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African Energy Commission
Commission Africaine de l'Energie

Africa and Just Energy Transition

Considerations for the Expansion of the African Oil & Gas Domestic Market

October 2022

The African Energy Commission (AFREC) is a specialised energy agency of the African Union (AU), mandated to develop the African energy sector through the facilitation, coordination, harmonization, protection, conservation, development, promotion of rational exploitation, commercialization, and integration of energy resources in Africa. It engages actively with a broad network of experts and partners in the 55 AU member states, ensuring that all energy initiatives align with the future development of the energy sector in Africa and the pursuit of building 'the Africa We Want'.

We welcome comments on this study report and these can be addressed to:

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Acknowledgements

The Analysis of the Prerequisites for the establishment of the African Oil & Gas Domestic Market is a publication of the African Energy Commission (AFREC). Its inception was motivated by the fact that Africa is considered as net exporter of crude oil and natural gas while it is net exporter of related products. In addition, most of the large oil and gas reserves are concentrated in Northern and Western Africa. This could create the need to supply oil and gas to other regions through regional energy infrastructure thus facilitating markets creation/expansion as well as regional integration.

This report consists of inputs from industry experts from focused countries, African Development Bank National Resources Centre and with contributions from the Organisation of Petroleum Exporting Countries (OPEC), the African Petroleum Producers Organisation (APPO), the African Refiners & Distributors Association (ARDA) and Islamic Development Bank (IsDB).

The study was conducted for AFREC by EPCM Holdings under the leadership of the Mr. Rashid Ali Abdallah, Executive Director of the AFREC and coordinated by Mr. Yagouba Traore, Head of Policy, Strategy and Support at AFREC.

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Executive Summary

Executive Summary

Africa is endowed with considerable oil and gas reserves and undeveloped resources that can assist the continent's economic growth if they are strategically developed.

There is a need to clarify Africa's position and develop strategies for future supply adequacy, considering current uncertainties about energy supply, the key drivers of future demand, policies of consumer countries (especially alternatives to oil and gas), and expected future global economic growth and technological developments.

Africa's Oil and Gas Landscape

A wealth of oil and gas resources provides the economic foundations for the sustainable development of many African countries, while the discovery and development of new hydrocarbon fields continue to provide economic leverage through trade and investment.

Crude Oil

The crude oil reserves in Africa are estimated to be more than 125 billion barrels, with production reaching 6,9 million barrels per day in 2020, which represents 7,8% of global production. About 87% of the continent's oil reserves are located in five African countries: Libya (39%), Nigeria (30%), Algeria (10%), Angola (6%), and Egypt (2%). Africa is the only continent in the world that is both a net exporter of crude oil and a net importer of petroleum products. African refineries can only refine 3,3 million barrels a day, despite recording a demand of 4,1 million barrels a day by 2020. The refined petroleum products market in Africa is dominated by diesel, gasoline and LPG.

Despite significant demand across the continent of Africa, trade in crude oil and petroleum products is limited within the continent, with the majority of products being shipped to the international market. SUMED, Tazama, Chad-Cameroon, and Petrodar pipelines are the most prominent crude oil trans-border pipelines, although several other pipelines are under consideration (LAPSSET, EACOP, AZOP, Niger-Chad pipelines) or construction (Niger-Benin oil pipeline).[1]

Natural Gas

Natural gas reserves in Africa are estimated to be 850 tcf, with production reaching nearly 8 200 bcf in 2020, which presents 6% of global production. Gas reserves are considerable in Northern (33%), Western (28%), and Southern Africa (31%), and commercial quantities of natural gas have been found in many African countries.

Algeria (39%) and Nigeria (30%) are the two largest LNG exporters, with operational LNG export terminals in Africa having a combined capacity of 75 MTPA. A large proportion of natural gas is exported from Africa; however it is also used in industry, power generation, transport, agriculture, commercial and residential applications. In terms of global adoption, gas-to-liquids applications are not well established, however, Africa is home to two plants, both of which are located in South Africa. Africa continues to promote gas as a key fuel to meet its growing baseload power generation (e.g. Nigeria), substitute oil products (e.g. South Africa), encourage industrial development (e.g. Algeria, Egypt), monetize associated and flared gas (e.g. Nigeria), and replace coal (e.g. South Africa).

Medgaz, GME, Trans-Mediterranean, AGP, EMG, Greenstream, ROMPCO, and WAGP pipelines are the most prominent natural gas trans-border pipelines, although several other pipelines are under consideration (ARP, Ghana-Côte d'Ivoire, GALSI, TSGP pipelines).[2]

1 SUMED connecting the Ain Sokhna terminal in the Gulf of Suez, near the Red Sea, to the offshore Sidi Kerir port in Alexandria in the Mediterranean Sea; Tazama connecting the port of Dar-es-Salaam, Tanzania, to the Indeni Petroleum Refinery in Ndola, Zambia; Chad-Cameroon connecting the Doba Oil Field in southern Chad to a floating export facility at Kribi, Cameroon; Petrodar connecting the Upper Nile State (South Sudan) to the Red Sea (Sudan); LAPSSET connecting Kenya, Ethiopia and South Sudan; EACOP connecting Kabaale, Hoima district in Uganda to the Chongoleani Peninsula near Tanga Port in Tanzania; AZOP connecting Lobito refinery in Lobito, Angola to Lusaka, Zambia; Niger-Chad connecting the Agadem oil field in Niger to the Doba Basin in Chad, where it would be connected to the existing Chad-Cameroon Oil Pipeline, for export through the Port of Kribi in Cameroon; Niger-Benin connects Niger's Agadem oil field with Benin's Port of Seme terminal via the Southwest of Niamey, Niger.

