



An African Energy Industry Report :: 2018

Part of ispy publishing's Industry Survey, Market Intelligence, and Forecasts Series

Published: May 2018

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Executive Summary



Africa is an energy poor continent and stands at a crossroads.

Energy is at the core of two very important issues in Africa: ensuring a steady, reliable and sustainable supply for all people in all settings and facilitating and extending the economic growth that has created opportunities and raised hopes across the continent in the past decade.

To address these issues, African countries will have to harness their own vast energy resources. For this, in addition to legacy energy sources modern renewable technologies have an important role to play. Renewable technologies promote more inclusive economic and social development than fossil fuel-based options, because they are suitable small-scale solutions that can run independently from central control.

Global renewable energy solutions are available and economical. Solutions which are specific to Africa's energy challenges are also emerging. These solutions will allow Africa to leapfrog to achieve minimum cost, environmentally friendly energy sector development, which ultimately contributes to sustainable development goals.

Since 2000, Africa has been experiencing economic growth and energy consumption that has risen by 45%. However, the regional energy systems are under-developed and unable to meet the populations' demand. Although resources are more than sufficient to meet domestic needs, access to modern energy services remains limited.

Africa is a continent rich in energy resources, but poor in energy supply. With over 130 million households still dependent on other forms of energy such as: charcoal, kerosene, lantern, candles, fossil fuels, and another 620 million who do not have access to electricity at all, it is a truism that energy development is moving, but not quickly enough.

With more than 620 million people in Sub-Saharan Africa without access to reliable electricity, Africa faces an enormous energy challenge that requires a firm commitment to the accelerated use of modern renewable energy sources and to developing energy infrastructures which presently use legacy fossil fuel systems.

Most people in Sub-Saharan Africa face severe energy poverty, and low availability of energy services hampers economic development.

Meeting the growing energy demand of their population and ensuring universal access to modern energy services with respect to the environment are the principal goals of African countries.

Its growing population and economic progress has sent energy demand soaring. This calls for a rapid increase in supply on the continent, to which all forms of energy must contribute in the future and the pursuit of sustainable energy development as a basis for long-term prosperity.

Although Africa is richly endowed with fossil-based and renewable energy sources, a continued reliance on oil and gas along with traditional biomass combustion for energy brings with it considerable social, economic and environmental constraints.

Countries such as Egypt, Ethiopia, Kenya, Morocco and South Africa are leading this effort, while some of Africa's smaller countries including Cabo Verde, Djibouti, Rwanda and Swaziland have also set ambitious renewable energy targets.

Undoubtedly, renewable energy is on the rise across the continent. Africa 2030, IRENA's comprehensive roadmap for the continent's energy transition, illuminates a viable path to prosperity through renewable energy development.

Africa can deploy modern renewables to eliminate power shortages, bring electricity and development opportunities to rural villages that have never enjoyed those benefits, spur on industrial growth, create entrepreneurs, and support increased prosperity across the continent. Modern renewables can also facilitate a cost-effective transformation to a cleaner and more secure energy sector.

Some technology solutions are relatively easy to implement but require an enabling environment, with appropriate policies, regulation, governance and access to financial markets.

As a promising sign of things to come, several African countries have already succeeded in making steps necessary to scale up renewables, such as adoption of support policies, investment promotion and regional collaboration.

