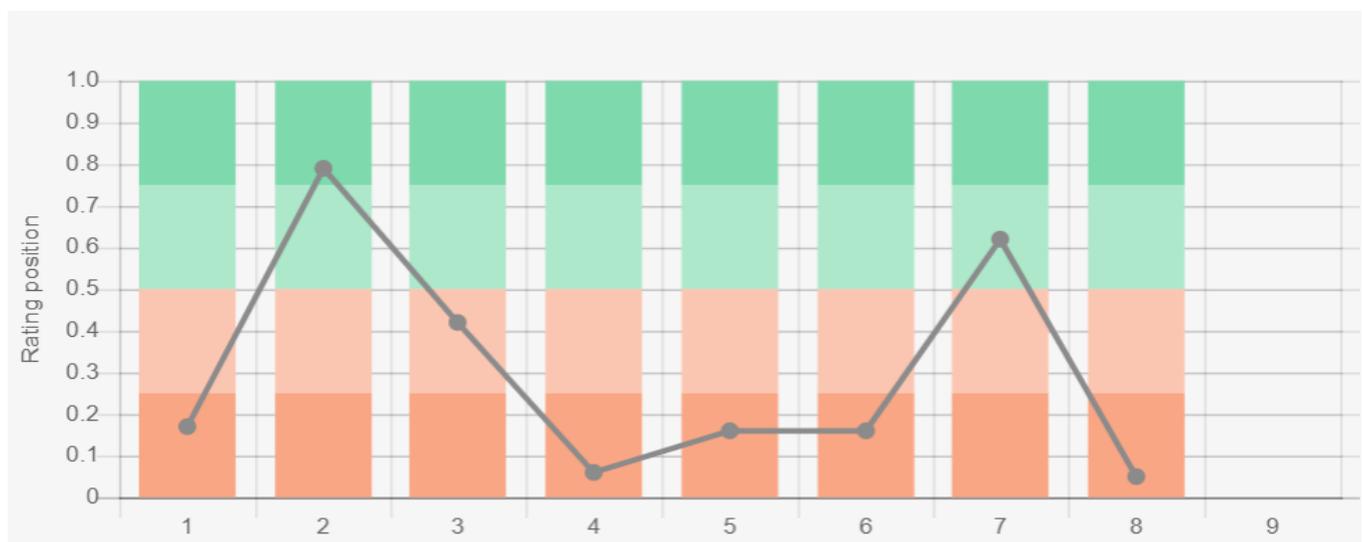
In the field of wind energy – Federal University of Technology and Michael Okpara University of Agriculture.

Detailed information about energy education in Nigeria is to be found [here](#).

Ecology and Environment Protection

A diagram of environmental indices is shown in Figure 8. The ecological situation in Nigeria cannot be called fa-

vorable. Most of the indicators are located in the lower part of the chart.



Sources:

1. CO2 total emission by countries 2020 / European Commission / Joint Research Centre (JRC) / Emission Database for Global Atmospheric Research (EDGAR)*208
2. CO2 per capita emission 2020/European Commission/Joint Research Centre (JRC) / Emission Database for Global Atmospheric Research (EDGAR) *208
3. Forest area 2020 (% of land area) / The Global Forest Resources Assessment 2020 / Food and Agriculture Organization of the United Nations *234
4. Forest area change 2010-2020 (1000 ha/year) / The Global Forest Resources Assessment 2020 / Food and Agriculture Organization of the United Nations *234
5. The Environmental Performance Index (EPI) 2020 / Rankings / Yale Center for Environmental Law & Policy / Yale University *180
6. Annual freshwater withdrawals (m3 per capita), 2017 *179
Annual freshwater withdrawals, total (billion m3), 2017 – Food and Agriculture Organization, AQUASTAT data. /License: CC BY-4.0;
- Population – United Nations, Department of Economic and Social Affairs, Population Division (2019).
World Population Prospects 2019, custom data acquired via website. Retrieved 15 November 2021
7. The National Footprint Accounts 2017 (Biocapacity Credit / Deficit) / Global Footprint Network *188
8. Methane emissions (kt of CO2 equivalent), 2018 / Data for up to 1990 are sourced from Carbon Dioxide Information Analysis Center, Environmental Sciences Division, Oak Ridge National Laboratory, Tennessee, United States. Data from 1990 are CAIT data: Climate Watch. 2020. GHG Emissions. Washington, DC: World Resources Institute. Available at: License : Attribution-NonCommercial 4.0 International (CC BY-NC 4.0) *191
9. The Climate Change Performance Index (CCPI) 2022 / Overall Results / Jan Burck, Thea Uhlich, Christoph Bals, Niklas Höhne, Leonardo Nascimento / Germanwatch, NewClimate Institute & Climate Action Network *60

* Total number of countries participating in ranking

Figure 8. Environmental indices of Nigeria

Nigeria has a high level of methane emissions, CO₂ emissions. There are no positive trends in forest area change, in terms of the ecological footprint on a global scale, Nigeria is a debtor.

