AFRICAN DEVELOPMENT BANK GROUP
GROUPE DE LA BANQUE AFRICAINE DE DÉVELOPPEMENT

African Development Bank

Power, Energy, Climate and Green Growth Complex

CHALLENGES AND OPPORTUNITIES FOR A NET-ZERO FUTURE IN AFRICA

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Responsible and Sustainable Natural Gas: Challenges and Opportunities in Africa (virtual workshop)

September 14th, 2021

Human activity has warmed the climate at a rate that is unprecedented in thousands of years, leading to widespread, intensifying and rapid changes in the world's weather patterns

CO_2 CONCENTRATION

Highest in at least 2,000,000 years

SEA LEVEL RISE

Fastest rates in at least 3,000 years

ARCTIC SEA ICE

Lowest level in at least 1,000 years

GLACIERS RETREAT

Unprecedented in at least 2,000 years

EXTREME HEAT

More frequent
More intense

HEAVY RAINFALL

More frequent
More intense

DROUGHT

Increase in frequency in some regions

FIRE WEATHER

More frequent
More intense

OCEAN

Warming, acidifying and losing oxygen

Source: Intergovernmental Panel on Climate Change Report, 2021

African countries need to prepare for significant shifts in their ecosystems and biodiversity, which will negatively impact the economic sectors and livelihoods that depend on them

Mediterranean (MED)

- **Observed** increases in aridity and droughts
- **Projected** decrease in rain
- **Projected** increases in fire weather

Sahara, including parts of the Sahel (SAH)

- **Projected** increases in heavy precipitation and flooding

West Africa (WAF)

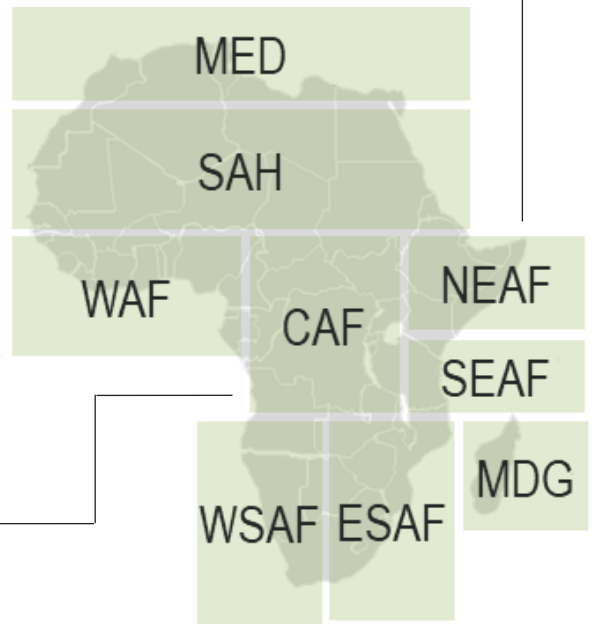
- **Observed** increases in river flooding and agricultural droughts
- **Projected** increases in droughts in seasonal timescales and pluvial flooding

Central Africa (CAF)

- **Observed** decreases in precipitations
- **Observed** increase in agricultural and ecological droughts
- **Projected** increases in pluvial and river flooding

West Southern Africa (WSAF)

- **Observed** increase in heavy precipitation and pluvial flooding
- **Observed** and **projected** increases in aridity, agricultural and ecological droughts
- **Projected** increases in dryness, mean wind speed and fire weather conditions



North Eastern Africa (NEAF)

- **Observed** decreases in precipitation
- **Observed** and **projected** decreases in snow and glaciers
- **Projected** increases in heavy precipitation and pluvial flooding

South Eastern Africa (SEAF)

- **Observed** and **projected** decreases in snow and glaciers
- **Projected** increases in frequency and/or intensity of heavy precipitation and pluvial flooding
- **Projected** increase of average tropical cyclone and associated heavy precipitation of the proportion of category 4-5 cyclones

Madagascar (MDG)

- **Observed** increases in aridity
- **Projected** increases droughts, pluvial flooding and average tropical cyclone

East Southern Africa (ESAF)