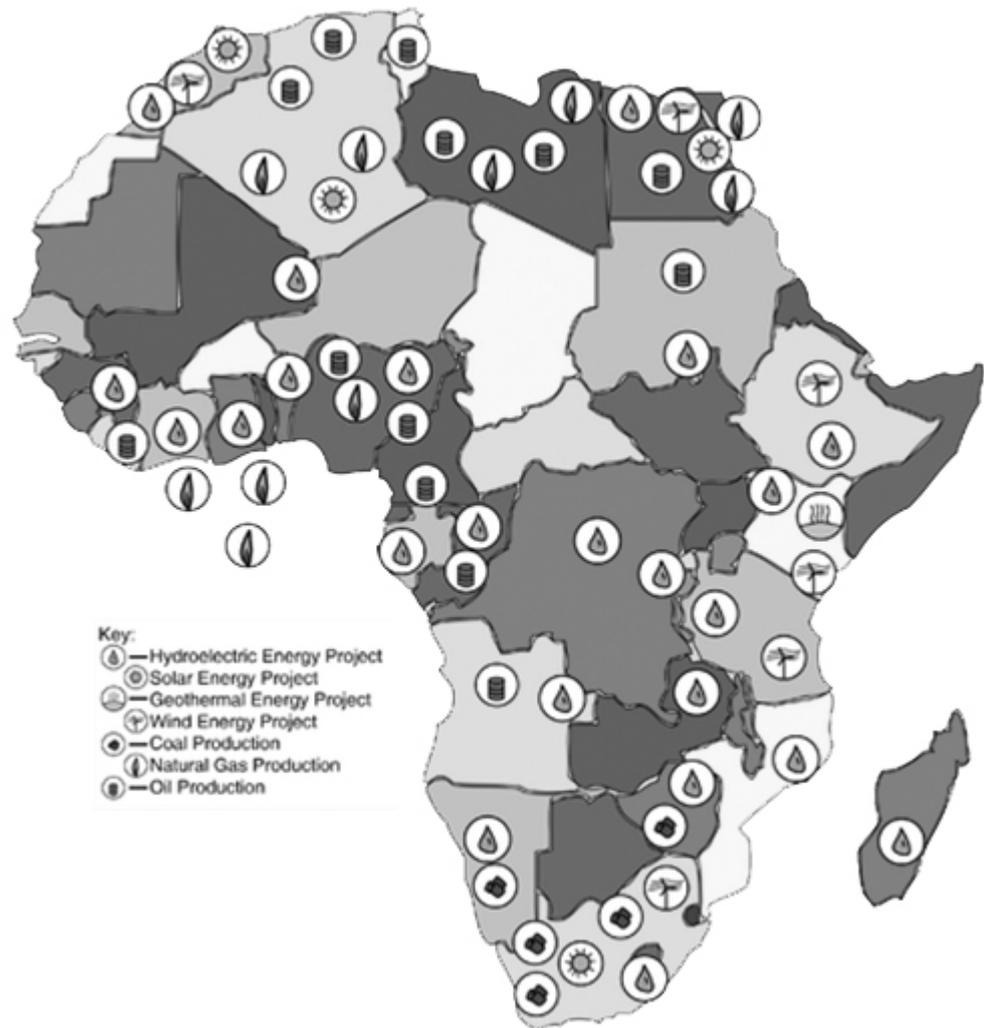
The African Energy Mix

- Oil 23%
- Coal 14%
- Gas 14%
- Bioenergy 48%
- Other (Nuclear, Hydro, Renewable) 1%

