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Africa's energy outlook
Renewables as the pathway to energy prosperity

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Africa's energy outlook: Renewables as the pathway to energy prosperity

Africa's wealth of energy and related resources

Africa is blessed with abundant natural resources, including renewable and non-renewable energy sources and critical minerals.

The continent holds 125 billion barrels (bbls) of proven oil reserves (7.2% of global reserves)[1] and is home to 620 trillion cubic feet (tcf) of proven natural gas reserves (7.5% of global reserves). Furthermore, about 84% of gas reserves in the pre-production stage are in Africa.[2] This is timely, as the European Commission has endorsed natural gas as a "transition" fuel.[3]

In addition to abundant fossil fuels, Africa has considerable potential in the renewable energy space. The continent is estimated to hold 60% of the world's best solar (10TW), hydro (35GW), wind (110GW), and geothermal energy sources (15GW).[4]

The International Energy Agency (IEA) estimates that Africa can produce 5 000 megatonnes of hydrogen annually, equivalent to the current total global energy supply annually.[5]

Africa also boasts considerable deposits of raw minerals used in new energy technologies for electric vehicles, stationary energy storage, and green hydrogen (GH2) production. The Democratic Republic of the Congo (DRC) accounts for 70% of the world's cobalt production, while South Africa provides 60% of global manganese supply, 75% of global platinum supply, and 40% of global palladium supply. Namibia is home to significant deposits of rare earth elements (REEs), including dysprosium and terbium. Mozambique is the world's third-largest graphite producer.[6]

Africa's energy outlook: Renewables as the pathway to energy prosperity

Widespread energy poverty hinders development

Africa's unfulfilled potential is evidenced by the challenges to convert its natural resources to economic prosperity. Despite the continent's vast resource wealth, energy poverty – which can be defined as a lack of reliable and affordable access to cooking fuel and electricity – remains a concern across the continent. Of the world's estimated 800 million people without access to electricity, 600 million are in Sub-Saharan Africa (SSA).[7]

The manifold causes of the continent's energy challenges include a lack of investment, ageing infrastructure, inadequate political consequences for poor government implementation, and a skills shortage (see Box 1).

Box 1. Africa's myriad energy challenges

A lack of investment in electricity infrastructure, particularly in generation capacity, distribution networks, and maintenance, has led to a combination of low energy supply and high electricity costs in many African countries. Between 2010 and 2020, Africa received 3% of global energy investment, with 0.5% of this investment in transmission and distribution networks.[8] A lack of energy investment was exacerbated by the COVID-19 pandemic, with several national budgets redirecting funds to emergency spending on health, social needs, and economic stimulus measures in 2020. It is estimated that at least US$25 billion in electricity grid, generation, and off-grid solutions investment is required annually to eradicate energy poverty in Africa by 2030.[9]

Slower investment can be partly explained by outdated or poorly implemented policies. Investment toolkits and policies may not support energy investment and the transition to cleaner energy sources. Where policies are effective, implementation may have been inadequate due to weak governance structures, a lack of accountability, and poor handover systems for changes of administration.[10]

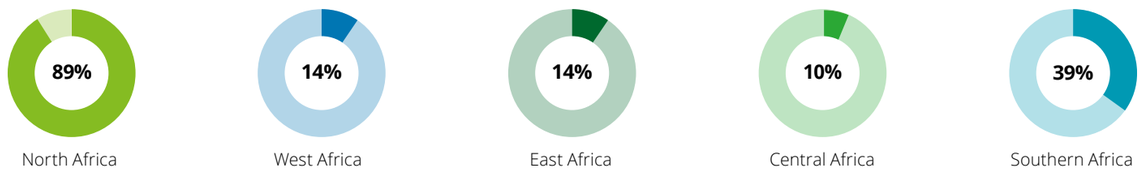
There are additional challenges for investments, such as new generation capacity. Projects could be plagued by delays and cost overruns caused by weak governance structures, improper planning, slow decision-making, poor risk management, and project designs that are not fit for purpose.[11] Navigating governmental approvals for permissions and consents has been a challenge, while critical stakeholders like national utilities are hamstrung by long-standing corruption and mismanagement.[12]

There is also a shortage of project and system design, installation, and maintenance skills, compounded by inadequate management capability and a lack of capability building.[13] This also makes implementing new technologies difficult.

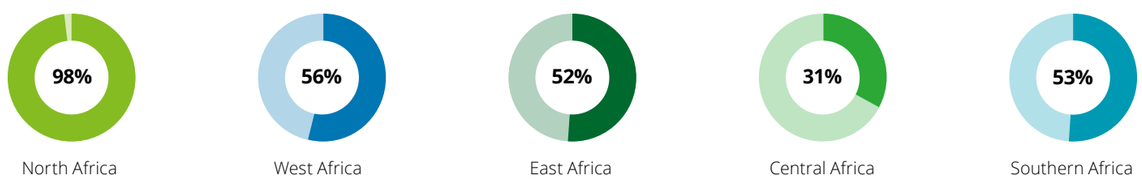
Africa's population is expected to almost double between 2018 and 2040 (from about 1.3 billion to 2.1 billion people), with more than half a billion people expected to flock to Africa's urban areas. Energy demand is expected to grow at a commensurate pace, with estimates for energy and electricity demand as high as increasing by 60% and 75% respectively by 2030.[14]

Figure 1. Access to clean cooking fuels and electricity in Africa, by region (2021)

Access to clean fuels and technologies for cooking (% of total population)



Access to electricity (% of total population)



Source: World Bank, 2023[15]

Box 2. Mozambique – the epitome of unfulfilled potential?