- **Observed** decreases in mean precipitation
- **Observed** increase in meteorological drought
- **Observed** and **projected** increases in heavy precipitation and pluvial flooding; aridity, agricultural and ecological droughts
- **Projected** increases in fire weather conditions; tropical cyclone and associated heavy precipitation of the proportion of category 4-5 cyclones

Source: Intergovernmental Panel on Climate Change Report, 2021

At the same time, Africa's energy needs are urgent and growing, with structural transformations projected to drive energy consumption over the next decades

Consumption growth drivers

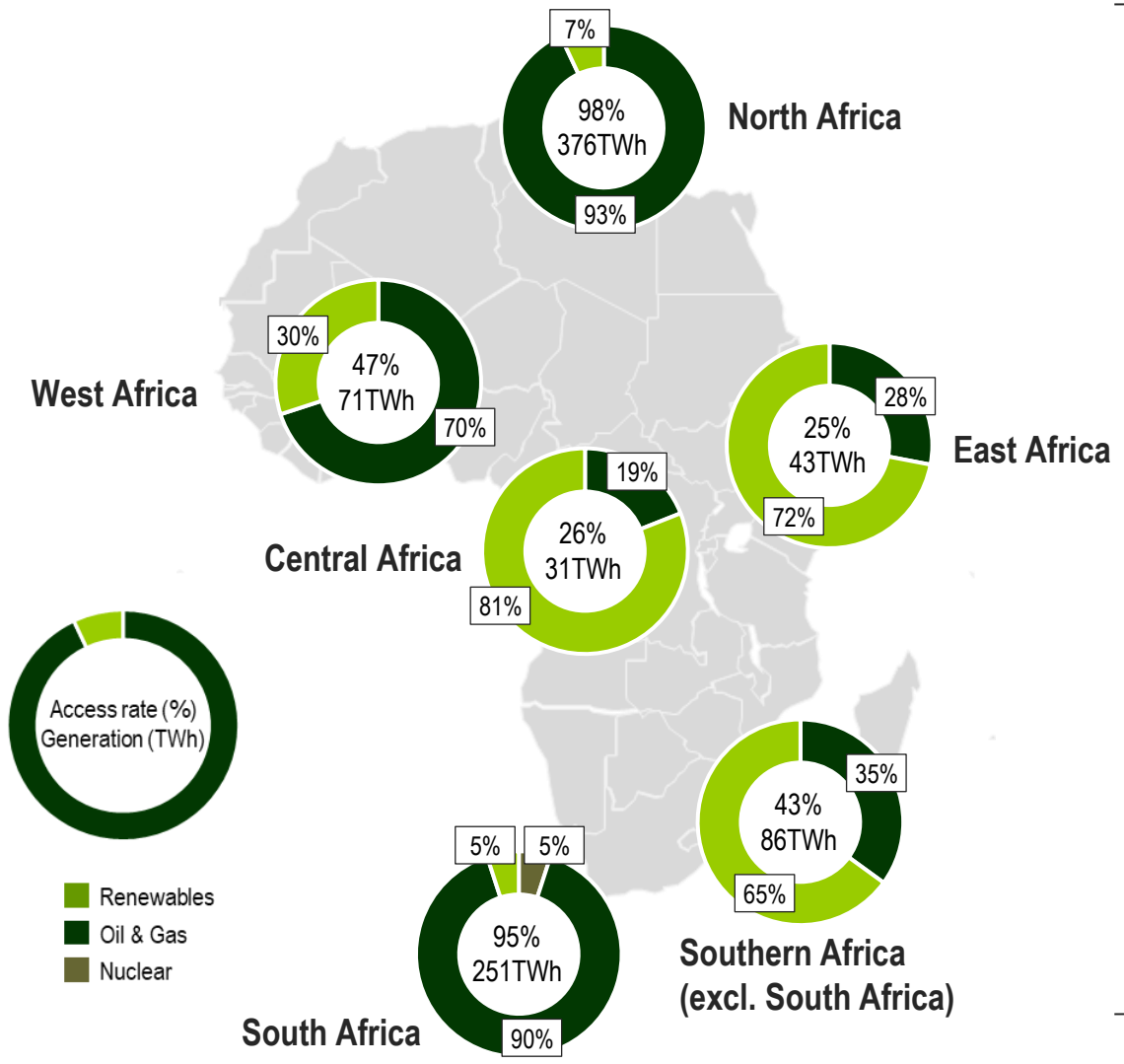
2.1B people will live in Africa in 2040, up from 1.3bn in 2020