Fast Facts :: Africa

- Africa is an energy-poor continent. Most people in Sub-Saharan Africa face severe energy poverty, and the low availability of energy services hampers economic development.
- North African countries and South Africa are major exceptions with significantly higher levels of electrification and overall energy consumption.
- Meeting current and future energy demand poses a major challenge in all African countries. Africa's share of global oil production dropped again slightly in 2016 moving it from 9.3% to 9.1% of global output.
- Proven oil reserves on the continent are still estimated to be 7.6% of the global total.
- Middle East and Africa digital oilfield market is projected to cross \$2 billion by 2022.
- Africa has proven natural gas reserves of 502 trillion cubic feet (Tcf) with 90% of the continent's annual natural gas production of 6.5Tcf coming from Nigeria, Libya, Algeria and Egypt.
- Skills, people training and development are among their top-five strategic priorities over the next five years.
- Africa's population will more than double to 2.3 billion people by 2050
- Nigeria is fourth largest oil exporter in the world, and Africa's biggest oil producer with about 2.2 million barrels produced every day. Top 10 oil producers in order of total exports: Nigeria, Algeria, Angola, Libya, Egypt, Sudan, Equatorial Guinea, Republic of Congo, Gabon, South Africa.
- South Africa is the 10th largest oil producer in Africa and the 41st highest oil producing country in the world. It has a daily output of around 160,000 barrels. South Africa has just 15 million barrels of proven crude reserves and its crude oil production continues to decline as oil fields mature. The large economy and the well-developed infrastructure of South Africa are the two main strengths of its oil industry; it has the second-largest crude oil refining capacity in Africa.
- Exploration activity off the coast of South Africa is expected to ramp in the next 18 to 24 months with many upstream exploration companies commencing with approval processes for offshore exploration.
- Renewable energy in South Africa will contribute a total of 18.2 GW by 2030.
- Natural gas accounts for 3% of energy consumption in South Africa.
- It is intended that nuclear will comprises 17% of South Africa's base load energy mix by 2030.
- 57% of Africa's export earnings are derived from hydrocarbons.
- Africa 2030, part of IRENA's global REmap 2030 analysis, identifies modern renewable technology options spanning different sectors and countries. Collectively, these "REmap Options" could supply 22% of Africa's total final energy consumption by 2030, compared to 5% in 2013.
- Key modern renewable energy technologies across Africa include modern biomass solutions for cooking, along with hydroelectricity and wind power. Solar installations will also play a critical role in providing electricity access for remote off-grid locations and for grid connected applications.
- Half of all energy use in Africa involves traditional biomass consumption, which entails health risks due to smoke inhalation and social disparities in wood collection. Modernising biomass is not only beneficial for the economy. It will also improve human health, create social benefits and reduce environmental damage.
- Electricity demand in Africa is projected to triple by 2030, offering huge potential for renewable energy deployment. The power sector requires investments of US\$ 70 billion per year on average between now and 2030. This can be split into about US\$ 45 billion per year for generation capacity and US\$ 25 billion for transmission and distribution. Renewables could account for two thirds of the total investments in generation capacity, or up to US\$ 32 billion per year. Realising this opportunity will create significant business activity in Africa.
- In the power sector, the share of renewables could grow to 50% by 2030. This would result in around 310 Mt CO2 emissions reduction compared to the Baseline scenario in 2030. Hydropower and wind capacity could reach 100 GW capacity each, followed by a solar capacity of over 90 GW.
- Abundant fossil and renewable energy resources are available across Africa. With rapid economic growth, changing lifestyles and the need for reliable modern energy access, the continent's energy demand is set to double by 2030.
- Renewable energy is growing rapidly around the world, driven by economics, environmental concerns and the need for energy security. The use of modern renewable energy technologies is also on the rise across Africa, where countries are uniquely positioned to leapfrog the traditional centralised energy supply model.
- Renewable energy technologies can be deployed locally, at small scale, opening up new forms of financing and productive uses, as well as broadening electricity access.
- The costs of renewable technologies are decreasing rapidly; recent project deals for renewables in Africa have been among the most competitive in the world.
- While the resource base varies, all African countries possess significant renewable energy potential. The continent's biomass, geothermal, hydropower, solar and wind energy resources are among the best in the world. Clear policy signals and an enabling framework can produce accelerated renewable energy deployment.
- Traditional biomass is the most widely used energy source in Africa and is mainly used for cooking.
- Fossil energy dominates electricity generation and the transport sector.
- Renewables are primarily employed in the electricity sector.

African Energy :: An Overview



This map shows a snapshot of fossil fuel resources and renewable energy projects across Africa.

Africa's economy is growing at unprecedented speed and with it a corresponding increase in the demand for energy.

One of the core challenges, as African countries continue to grow and develop, is energy: meeting rising demand for power, transport and other uses in a way that is economically sustainable and safeguards livelihoods.