Mozambique is a prime example of Africa's energy paradox: despite its vast energy resources, poor energy access and poverty remain extreme. With a capacity to generate more than 180GW of power, the country has some of the largest untapped power generation potential in Southern Africa across renewable and transition resources such as wind, solar, hydro, and gas, as well as coal reserves.[16]

Yet, Mozambique ranks among the lowest globally in electricity access: around 40% of the population had access to the grid in 2022 (and only 4.5% of the rural population in 2020). Similarly, only 5% of the population can access clean cooking fuels.[17] From an economic perspective, the country's poor energy access has hampered development, with Mozambique ranked 181st out of 189 countries on the Human Development Index (HDI), making it one of the poorest countries in the world.[18]

Poor access to reliable, affordable energy has often been a serious hindrance to economic and human capital development across Africa. Unreliable or no electricity access leads to lower enrolment and retention rates in schools and negatively impacts healthcare facilities' ability to provide services. Additionally, the overreliance on biomass fuel (BMF) for cooking and space heating has considerable and detrimental health consequences.[19]

Beyond the impact on human capital development, the adverse consequences for economic development are significant, given that energy access is fundamental to producing almost all goods and services. A route to economic diversification and development without greater energy consumption would be difficult, as countries with energy insecurity, i.e., where energy is in short supply, have lower industrial and economic output.[20]

Box 3. The costs of insufficient power – the case of South Africa

South Africa's inadequate power infrastructure is a serious challenge to electricity access. "Loadshedding" refers to planned electricity supply interruptions when electricity demand exceeds supply. These supply shortages continue to severely impact South Africa's socio-economic development, resulting in a fivefold increase in GWh lost (i.e., not generated) between 2021 and 2022. In 2022, rolling blackouts are estimated to have cost the country between R400 billion and R600 billion (approximately US$21 billion and US$31 billion), while an estimated 11 970GWh was lost between 1 January and 10 May 2023 – more than the total loss of 2022. The cost of 14 years of systemic power failures will likely be over R3 trillion (approximately US$157 billion).[21]

With sophisticated manufacturing and industrial sectors spanning the agriculture, mining, metals, automotive, chemical, and other value chains, South Africa has suffered a 1.0-1.5% annual reduction in GDP due to power outages since 2007.[22] Earlier in 2023, the South African Reserve Bank estimated that longer and more frequent spurts of loadshedding in 2023 could shave off two percentage points of South Africa's GDP growth that year.[23] The lack of power poses the biggest risk to the country's growth outlook, with pre-COVID-19 lacklustre economic growth failing to keep up with population growth and trimming per capita incomes. Loadshedding has additional social impacts, such as increased crime, social unrest, and vandalism.[24]

On 9 February 2023, the South African President declared a state of disaster to allow the government additional powers to resolve the country's energy crisis. Despite these measures, electricity outages continue to have a significant negative impact on economic activity, rural and urban, and domestic and commercial life in South Africa.[25]

Africa's energy outlook: Renewables as the pathway to energy prosperity

While diversifying economic activity and industrialisation are key to raising living standards, Africa cannot replicate the carbon-intensive path that other countries have followed, as this would increase the continent's relatively low carbon emissions.[26] Instead, Africa should chart a new path to a greater, yet cleaner, energy supply. Value-adding activities in more climate-resilient industries that will create jobs and eliminate poverty are vital. Successive cohorts of industrialising economies have seen carbon intensity decrease, given progress in green energy.[27]

A transition to cleaner energy sources, such as natural gas, hydropower, wind, solar, modern biogas, and green hydrogen, allows Africa to bridge the developmental gap left by decades of energy poverty. Just as importantly, access to cleaner energy sources could also present the much-needed impetus to build industries that attract new investment, ecosystems, skills, human capital, technology, and access to untapped markets.

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Accessibility, affordability, and sustainability are Africa's energy goals

The United Nations Sustainable Development Goals (UN SDGs) are a global call to end poverty, create prosperity, and protect the environment. The seventh goal (SDG 7) aims to achieve "access to affordable, reliable, sustainable and modern energy for all" by 2030.[28] In Africa, SDG 7 means connecting 90 million people annually to electricity by 2030 and shifting 130 million people to clean cooking fuels annually.[29]

One starting point is **accessibility**, i.e., access to a reliable and quality energy supply. This could help spur development by boosting productivity, economic diversification, and growth. Small-scale renewable energy has become increasingly affordable over the last decade, with solar, wind, hydropower, batteries, power packs, and modern biomass (renewable fuel produced primarily from waste products in the agricultural and food industries) helping to alleviate Africa's energy access challenge.[30] In remote areas where populations are dispersed, and there is a lack of traditional grid infrastructure, leveraging alternative or renewable energy sources would also mean increasing access to energy storage to help provide consistent power access.[31] Ultimately, countries could "leapfrog" traditional electricity models by promoting off-grid and mini-grid energy solutions for greater accessibility.

With improved access and related infrastructure (centralised or decentralised), a next step would be to ensure that electricity is **affordable**. While improved access to energy will likely lead to greater economic prosperity and subsequently reduce poverty rates, simple economics suggests that increased supply should in theory reduce the cost of electricity. However, additional measures are needed to reduce energy costs in Africa, for example, implementing innovative financial instruments to alleviate or even remove financial barriers.[32] To attract investment in the energy sector, the government should promote these innovations, designed to reduce risk premia and cost of capital required for infrastructure.