59% of the population will live in urban areas by 2050

43% increase in investment in manufacturing by 2030

2.3% growth in household consumption by 2030

100% increase in electricity demand by 2040



858TWh of electricity generated by all 54 African countries in 2019, i.e. **5x less than what the US generated that year**

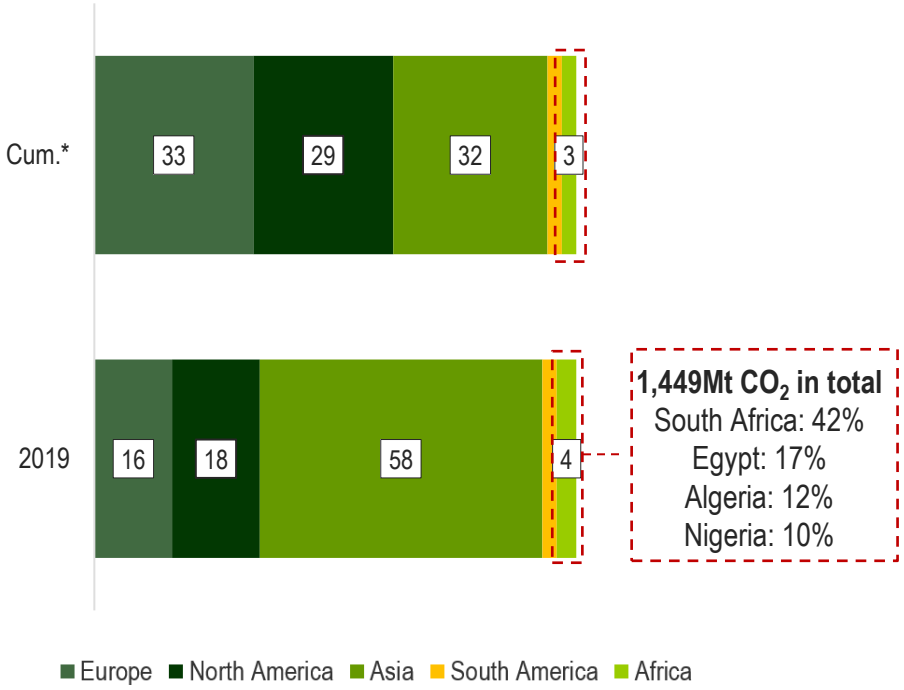
Africa's energy production must **grow by 150% to reach universal access by 2030**

Sources: Tracking SDG7 database; International Energy Agency database; UN World Population Prospects 2020; Medium Variant Scenario; US Energy Information Administration; AfDB analysis

Africa's emission profile is different to the rest of the world: it has marginally contributed to global GHG emissions and presents an energy sector that is not as polluting

Africa accounts for only 3% of global emissions, with 81% of its emissions driven by 4 countries