Economic growth, changing lifestyles and the need for reliable modern energy access is expected to require energy supply to be at least doubled by 2030. For electricity it might even have to triple.

Africa is richly endowed with renewable energy sources, and the time is right for sound planning to ensure the right energy mix. Decisions made today will shape the continent's energy use of decades to come.

Although legacy fossil fuels are dominant in Africa, the continent is increasingly embracing modern renewable energy technologies. For many years they have been supported because of environmental and energy security concerns but in a rising number of situations they are now seen as the most economic option.

The use of modern renewables is growing in Africa, and fostering this growth is imperative.

Four key modern renewable energy technologies with highest deployment potentials for Africa are modern biomass for cooking; hydropower; wind; and solar power.

In all regions of Africa except the North, hydropower will continue to play an important role. North, Eastern and Southern Africa can all derive renewable power from other sources, such as wind energy, while concentrating solar power (CSP) will matter specifically in North Africa. Additional renewable power capacity

The challenges are not easy ones.

Supply lags demand, and in as many as 30 countries in Africa recurrent electricity outages and load shedding are the norm.



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Alternative energy will play a transformative role in the African energy mix. Abundant fossil fuels and renewable sources in many countries on the continent mean policy makers have a choice. But for a diversified, sustainable energy mix, it is more important than ever to ensure that renewables play as large a role as possible.

Solar resources are abundant everywhere, while biomass and hydropower potential are more plentiful in the wet, forested central and southern regions. Wind resources are of the highest quality in the north, the east, and the southern regions, while geothermal energy is concentrated along the Great Rift Valley.

The possible applications for all these resources include power generation, heating and cooling for both industrial and domestic applications, lighting, transport and direct uses of mechanical energy.

Africa :: Outlook

The African economy is growing at an unprecedented speed. Despite the global recession triggered by the 2008 financial crisis, growth has averaged 5% for over a decade, making Africa the fastest growing continent in the world.

The Africa Energy Outlook 2040, developed as a part of Programme for Infrastructure Development in Africa (PIDA) (NEPAD, African Union and AfDB, 2011) forecasts the economic growth between 2015 and 2030 to be even higher, at 7% per year on average, with varying rates across five African regions.

Renewable energy has the potential to transform Africa's industrial sector, supporting sustainable growth through the provision of reliable and affordable energy, as well as transforming the economic competitiveness of small and medium-sized enterprises.

Reliable and affordable energy is an important factor for industries. However, unreliable power supply has been one of the obstacles in accelerating economic transformation. More than 30 African countries experience regular outages and load shedding, with opportunity costs amounting to as much as 2% of their GDP.

Power shortages are substantial, pushing industrial plants to resort to expensive diesel generators as a secondary source. One in two plants in sub-Saharan Africa considers electricity supply a major constraint.

The mining industry, which has been an important driving factor for Africa's growth, accounts for 6% of the continent's electricity demand. In smaller countries, individual mining projects may dwarf most local countries' electricity demand from all other sources.

Mining represents more than 20% of installed diesel generator capacity, making the sector the second-largest user after the power sector itself, which accounts for 36% (World Bank, 2015).

One positive trend is that miners are increasingly adopting renewable power and can be relied on to provide steady demand and justify investments for hydropower. The cost advantages of hydro over diesel generators are already established and more mining companies are looking to renewable technologies to reduce fuel costs.

Currently industry in Africa, in comparison with other regions of the world, is more focused on activities that are not energy-intensive. These include wood and food processing and textiles production.

Industries in Africa rely on a mix of fossil fuel and biomass. About 70% of thermal energy demand comes from coal, oil and natural gas, whereas 30% is a mixture of biomass and waste products. The biomass breakdown is not known in detail, but IRENA analysed a portion of residue use, notably from black liquor and bagasse. Only 8% is from modern biomass, either purchased or produced as a by-product of industrial processes.