Alongside accessibility and affordability, the long-term **sustainability** of Africa's energy supply could prove vital. For example, investing in renewable sources like solar, wind, and green hydrogen power is sustainable and potentially more reliable than state-provided fossil fuel generation. New technologies also offer sustainable solutions. For example, Africa has the potential to produce up to 50 million tonnes of low-carbon modern biogas from agricultural residues, animal manure, and municipal solid waste through household-scale biodigesters.[33]

The impact of and responses to climate change also underpin the long-term sustainability of the energy mix. Even though Africa's current contribution to global emissions is relatively low (contributing 4% of global emissions despite housing 20% of the world's population), countries are determined to further reduce their CO_2 emissions.[34] All 54 African countries have signed the Paris Agreement, with 40 countries including renewable energy targets and 38 countries highlighting ambitions to reduce emissions in their voluntary Nationally Determined Contributions (NDCs).[35]

The challenge accompanying this determination is that livelihoods and incomes currently dependent on the sectors that need to decarbonise may be eliminated. Africa's energy transition will thus need to carefully balance potentially conflicting priorities, hence the focus on a *just* energy transition. ('Energy transition' refers to the movement away from carbon-intensive to clean energy generation, while 'just' acknowledges the importance of not negatively impacting society, jobs and livelihoods during the transition.)[36]

Figure 2. Key gaps to bridge to achieve Africa's 2030 energy goals

Investing in a modern primary energy supply	Africa's universal energy access goals will require a sufficient increase in its modern primary energy supply to meet rising demand, estimated to rise by a third between 2020 and 2030.
Transitioning towards cleaner energy solutions	The traditional use of bioenergy for cooking will require a shift towards modern energy sources.
Generating new sources of energy from renewables	By 2030, solar and wind will likely need to provide 27% of power generation, with electricity demand increasing by 75%. 40% of the annual energy investment would need to be dedicated to solar, wind, and other low-carbon sources.
Using targeted financial investments	Increasing Africa's capacity to achieve universal access to energy by 2030 would likely require at least US$25 billion per year, specifically in distribution networks, power generation plants, and off-grid solutions.
Realising the potential of natural gas as a transition fuel	Africa has vast natural gas potential with recent major discoveries. These are mostly undeveloped, so significant greenfield spending (US$375 billion over the next decade) would likely be required.

Source: IEA, 2023[37]

Africa's energy outlook: Renewables as the pathway to energy prosperity

Charting Africa's future energy mix – a transition to renewables and cleaner sources of energy

The road to a future of energy accessibility, affordability, and sustainability in Africa is unclear; however, any potential energy outlook must consider universal energy access for a growing population, increased economic activity, and future demand.

The Sustainable Africa Scenario, as modelled by the IEA, outlines a path to 2030 in which "all of Africa's energy-related development goals are achieved, modern primary energy supply rises by a third", and "traditional use of bioenergy for cooking is eradicated thanks to universal access to modern fuels and technologies".[38] Furthermore, in this scenario, countries will meet the carbon emissions reduction commitments outlined in their NDCs.[39] In this scenario, the per capita energy use remains below the world average because of energy-efficient technology. The scenario assumes that countries will set ambitious goals for sustainable development that include creating an enabling policy environment for developing their energy economies while driving clean energy investments.

However, the IEA's scenario predates the endorsement of natural gas as a transition fuel, meaning gas could feature more prominently in Africa's future as a resource for the continent and as a significant African export. At the time of writing, the scenario acknowledges the economic challenges of African economies emerging from various crises (e.g., COVID-19 lockdowns, supply chain disruptions, Russia-Ukraine war, geopolitical uncertainty, and climate change) and the resulting depletion of resources (including fiscal buffers and foreign exchange holdings).

Nonetheless, Africa is still expected to be the second-fastest growing region globally after developing Asia in terms of GDP growth in the coming years.[40] With its rapidly growing and youthful population and growing economies, Africa is expected to experience an increase in the consumption of primary fuels, barring coal and solid biomass. In the IEA's scenario, the modern primary energy supply will increase by 3% annually to 2030, while the total primary energy supply will fall by 13%, largely due to the eradication of solid biomass (e.g., wood and charcoal) as cooking fuel. This assumes households will have access to modern and cleaner cooking methods.

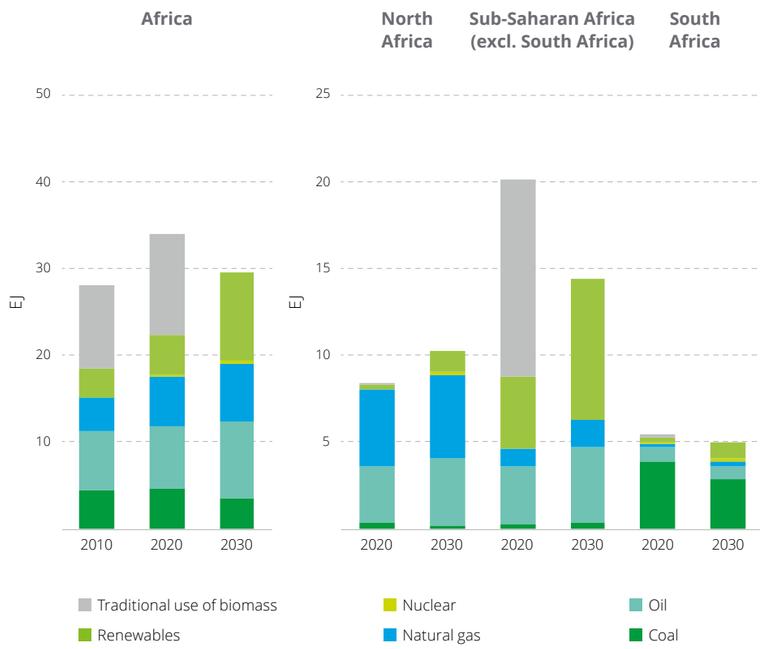
The scenario continues with the assumption that renewables will proliferate across the continent, despite regional differences. Renewables will become a leading energy source in SSA (excluding South Africa), replacing traditional biomass. In North Africa, natural gas is expected to trump oil's share by 2030. Nonetheless, oil's share in the energy mix is expected to rise, driven by increased demand for transport and industry.