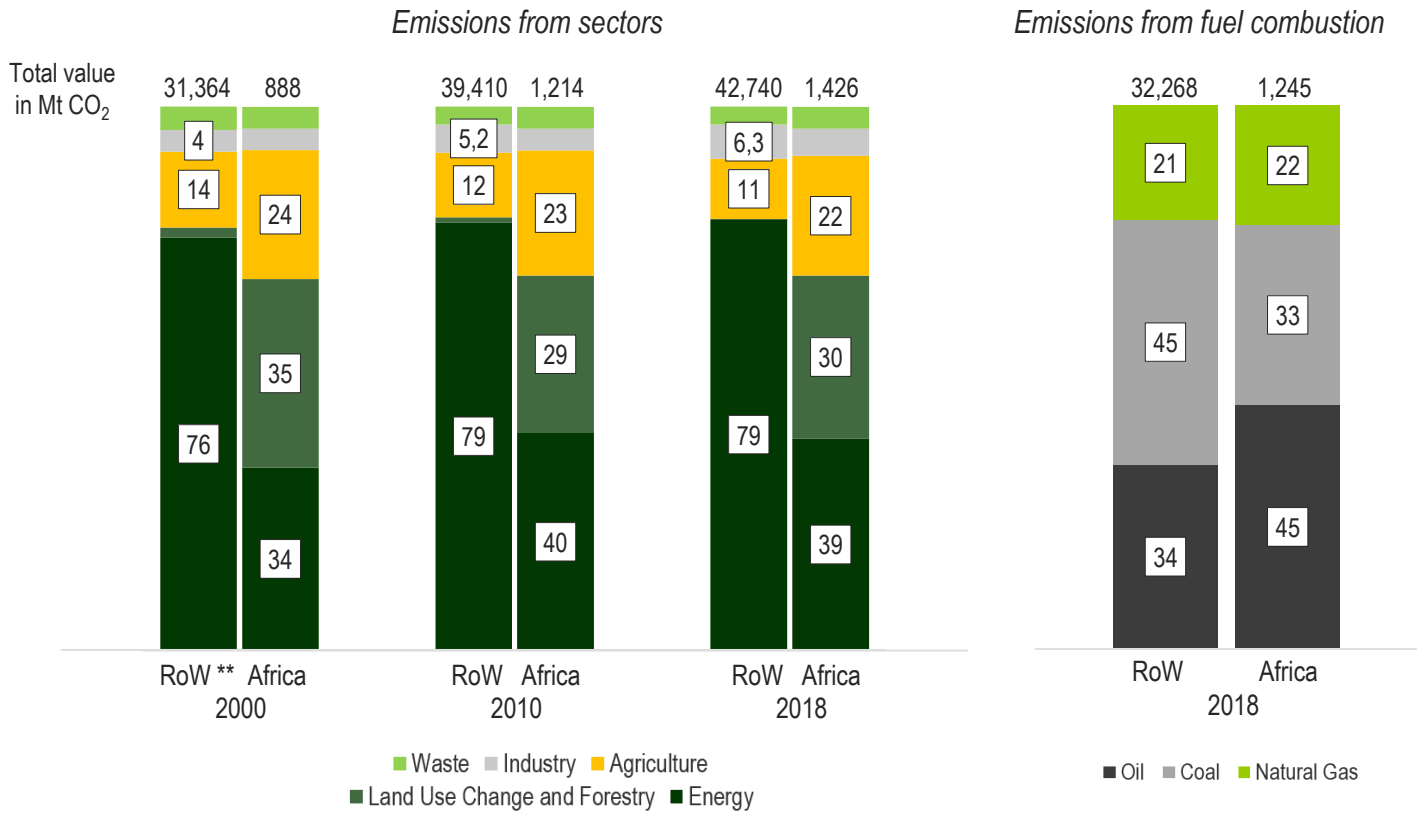
Breakdown of global GHG emissions per region (%)



**Cumulative value as of April 2021. Total historical value goes back as far as data is available: 1750 for Europe, 1785 for North America, 1830 for Asia, and 1884 for Africa and South America*

The energy sector contributes to only 40% of Africa's emissions, while natural gas contributes to 19% of Africa's emissions

Breakdown of GHG emissions per sector and fuel combustion (%)



***RoW refers to the Rest of the World*

Sources: Climate Analysis Indicators Tool database; AfricaScoping Study, ClimateWorks Foundation, 2020; Global Carbon Atlas Database, Climate Watch Database; AfDB analysis

Although renewables will play an important role in Africa's pathway to net-zero, African countries cannot rely solely on variable renewable energy to power their economies

African countries can rely on abundant and cheaper RE sources of power, with a generation potential 100x higher than current levels

	SOLAR PV	WIND
GENERATION POTENTIAL BY REGION, in TWh/year		
Northern	109,033	130,316
Western	103,754	40,846
Central	61,153	12,395
Eastern	219,481	165,873
Southern	162,817	108,236
GLOBAL AVERAGE PRICE IN AUCTIONS, in USDc/kWh		
2011	28.44	7.65
2013	12.25	6.63
2015	8.15	7.11
2017	5.80	4.30
2019	5.58	4.92