These by-products come from the processing of sugar, dairy products, coffee, tea, and wood. The residues can be used to generate on-site heat and electricity. By 2030, waste-generated process heat could meet about 120 PJ of energy needs in industry. The use of bagasse (waste from sugar cane processing) for process-heat generation is already a common practice.

Overcoming lack of quantity and quality of power supply and achieving a transformation of the economy would imply that industrial energy demand would triple in 2030 despite significant efficiency improvement. Electricity demand would grow by 270%, surpassing the rate of total industrial energy demand growth. Through the development of its abundant renewable energy resources, Africa can attract new industries and build a truly green economy.

South Africa

At present, South Africa does not have significant proven oil and gas reserves and produces oil and gas from coal and imported crude oil. The relative underutilization of gas is because of the abundant coal resources in the country that allowed South Africa to produce petroleum and by-products as well as electricity cheaply from coal.

Coal provides over 70% of the country's primary energy needs. In the past, however, coal's share of the primary energy mix has been above 80% and as a result considerable effort has been made to diversify the energy industry. However, declining coal resources and the relative cost of coal-produced electricity and petroleum in financial and environmental terms will see South Africa diversify its energy mix, a process that is already under way.

Several initiatives and programmes have been launched to expand oil and gas production, and, in recent years, a significant shale gas resource has been identified. South Africa has a history of developing unconventional energy resources in its bid for greater self-sufficiency, and the country has shown its ability and determination to invent and employ technology to diversify its fuel mix.

Should offshore exploration and onshore shale gas exploration prove to be successful, South Africa will have a localised supply of oil and gas to enable and promote the diversification of the country's energy mix.

Offshore exploration off South Africa's coast was previously limited primarily by the depth of the potential resources and secondly by the ocean currents. Recent improvements in exploration technology, coupled with the need for South Africa to diversify its energy mix has seen increased interest in exploration activity off South Africa's coast, with 20 exploration licenses issued.

Coal bed methane exploration interest in South Africa continues to grow with 25 exploration rights awarded to date, and some companies applying for production rights.

Five Technical Cooperation Permits have been issued for Shale Gas exploration. South Africa is ranked between fourth and eighth for shale gas exploration potential with ~390 tcf of recoverable resource. The Petroleum Agency of South Africa estimates the recoverable resource to be ~30 tcf.

Navigating the future is increasingly challenging in a more complex global market, and the longer-term backdrop has changed.

Africa represents the new frontier for energy in many ways. For example, 70% of households in sub-Saharan Africa do not have access to electricity.

Now is the opportunity for oil & gas companies in Africa to reinvent themselves to deliver this much needed commodity in a lower-carbon form.

Factors which will drive the industry will include gradual, and uncoordinated production cuts by OPEC and improved political unrest in the Middle East.

In addition, a report from the World Energy Council predicts that global demand for crude oil could hit a peak in 2030 at 103 million barrels per day. The scenario would require rapid and substantial advancements in electric vehicles, efficiency, renewable energy, and digital technologies. The WEC report envisions a scenario in which global primary energy demand – which includes energy demand for everything including transportation and electricity – could also peak before 2030.

These conclusions fly in the face of the prevailing assumptions within the oil and gas industry, which assumes consistent and stable growth in demand for decades to come. The cyclical nature of the industry has overwhelmingly been due to the changing nature of global or regional economic growth. But while demand has always been volatile in the short-term, oil demand has grown inexorably for more than a century as population and GDP expand. Recessions hit demand, but once economies recover, demand resumes its upward trajectory. This constant, almost a law of nature, makes it difficult for many to picture a structural, rather than just a cyclical, decline in oil demand. But many analysts, including the WEC, say that such a development is underway.

For the oil and gas industry to improve in the upcoming year; companies will need a better understanding of the recession and re-think strategies for projects to save more money as well as prioritizing their main assets. They may also start considering alternative sources of energy.

New pricing levels force ongoing capital discipline in development of new projects, and the Northern Gateway appears to be the most viable option for Canadian energy companies to access global markets.