Coal's role as a primary energy supply source is expected to decline in Africa's energy mix, primarily driven by the decommissioning of coal-fired power plants in South Africa and with renewables likely to make up a more significant share of energy supply in that country.

In summary, the IEA's scenario sees the rapid emergence of renewables underpinning growth in each of the outlined regions. While coal is declining, oil and gas will likely continue to play an important role in Africa's energy mix by 2030.

Capitalising on the continent's natural resources to achieve the above scenario will require African governments to leverage the proceeds from fossil fuel rents and invest in the clean energy sector, related infrastructure, and broader enabling environment to diversify their export base and create downstream and value-adding industries. Each country's policies should reflect the move from fossil fuels to renewable resources as they chart their future energy mixes and transition pathways.

Figure 3. Africa's total primary energy supply by 2030 (IEA's *Sustainable Africa Scenario*)



Source: Taken from IEA, 2023[41]

Africa's energy outlook: Renewables as the pathway to energy prosperity

A snapshot of six African economies' plans and ambitions

Individual African countries are at different stages of economic development and varying points in their energy transition pathways. The following snapshots focus on six countries, specifically looking at their energy transition strategies, resource endowments, and envisioned energy mixes.

Mozambique: Using natural gas to realise potential

Mozambique's energy poverty (see Box 1) can be overcome by renewable energy generation, realising the potential of natural gas as a transition fuel, and increasing access to clean energy sources for cooking. Linked to a broad portfolio of investments across different energy sources, the country looks to more than double its generation capacity by 2030, per its *Integrated Power Sector Master Plan*.[42]

The plan aims to leverage Mozambique's hydropower potential of more than 12GW, one of the largest in SSA and located primarily along the Zambezi River.[43] As part of its *Energy Strategy Plan*, Mozambique is looking to invest more than US$6 billion in large hydropower projects such as Cahora Bassa North and Mphanda Nkuwa,[44] with neighbouring South Africa as a key target market.

Other renewable opportunities include untapped solar potential. By 2022, 125MW of solar power plants had been established via Public-Private Partnerships (PPPs), with 60MW already connected to the grid.[45] By 2040, Mozambique aims to have 20% of its energy generated by solar and wind resources through strategic investments in projects like the Cuamba II solar plant (20MW) and the Inhambane and Namaacha wind projects (combined 170MW).[46]

However, the most substantial expansion in the country's energy mix is predicted to stem from natural gas. Mozambique has the largest natural gas reserves in SSA, exceeding 180tcf.[47] With various projects that look to double gas production by 2030, the country is expected to become a gas powerhouse over the next decade.[48] Natural gas investments already underway could make Mozambique the third-largest gas producer in SSA and bring US$100 billion in revenues to the country.[49] Natural gas has the potential to become one of the world's most in-demand and valuable energy resources, which would reduce the country's reliance on imported oil and petroleum, drive economic growth, and bolster its energy export capacity. By 2030, Mozambique envisages about 44% of total electricity coming from natural gas-fired plants.[50]

The above changes are supported by Mozambique's *Energy for All* programme and complemented by its *National Electrification Strategy*.[51] However, the nation should consider to bolster its institutional capabilities and improve its legal framework to effectively utilise its resources and execute planned energy infrastructure development. The recently approved *Electricity Law* is a step in the right direction: this legislation simplifies permitting and concession processes for power generation projects, particularly off-grid ones (up to 10MW).[52]

Similarly, new regulations, such as the *Energy Access in Off-Grid Areas*, should help reach the electrification goals under the *Energy for All* programme in rural areas by attracting private investments through mini-grids and other off-grid solutions.[53] Implementing these plans would likely trim Mozambicans' energy costs, boost private sector participation in power generation, and make the country more attractive to investors.

Angola: Re-investing fossil fuel revenues to transition to renewables

Oil-rich Angola has a massive energy challenge: only half of the population has access to clean cooking sources,[54] and several provinces do not meet the minimum government-defined electrification rate of 20%, putting the achievement of its electrification rate target of 60% by 2025 at risk.[55]

On the flipside, electricity demand has increased due to population growth, urbanisation, and economic development. Per capita electricity consumption more than doubled between 2010 and 2020 but remains relatively low compared to other countries in the region.[56] Based on population growth forecasts, Angola's energy demand could increase by 25% by 2030.[57] Angola is looking to invest substantially in renewable energy production, including solar (given its relative affordability), wind, and hydropower, to deal with growing demand and mitigate high costs. The share of renewable energy in Angola's energy mix is informed by a target of 70% installed renewables capacity by 2030.[58]