However, the degree to which solar and wind can be deployed is constrained by their inherent intermittency and integration cost

LOAD BALANCING AND BATTERY STORAGE

Switching to renewables can cause **load balancing challenges for a grid system that does not have a reliable baseload**. In the case of the use of battery storage, even though their cost decreased by 87% between 2020 and 2019, their **storage capacity is still limited**. Furthermore, a flexible use of storage requires **high-resolution forecasting capacity for both supply and demand that most utilities in Africa do not have.**

LEVELIZED COST OF ELECTRICITY

System costs associated with managing Variable Renewable Energy are not included in LCOE and not paid for by the developers (mostly Independent Power Producers) of RE projects: in Kenya for example, the contribution of VRE to the national installed capacity rose from 0.3% in 2013 to 14.6% in 2019, with system costs requiring an **additional USD 50 million per year.**

Sources: IRENA Database; Decarbonizing Africa's grid electricity generation, CDC, 2021; AfDB analysis

Gas technologies present promising options to accelerate Africa's sustainable development agenda, offering ways to improve people's lives and support the industrialization of the continent

INDUSTRIAL

- **Fuel** for process heating in combined heat and power systems
- **Raw material** (feedstock) to produce chemicals, fertilizers and hydrogen

LOGISTICS

- **Fuel** to operate compressors that move natural gas through pipelines
- **Vehicle fuel** in the form of compressed natural gas and liquefied natural gas

COMMERCIAL

- **Heat** buildings and water
- Operate **refrigeration** and cooling equipment
- **Clean cooking**
- Outdoor **lighting**

RESIDENTIAL

- **Heat** buildings and water
- **Clean cooking**
- **Power appliances** such as air conditioners and heaters

Sources: AfDB analysis

Natural gas pairs very well with variable renewable energy and has historically facilitated the integration of renewable energy into the power system of developed markets

Unabated natural gas: gas power stations that have not been fitted with carbon capture and storage technology to stop carbon emissions

- ✓ Meets energy demand growth
- ✓ Good substitute for higher-carbon fuels such as coal
- ✓ Supplies hydrogen feedstock

CONVERSION OF GAS INFRASTRUCTURE
no risk of stranded assets

Abated natural gas: gas power stations that have been fitted with carbon capture and storage technology to stop carbon emissions

- ✓ Hydrogen and ammonia
- ✓ Renewable natural gas (biomethane)
- ✓ Synthetic natural gas

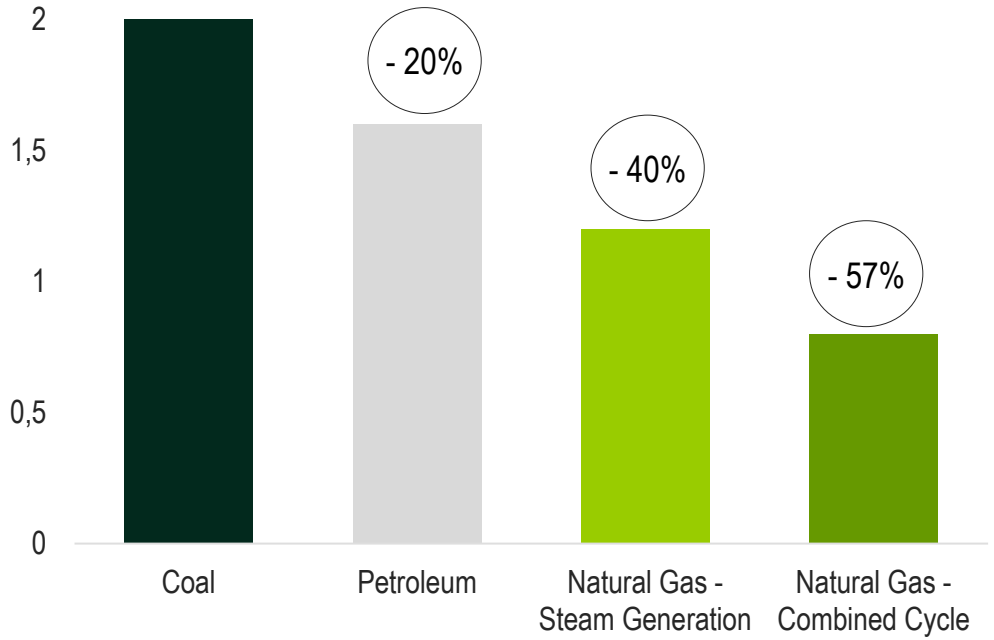
- Natural gas generators can **ramp up quickly when variable renewable energy resources are not available**
- Lower natural gas prices **help make renewables more affordable for consumers**: when natural gas is used as a "backstop" for renewables, the overall costs of electric power decrease
- Gas technologies for power generation have become **more flexible and cost-efficient**: CCGT ramp times have improved by 44% while capital costs have fallen by 25%
- **Construction time is cut by half compared to geothermal and hydropower plants**, with lower upfront capital investment and better profitability when not used (low fixed cost/high variable-cost)
- In the US, there is a correlation between the adoption of natural gas an renewables for electric generating capacity: **for every 1% increase in natural gas capacity, renewable power generation increases by 0.88%**