The oil and gas industry will adapt. For years, the industry has been subject to consistent fluctuation. Unless the price bottoms out, there will be a big change that really refocuses the industry.

Oil & gas companies need to make sure that they have the right people, processes and strategy for managing regulatory risk and meeting taxation requirements.

Tax and regulation remains a key challenge in the industry and a factor that will impact the industry for years to come.

In a low oil price environment, companies are continuing to look at asset management and operational excellence, as well as general and administrative cost management. In such an environment, companies need to make sure that they don't cut costs across the board and understand their core capabilities. Companies should also look at using digital technology to better enable their businesses.

Renewable energy in South Africa

Renewable energy in South Africa is energy that is obtained from renewable resources, those which naturally replenish themselves, such as; sunlight, wind, tides, waves, rain, biomass, and geothermal heat. Renewable energy focuses on four core areas including; electricity generation, air and water heating/cooling, transportation, and rural energy services. The energy sector in South Africa is an important component of global energy regimes due to the country's innovation and advances in renewable energy. South Africa's contribution to greenhouse gas (GHG) emissions is ranked as moderate and its per

capita emission rate is higher than the global average. Energy demand within the country is expected to rise steadily and double by 2025.

Of all the renewable energies in South Africa, solar power holds the most potential. Because of the country's geographic location, it receives large amounts of radiative energy which is useful in the solar electricity sector. Another renewable energy in South Africa with high potential is wind energy. Due to the high wind velocity on the coast of the country, Cape Town has implemented multiple wind farms which are successful in generating significant amounts of electricity for residents. Renewable energy systems in the long-term are comparable or cost slightly less than non-renewable sources. Biomass is currently the largest renewable energy contributor in South Africa with 9-14% of the total energy mix. Renewable energy systems are costly to implement in the beginning but provide high economic returns in the long-run.

The two main barriers accompanying renewable energy in South Africa are; the energy innovation system, and the high cost of renewable energy technologies. The Renewable Energy Independent Power Producers Procurement Programme (REI4P) suggests that the cost associated with renewable energy will equal the cost of non-renewable energy by 2030. Renewable energy is becoming more efficient, inexpensive, and widely used. South Africa has an abundance of renewable resources that can effectively supply the country's energy.

The digital oilfield

Digital oilfields – also known as the online field – are one of the more promising applications of digital technology in the South African industry.

A digital oilfield provides robust data aggregation and formatting resources capable of sending real-time reservoir, wellhead and plant operating data to one or more remote locations via satellite (if needed) and then over the internet. Its main advantage derives from multi-discipline end-use software than can be used to transform business performance and productivity. This software is extensive and powerful. It can be used for production reporting, to monitor KPI performance, spot adverse trends, evaluate possible solutions and identify the very best optimal solutions/outcomes by modelling them using predictive software.

It makes competent end-users immensely more productive. They can, for example, identify in-fill drilling opportunities much more easily and future test them economically in advance using simulators. Remote end-users can be located anywhere if they have internet access. Location in lower-cost regions is very doable and attractive to a small, dedicated but affluent/aspiring workforce.

During the drilling phase, experts can be engaged from any location on the planet, advising drilling teams on the rig itself on difficult wells in real-time. Once operations commence, the same applies in corollary, operations experts can again be engaged anywhere on the planet to help solve operational problems.

Middle East and Africa **digital oilfield** market is projected to cross \$2 billion by 2022. The global digital oilfield solutions market is expected to grow to \$40.61 billion by 2022 with a CAGR of 6.1%. The automation and instrumentation segment are expected to witness a highest growth rate. EMEA is one of the key markets for digital oilfield solutions.

Growing exploration and production activities, increasing demand to minimize production costs, and raising safety concerns are some of the factors fueling the market growth. In addition, recent technological developments in oilfield solutions are bolstering the market growth. However, fluctuating oil prices, low adoption of new technologies are limiting the market growth.

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