While Angola has a potential generation capacity of about 55GW for solar[59] (given the high radiation in the central-west region), the government looks to install 100MW by 2025.[60] Similarly, the 2025 programme aims to reach 100MW in generation capacity for wind, with a further 3.9GW of additional wind power potential in the Cuanza Sul region, which has the highest wind energy potential.[61]

Underpinning Angola's renewables target will be hydropower, which is already a primary source of electricity, supply having doubled between 2016 and 2020.[62] Hydropower will fulfil two-thirds of the country's installed capacity by 2030, and there are plans to develop additional capacity in the coming years.[63] Furthermore, to bridge the demand-supply gap, about US$23.3 billion in public investment in electricity production will be pursued between 2018 and 2025.[64] Smaller hydropower projects are also being developed across the country.[65] This capacity could allow for green hydrogen production along more than 150 000km of rivers, with initial green hydrogen exports planned as early as 2024.[66]

As one of Africa's largest oil producers, Angola depends disproportionally on this fossil fuel as a primary source of energy, foreign exchange, and funding. However, declining oil reserves add impetus to the country's desired energy transition toward a more diversified economy and energy mix.[67] Electricity from natural gas could double by 2030,[68] with new natural gas plants planned in Cabinda, Benguel, and Namibe,[69] complimenting the first natural gas plant that began operating in 2017 in Soyo.[70] As a transition resource and through Combined Cycle Gas Turbines, natural gas could make up one-fifth of the electricity produced in the coming years,[71] representing an opportunity for Angola to industrialise.

These developments depend on a sizable investment in power production, transmission, and distribution infrastructure, given Angola's limited interconnectivity and dilapidated power infrastructure.[72] To increase electrification, the country should improve its regulatory framework to attract private investors and invest in technical expertise and local content.[73] Similarly, efforts to improve the business environment and foster a favourable climate for investors will likely be important in supporting Angola's goals.

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Nigeria: Leveraging renewables and off-grid solutions to achieve higher electrification

Despite being Africa's largest and most populous economy and with abundant energy wealth, Nigeria's growth has been limited by inadequate access to and reliability of electricity. Growth has been sluggish over the past decade,[74] and only 17% of the population have access to clean cooking fuels.[75]

A lack of infrastructure (including power infrastructure) and a demanding business environment have hampered foreign investment, economic progress, and diversification.[76] The country's population is expected to reach 400 million by 2050,[77] with its urban population expected to increase from 54% in 2022 to 70% by 2050.[78] Although 55% of the population has access to electricity, 66% are underserved or unserved in terms of electricity access, with frequent power outages across rural and urban areas.[79] Nigerians' standard of living is low as a result.

In the short term, electricity demand is expected to grow by 4-5% annually, from 262TWh in 2015 to about 419TWh by 2025.[80] Current power generation generally is only one-third of the country's installed capacity, while per capita electricity consumption is the second lowest globally (less than 150kWh).[81] Given poor and outdated infrastructure, the country's national grid had seven system collapses in 2022.[82]

Without significant gains in electricity supply, Nigeria's supply deficit could continue to increase. The country urgently needs to ramp up energy and electricity access. This requires investment across the electricity value chain, including generation, transmission, and distribution infrastructure.[83] At the same time, Nigeria would need to move away from the oil industry as the mainstay of the economy and unlock new revenue streams through energy diversification by reprioritising resources such as gas and harnessing renewable energy sources such as hydropower, solar, and wind.

One area to consider for diversification is domestic gas utilisation. Nigeria's *Energy Transition Plan (ETP)* positions gas as a transition fuel to achieve carbon neutrality by 2060.[84] Domestic gas utilisation has recently increased due to growing electricity demand and industrial activity. Export gas in the form of LNG to Europe is still being prioritised.[85] While natural gas makes up about 78% of electricity generation by source, domestic gas utilisation remains low in comparison to export gas. An estimated 35% of natural gas produced in Nigeria in 2020 was either re-injected to improve oil recovery (about 26%) or flared (about 9%), while domestic gas utilisation was about 21%.[86] The *Petroleum Industry Act (PIA)* enacted in 2021 includes provisions and fiscal incentives designed to promote the development of critical infrastructure and the efficient use of gas resources for national development.[87]

Hydropower (21%) and solar (about 0.1%) comprise the balance of electricity generation.[88] The country has a large-scale hydropower potential of over 14 000MW, although installed capacity remains low,[89] as does the untapped solar and wind generation potential. Utility-scale solar projects are growing, adding up to 33MW of installed capacity in 2021.[90] The ETP has a target of over 190GW of solar photovoltaic (PV) energy by 2050, which could be a game changer in replacing expensive diesel backup generators.[91]

Higher electrification rates (75% target by 2025), increased renewables supply in electricity generation (a minimum of 30% by 2030), and off-grid renewable capacity are primary targets of the country's *Renewable Energy Master Plan*, from small hydropower projects, solar PV, and biomass-powered plants.[92] Legislation such as the *Electricity Act 2023* is expected to enhance renewable utilisation in power generation and increase private participation along the electricity value chain.[93]

Renewable energy utilisation will likely be essential to meet the country's universal electricity access target by 2060. Rural areas could be electrified through increased development of mini-grid and off-grid solar projects. This approach may be more economically viable than the complete dependence on the grid and network lines for accessing electricity. However, policy uncertainty, linked to uncertainty in energy pricing strategies, considerable infrastructure gaps, a challenging operating environment and declining FDI have at times hampered efforts to bridge the technological and skills gap. These challenges will have to be addressed to unlock the country's total energy potential.