The situation is aggravated, however, by a relatively low valuation of Nigeria in the Environmental Performance Index rankings (EPI) 2020, which focuses primarily on assessing the environmental performance of national governments.

In this rating Nigeria is below Egypt and is 151st out of 180 member countries and demonstrates a negative trend.

For more information on Nigerian energy industry, please click [here](#).

References

- [1] List of sovereign states and dependencies by area / Wikipedia / https://en.wikipedia.org/wiki/List_of_sovereign_states_and_dependencies_by_area
 - [2] List of countries and dependencies by population density / Wikipedia / https://en.wikipedia.org/wiki/List_of_countries_and_dependencies_by_population_density
 - [3] Nigeria / The world factbook / Library / Central Intelligence Agency / <https://www.cia.gov>
 - [4] GDP, PPP (constant 2011 international \$) / World Bank, International Comparison Program database. License : CC BY-4.0 / Data / The World Bank / <http://www.worldbank.org/>
 - [5] GDP per capita, PPP (current international \$)/ World Bank, International Comparison Program database .License : CC BY-4.0 / Data / The World Bank / <http://www.worldbank.org/>
 - [6] BP Statistical Review of World Energy 2021 (PDF) / BP / <https://www.bp.com/>
 - [7] Coal Resources / U.S. Energy Information Administration (Jan, 2020) / <http://www.eia.gov/>
 - [8] 2010 Survey of Energy Resources (PDF) / World Energy Council / www.worldenergy.org/
 - [9] The Nature of Gas Hydrates on the Nigerian Continental Slope. (1999) (PDF) / James M.Brooks, William R.Bryant, Bernie B.Bernard and Nick R.Cameron. / TDI Brooks / <https://www.tdi-bi.com/>
 - [10] 2015 Oil and Gas Annual Report (PDF) / Department of Petroleum Resources / <https://dpr.gov.ng/>
 - [11] Solar resource data obtained from the Global Solar Atlas, owned by the World Bank Group and provided by Solargis / Global Solar Atlas / <http://globalsolaratlas.info/>
 - [12] Wind Map / Global Wind Atlas 2.0, a free, web-based application developed, owned and operated by the Technical University of Denmark (DTU) in partnership with the World Bank Group, utilizing data provided by Vortex, with funding provided by the Energy Sector Management Assistance Program (ESMAP). For additional information: <https://globalwindatlas.info>
 - [13] Agricultural land (% of land area) / Food and Agriculture Organization, electronic files and web site. License : CC BY-4.0 / Data / The World Bank / <http://www.worldbank.org>
 - [14] Forest area (% of land area) /Food and Agriculture Organization, electronic files and web site.License : CC BY-4.0 / Data / The World Bank / <http://www.worldbank.org/>
 - [15] World Small Hydropower Development Report 2016 – Nigeria (PDF) / Small Hydropower World / <http://www.smallhydropower.org/>
 - [16] Wave power / Wikipedia / https://en.wikipedia.org/wiki/Wave_power
 - [17] World Bank What a Waste / Data / The World Bank / <http://www.worldbank.org>
 - [18] Nigeria / Geography / U.S. Energy Information Administration / <http://www.eia.gov/>
 - [19] International Energy Statistic / Geography / U.S. Energy Information Administration / <http://www.eia.gov/beta/international/>
 - [20] Port Harcourt Refining Company / Wikipedia / https://en.wikipedia.org/wiki/Port_Harcourt_Refining_Company
-

- [21] Qua Iboe / Crude Trading / Worldwide operations / ExxonMobil / <http://corporate.exxonmobil.com/en/>
- [22] Erha / Nigeria / Offshore Projects / SubseaIQ / <http://www.subseaig.com/>
- [23] The Plant / Our Company / Nigeria LNG Limited / <http://www.nlng.com/>
- [24] List of natural gas processing plants in Nigeria / Wikipedia / https://en.wikipedia.org/wiki/List_of_natural_gas_processing_plants_in_Nigeria
- [25] Mines / Nigerian Coal Corporation / Wikipedia / https://en.wikipedia.org/wiki/Nigerian_Coal_Corporation
- [26] Egbin Gas Power Plant / Nigeria / Fossil Fuels Energy / Industry About / <http://www.industryabout.com/>
- [27] Azura Thermal Power Station / Wikipedia / https://en.wikipedia.org/wiki/Azura_Thermal_Power_Station
- [28] Kainji Dam / Wikipedia / https://en.wikipedia.org/wiki/Kainji_Dam
- [29] Is the 10-MW Katsina Wind Farm Project Slowly Becoming Another Expensive White Elephant? By Daudu Abdulaziz / April 17, 2016 / Katsina Reporters / <https://katsinareporters.wordpress.com/>
- [30] Buhari inaugurates Nigeria's first solar power plant in UI / October 16, 2016 / Punch Newspapers / <http://punchng.com/>
-

The sources of charts and curves are specified under the images.