Sources: A Role for Fossil Fuels in Renewable Energy Diffusion, US National Bureau of Economic Research; A Sustainable Flame: the Role of Gas in Net-Zero, HIS Market; AfDB analysis

Natural gas has greatly contributed to the decarbonization of some of the most polluting power systems in the world and therefore represents a promising transition fuel for Africa

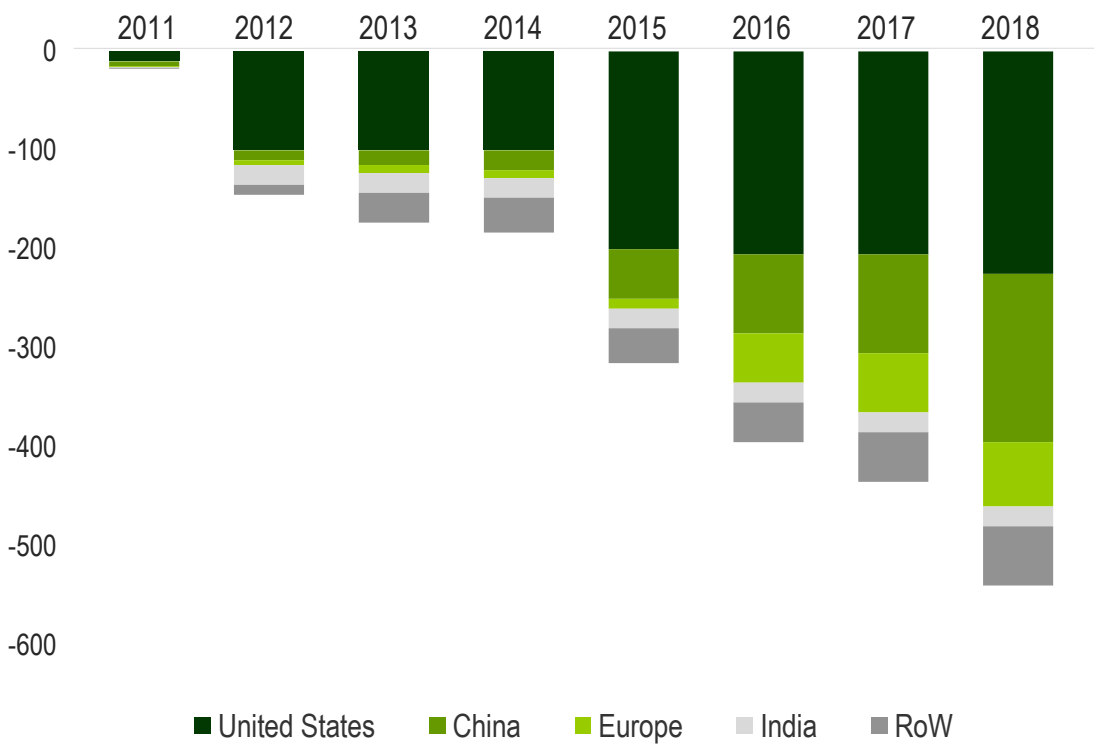
CO_2 emissions from the combustion of natural gas are 40% to 57% lower than coal