Côte d'Ivoire: Promoting infrastructure and renewables investment

As one of the largest economies in SSA, Côte d'Ivoire has made great strides in improving its business environment to attract investment, promote economic growth, and diversify away from cocoa in its export portfolio. The nation has been among the fastest-growing economies in Africa, averaging 7.6% GDP growth over the 2012-2019 period.[94] With relative political stability, a high birth rate, and improved healthcare, the country has seen rapid population growth and urbanisation: over half the population lives in urban areas.[95]

However, only 32% of the population can access clean cooking sources;[96] over 60% use traditional means such as wood and charcoal.[97] Still, the country has among the highest electricity access rates in West Africa (71%),[98] aiming to achieve universal access by 2030.

To ensure energy security, drive economic development and diversification, and reduce poverty levels, Côte d'Ivoire aims to leverage its potential for renewable energy development while collaborating with investors on energy projects and implementing electrification programmes.

Currently, about 75% of power is generated using thermal energy through burning natural gas.[99] With recent discoveries, such as at the Baleine Field, natural gas production and consumption are expected to increase, a significant opportunity for electricity generation.[100]

Discoveries at the Baleine Field also include oil, which could increase oil production and exports for a country that is better known for oil refining rather than production. Oil earnings are key to developing other sustainable energies and related sectors. Government policies, such as those on local content, are expected to drive employment while responsibly managing this resource.[101]

Notably, the government aims to raise the share of renewable energy in the country's energy mix to 42% by 2030, with 16% from solar. Solar projects are projected to have a capacity of 400MW, with a potential (given sunshine conditions) of more than 1 900kWh/m². New projects will enhance production, such as the country's first solar power independent power producer (IPP) with a capacity of 50MW, generating 85GWh annually.[102]

About 24% of the total installed capacity is produced by hydropower.[103] With numerous rivers and water resources, the country has considerable hydropower potential. Between 2015 and 2019, Côte d'Ivoire increased hydropower generation, largely from developing new plants like de Soubre. Hydropower is a government-backed sector, and various projects are under development on the Bandama, Sassandra, and Cavally Rivers, both for large and small-scale hydro plants. Among these is the first private sector-funded project, the Singrobo-Ahouaty hydropower plant, located 150km north of Abidjan. The project is symbolic of private sector mobilisation for climate and green growth. The facility is expected to supply electricity to 100 000 households and reduce the country's CO_2 emissions by 109 000 tonnes annually.[104]

Modern biomass energy from cocoa, coffee, and rubber production, as well as municipal waste, is another renewable source that could help to decrease deforestation, given that rural regions mostly rely on traditional biomass (wood) for fuel.

Several measures are needed to position the country as a key energy hub in West Africa. These include improving the regulatory framework and legislation, strengthening interconnections to increase electricity exports, investing in off-grid solutions (such as off-grid solar PV) for remote and underserved communities far from centralised power generation, lowering the electricity social tariff to make power affordable, and addressing fraud and other revenue losses such as illegal connections.[105]

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South Africa: Overcoming a power crisis with renewables

South Africa's energy sector's mixed success is dominated by the unfortunate reality of state-controlled "loadshedding." Loadshedding is a method used by the state to relieve stress on a primary energy source when the demand exceeds supply.[106] Electricity supply shortages continue to severely impact the country's socio-economic development and growth potential (see Box 3).

Nevertheless, South Africa's rate of access to electricity is among the best on the continent, having improved from 57.6% in 1996 to 89.3% in 2021.[107] However, South Africa relies heavily on fossil fuels for its power, accounting for nearly 95% of the primary energy consumed in 2022 (coal 68.75%, oil 22.08%, gas 3.40%).[108] The country ranks amongst the world's top 10 coal producers, providing around 250 million tonnes annually, with coal reserves and production representing approximately 3.5% of global supplies. Nearly 80% of electricity in South Africa is generated by a fleet of 15 coal-fired power plants (176.6TWh of the total of 272.2TWh generated in 2022). At current rates of production and consumption, South Africa has sufficient reserves to satisfy its domestic needs for more than a century.[109] However, using coal resources on this scale has consequences – South Africa is the fourteenth largest emitter of greenhouse gases globally, emitting 523.3MtCO_2-equivalent of GHG in 2022 (1.1% of global emissions).[110]

The South African government launched the *Renewable Energy Independent Power Producer Procurement Programme (REIPPPP)* in 2011 to address the energy shortages and promote energy transition. This measure aims to increase electricity capacity through private sector investment in solar PV, concentrated solar, onshore wind power, small hydropower (<40MW), landfill gas, biomass, and biogas. Since 2011, and through six successive bid windows, the REIPPPP has attracted around 10 000MW in renewables projects, with an additional 15 000MW expected in bid window 7.[111]

As a result of the REIPPPP, South Africa is one of the top five host economies for renewable projects in Africa. It has the most extensive base of renewable developers, including utility developers (not funding vehicles), OEMs (Original Equipment Manufacturers), EPCs (Engineering, Procurement, and Construction firms), DFI (Development Finance Institution) vehicles, and many international and well-established local companies.[112] While recognising that renewables offer the least environmental footprint and at the least cost, state policy interventions have constrained uptake. Also, South Africa's grid access is inadequate for new renewable energy projects to be constructed and connected to the national transmission network. The transmission capacity is insufficient, and the regions with abundant wind and sunlight exposure are poorly served by transmission lines.[113]

With an average of 2 500 hours of sunshine per year, 4.5-6.6kWh/m^2 of radiation level, and rainfall half the global average, South Africa ranks third in the global solar potential stakes. The country's total wind power potential is around 6 700GW, competing with the solar potential. The long-term renewable energy capacity is likely to be driven by solar PV and onshore wind, from an estimated 10 600MW in 2023 to about 16 000MW by 2025 and 18 000MW by 2030.[114]

Power generation in South Africa is forecast to gradually shift from coal to renewables and natural gas, in line with the NDC and net-zero emissions strategy. The share of coal-fired generation is expected to decrease to 65% of the total by 2030, fall below 50% by 2035, and provide only one-quarter of generation capacity by 2045. Low-carbon sources (including renewables, nuclear, and gas) will likely be responsible for three-quarters of power generation, with onshore wind and solar PV collectively providing nearly 50%.[115]

South Africa's *Just Energy Transition Investment Plan (JET IP)* sets out the scale of need and the investments required to support the decarbonisation commitments made by the government. The plan, announced in November 2022, runs over five years (2023-2027) and focuses on shifting the country from coal-fired electricity to producing new energy vehicles (NEVs) and investing in green hydrogen.[116]

South Africa aims to become a global leader in green hydrogen and the preferred investment destination for so-called GH2 projects.[117] Green hydrogen is seen as an alternative, cleaner fuel for emission-intense industrial processes such as steelmaking and the mobility and aviation sectors. Green hydrogen could help the country meet its climate commitments and remain globally competitive, as trading partners in Europe penalise products with a high carbon content through the Carbon Border Adjustment Mechanism (CBAM).[118] South Africa's green hydrogen potential is underpinned by the country's strong renewable energy capabilities, which are vital in powering green hydrogen production. The country enjoys an abundance of platinum group metals (PGMs), critical as catalysts in hydrogen production through electrolysis and fuel cells, and the proprietary Fischer-Tropsch technology applied on an industrial scale to synthesise hydrocarbons.[119]

Shifting away from coal towards low-carbon energy sources will likely allow South Africa to effectively address domestic energy supply shortages, accelerate growth, and improve its global competitiveness. The country will however need to overcome serious challenges, including allegations of corruption, poor policy implementation, and inefficient cooperation between the private sector and public sector players.[120] However, South Africa has demonstrated that it can attract private domestic and foreign resources to finance new investments in the energy transition, as demonstrated by REIPPPP and many other flagship green energy initiatives.

Morocco: Reducing reliance on fossil fuel imports through renewables

The energy scenario in Morocco differs from the other countries under discussion. Having reached universal electricity access in 2020, the country has shifted focus to reducing its reliance on imported fossil fuels and boosting clean energy. About 90% of Morocco's primary energy consumption is from imported oil and coal. Coal-fired plants are expected to start closing in 2030. By 2050, they are expected to be entirely replaced by natural gas for gas-to-power and industry applications, given environmental and economic advantages.[121] However, local gas resources make up a fraction of total gas consumption, highlighting the need for natural gas exploration and gas imports.

To successfully embark on this transition, renewables could prove to be a game changer for Morocco. Renewables already make up about 38% of installed electricity generation capacity (about 4GW), with the aim of 52% or more coming from renewables by 2030.[122]

Progress has been made in developing large-scale projects and production from IPPs, mainly in the north-eastern parts of the country. These include the world's largest concentrated solar plant (CSP), the Noor Ouarzazate Solar complex, and the Noor Midelt I and II projects. Wind power is expected to expand at about 200-500MW annually, with several projects and mega projects underway.[123]

Authorities are working to provide industrial zones and small businesses with cleaner energy.[124] Indeed, this could be a differentiator for Morocco's export-based industrial sector, decarbonising production for exports into Europe under CBAM. Furthermore, to create more value in the manufacturing industry for solar and wind technologies, downstream industries are also being considered.

Morocco's GH2 capacity adds to its attractiveness for renewables investment, being in the top three in the world for GH2 potential and the third most competitive industry in terms of cost of GH2 production.[125] Leveraging GH2 can decarbonise heavy industries while dealing with the intermittence of renewables. The country's abundant renewable resources include more than 3 000 hours of sunshine a year and offshore and onshore wind resources that can reach and exceed 10m/second.[126] These resources underpin the country's plans to build a green hydrogen sector.

This aim will likely require a sizable investment, including in infrastructure, estimated to reach up to €95 billion between 2020 and 2050.[127] Already, state-owned phosphate producer OCP has announced plans to invest US$7 billion in constructing an ammonia plant that will utilise green hydrogen produced from renewable sources.[128] Furthermore, the government has created the *Green Hydrogen Cluster* to increase green hydrogen uptake and use and set up an institutional regulatory framework that has shaped renewables development and encouraged private investment in the sector (the private sector installed 3.1GW in renewables capacity).[129]

However, further measures are needed to encourage and support renewables development, including harmonising the institutional framework for renewables and administrative procedures for projects. With these ambitious plans, the Kingdom could become a hub for renewable energy both in Africa and for Europe, while decarbonising local industry and export-based sectors.

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Accelerating Africa's energy ambitions

Globally, the energy transition has accelerated. According to the IEA, climate policies are effective, with consumption of carbon-based fuels set to peak by 2030 and then decline.[130] Predicted dates have been brought forward, largely due to the accelerated rollout of clean technologies in 2023, driven by increased government support for investment in renewable energy. With the declining costs of renewable energy technology, Africa has an added impetus to promote investment in renewable resources.