Pounds of CO_2 emissions per kWh



Coal-to-gas switching has avoided more than 500 million tons of CO_2 emissions between 2010 and 2018

CO_2 savings from coal-to-gas switching compared with 2010, in Mt CO_2

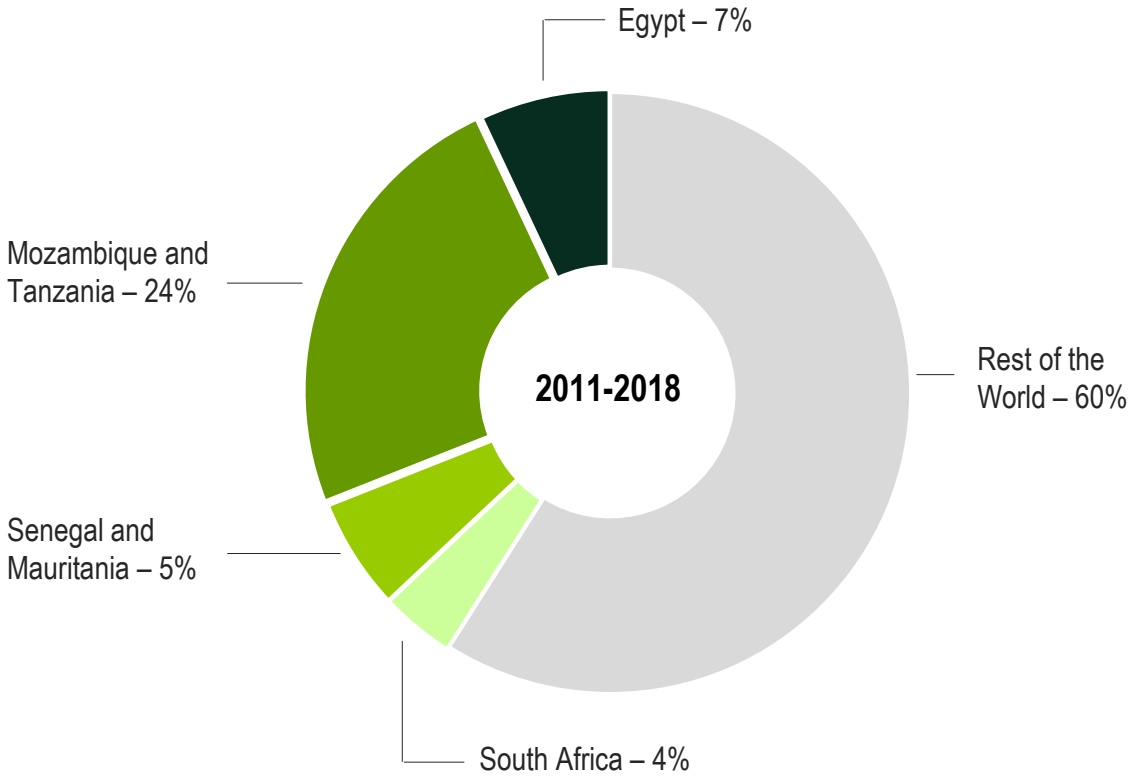


Sources: U.S. Carbon Dioxide Emissions in the Electricity Sector: Factors, Trends, and Projections, Congressional Research Service, 2019; Estimates from The Role of Gas in Today's Energy Transition, International Energy Agency

Recent discoveries in natural gas represent a turning point for Africa to support countries' industrial growth whilst accompanying their energy transitions