Policy support: creating an enabling environment for clean energy investment

Historically, African governments have struggled to implement longer-term visions or plans, create policy certainty and clarity, and adequately invest in the broader enabling environment to promote private sector activity. It is imperative that African governments implement the right policies to not only promote investment for economic prosperity, but to provide clean, reliable energy to the millions of people that currently rely on traditional biomass fuel for cooking and space heating.

While significant progress has been made in energy access policies and investment regulatory frameworks, there is still much room for improvement. Of course, some countries are further ahead than others: several African countries have no specific renewables policies, while others have dedicated but outdated policies, lacking the latest technological and financial advancements.[131] With targeted policy support, energy transition policies will likely have to be created or updated to scale Africa's clean energy potential.

Box 4. Policy support measures

Policy support measures are likely to require fundamental underpinning to ensure transparency, credibility, and the proper legal framework. These should include strengthening policies to drive policy synergies and harmonisation at national and regional levels and targeted support to promote financing and cost reduction to attract investment.[132]

Areas of targeted policy support	Desired outcomes
Foundational support: to put the basics in place	• Improving transparency and credibility across national and regional renewable energy strategies • Creating robust shared certification processes for clean energy • Establishing or improving legal frameworks for clean energy • Promoting the value and benefits (direct and indirect) of clean energy
Resilience: updates should ensure longevity amid changing economic and political environments	• Strengthening synergies between energy, climate, and development policies • Promoting energy diversification throughout the value chain • Fostering public-private alliances for infrastructure and storing clean energy • Promoting strong regional integration
Financing and cost reduction: for investments to be as financially viable as possible	• Prioritising risk-sharing between public and private finance sources • Increasing requirements for data transparency to support risk-sharing to minimise the cost of capital • Streamlining processes to support increases in both the pace and scale of financing

Source: UNCTAD, 2023[133]

To achieve universal energy access by 2030 and move the needle on Africa's energy mix, significant annual investment is needed. Mobilising financing and investment in clean energy and related infrastructure means that energy transition policies should actively set targets for energy access, emission reductions, climate change mitigation, and adaptation goals; plan and explain the shift from current to more sustainable and renewable energy; and implement the energy transition plans, establishing the necessary regulatory changes, incentives, investment promotion, and facilitation initiatives.[134]

Clarity in and stability of energy policies and the broader policy and regulatory framework should help to mobilise energy finance and private investment as countries affected by the COVID-19 pandemic, the Russia-Ukraine war, and the recent funding squeeze rebuild fiscal buffers and refocus on their longer-term visions. The downgrading of 56% of African countries – above the global average of 31.8% – has increased the cost of capital for publicly financed projects.[135]

Financing support: leveraging funding and innovative finance

Specific efforts are likely needed to strengthen the investment framework in countries with low financing flows, including multilateral development funds, private sector investment pools, PPPs, climate finance, and philanthropic capital to support market development. Local enterprises struggle to access financing, with investments concentrated in a few companies. Unlocking domestic capital, including local currency debt, through risk-management instruments and on-lending facilities for commercial banks and intermediaries could alleviate some of these challenges.[136]

On the back of updates to energy transition policies, Africa can also leverage innovative financial instruments that benefit capital markets and society generally. Investors are developing new competencies in innovative finance by combining the skills and capital of private capital players and the risk appetite of philanthropy.[137] Examples of innovative financial structures include catalytic pooled funds and blended finance, which combines public sector investment and private philanthropy through concessionary loans or grants. These can mobilise flexibly packaged and deployed private capital to achieve socioeconomic outcomes by removing obstacles capital seekers face and reducing investment risk. More private and traditional capital providers could, therefore, consider projects they would otherwise regard as too risky.[138]

Technology and innovation: tapping rapidly proven technologies and innovation

Alongside new financial instruments, technology and related innovations, such as advances in clean energy generation, must be leveraged to unlock Africa's full potential in the renewables and broader energy market. For example, PV technology has transformed solar power and paved the way for innovative applications and improved efficiency.[139] Thermal conversion methods, such as hydrothermal liquefaction, pyrolysis, and gasification, are used to obtain high-quality liquid biofuels, while robotics technology can enable precise and optimal resource utilisation.[140]

Existing and evolving technologies such as the Internet of Things (IoT), artificial intelligence (AI), and blockchain could revolutionise utilities, grids, mini-grids, and systems by enhancing demand management, metering, predictive maintenance, and even by creating virtual power plants. These technologies could make power grids smarter and more efficient by improving system flexibility – an essential requirement for power grids to integrate high shares of renewable energy sources into energy mixes.[141] Similarly, innovations in electricity market business models and design could enable the rapid deployment of energy sourced from renewables.

Another area of rapid innovation has been in battery storage technologies, offering the ability to back up the energy supply provided by renewables to supplement services to national grids.[142] Startups, in particular, can offer diverse solutions, including battery technologies such as flow and solid-state batteries and capacitor-based systems for high-power applications.

Given a policy focus on technology (e.g., the United States' Inflation Reduction Act), increased research and development (R&D) spending and more startup activity will likely drive continued innovation in clean energy technologies. These could be part of transforming and unlocking Africa's clean energy potential.[143]

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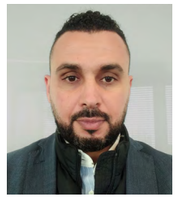

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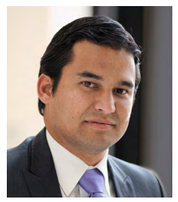

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