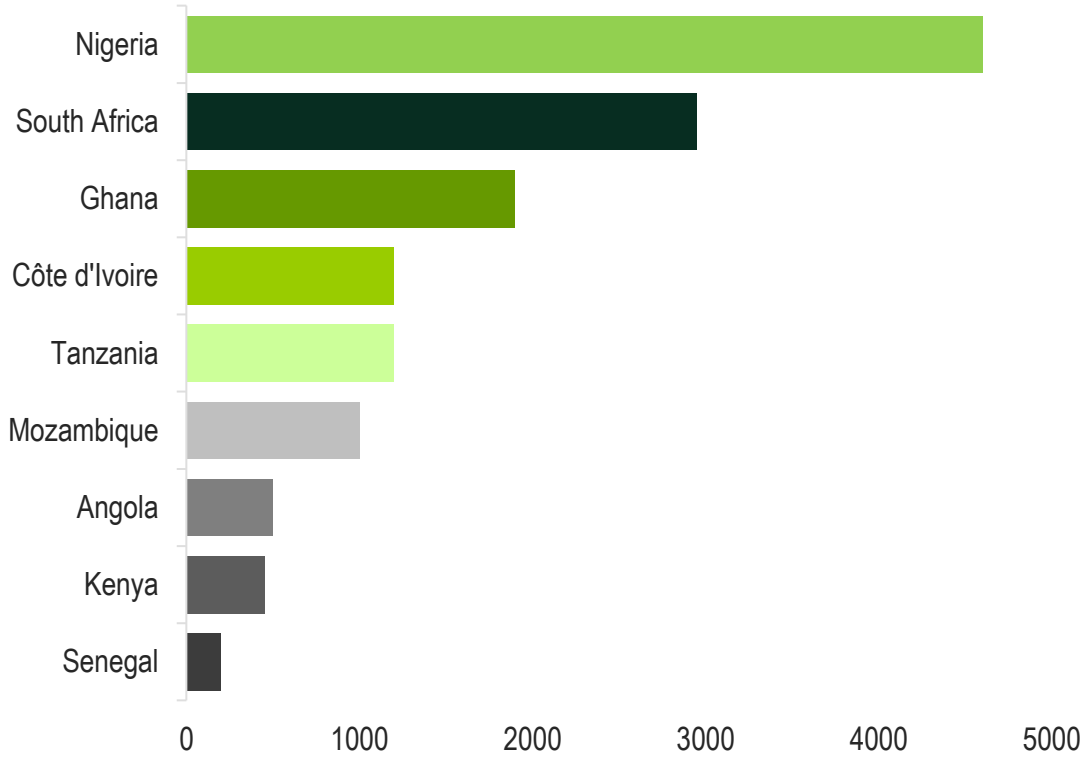
40% of global natural gas discoveries between 2011 and 2018 were found in 6 African countries

Share of global gas discoveries



Based on current known reserves, 9 countries hold the potential for around 16 GW of new gas-fired power generation by 2030

Projected gas-based generation capacity, MW



Sources: Africa Energy Outlook 2019, International Energy Agency; USAID/Power Africa (2018) Gas Roadmap to 2030; AfDB Analysis

In limited circumstances, Development Financial Institutions will support the development of natural gas as a transition fuel to facilitate the pathways of African countries towards net-zero

POSSIBLE ROLES FOR DFIs

- **Long-term planning,** e.g. economy-wide Long-Term Strategies and associated Least Cost Integrated Resource Plans
- **Program planning,** e.g. second phase of SADC's Regional Gas Master Plan, potential expansions of the West African Gas Pipeline and the Mozambique-South Africa Gas Pipeline, etc.
- **Capacity building** for regulators and government officials to undertake required sector reforms and ensure affordable, cost-reflective and sustainable tariff/subsidies policies, while considering carbon pricing in planning
- **Project preparation and project investments,** e.g. production and liquefaction facilities, gas-to-power along with related transmission and distribution infrastructure, clean cooking, gas-based products such as petrochemicals and fertilizers, along with technical assistance to increase linkages between large projects and local economies and to minimize and avoid leakage and flaring of methane

POTENTIAL GAS-BASED PROJECTS

- Gas-to-power plants, midstream (e.g. transportation, storage, gasification) and downstream (e.g. NG, LPG, CNG) where it is demonstrated that the **underlying projects are aligned with the Paris Agreement by being consistent with their Nationally Determined Contributions and/or Long-Term Strategies**
- Gas-based projects where it is demonstrable that they will **lead to improved energy access, improved energy security, have positive economic impacts while promoting appropriate technologies/business models and maximizing local content**

Sources: AfDB analysis

Thank you

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