2 Medgaz connecting Algeria to Spain; GME connecting the Hassi R'Mel gas field in Algeria to Cordoba, Spain, through Morocco, where it is connected to the Spanish and Portuguese gas grids; Trans-Mediterranean connecting Algeria via Tunisia to Sicily and mainland Italy, with an extension to Slovenia; AGP connecting Egypt to Jordan, Syria and Lebanon; EMG connecting the Israeli terminal of Ashkelon to the Egyptian receiving station of Al-Arish; Greenstream connecting Mellitah in Libya to Gela, in Sicily, Italy; ROMPCO connecting the onshore gas fields in Pande and Temane in Mozambique to Gauteng, South Africa; WAGP connecting Nigeria's Escravos region of the Niger Delta area to Benin, Togo and Ghana; ARP connecting Mozambique's gas-rich Rovuma basin to Gauteng, South Africa; Ghana-Côte d'Ivoire connecting the gas processing plant near Atuabo, in the Western region of Ghana, to the border of Cote d'Ivoire; GALSI connecting Algeria to Italy via Sardinia; TSGP connecting Nigeria's resources to Hassi R'Mel in Algeria, linking to a wider regional network of pipelines, including GME, Medgaz, Trans-Mediterranean

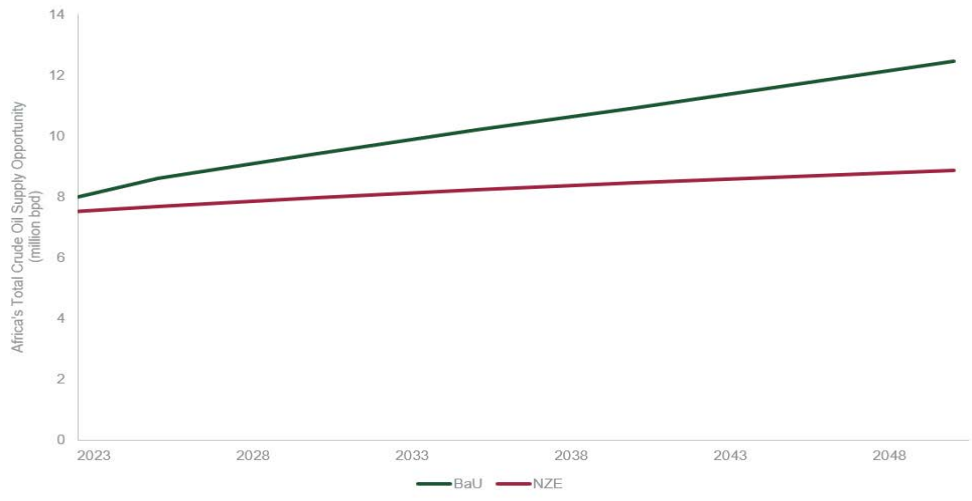

Figure 1 Potential crude oil supply opportunity for Africa (intra-African and international markets)

Regional Economic Communities

Through regional integration, African countries have the opportunity to exploit regional value chains and expand their markets, which would otherwise be small and fragmented. In turn, regional value chains are important anchors for industrialization and broader economic transformation. Recently discovered oil and gas deposits in several African countries provide a great opportunity for African economies to undergo a rapid industrialization process.

Africa's current integration landscape contains an array of Regional Economic Communities, namely the Arab Maghreb Union (AMU), the Common Market for Eastern and Southern Africa (COMESA), the Community of Sahel-Saharan States (CEN-SAD), the East African Community (EAC), the Economic Community of Central African States (ECCAS), the Economic Community of West African States (ECOWAS), the Southern Africa Development Community (SADC) and the Intergovernmental Authority on Development (IGAD).

African Continental Free Trade Area (AfCFTA)

AfCFTA provides a unique opportunity for African countries to integrate competitively into the global economy, reduce poverty, and promote inclusion.

In the oil and gas industry, the AfCFTA is expected to trigger substantial investment from countries overseas, such as the United States and other European countries, mainly because it provides investors with a larger market with lower risk. AfCFTA expands the market by providing a single market with fewer cross-border barriers, which allows investors to undertake larger revenue projects on a regional rather than national scale. By taking advantage of economies of scale offered by the AfCFTA to develop regional solutions, the market for exports could grow considerably. Among other things, the AfCFTA provides a protocol for the reasonable resolution of investor-state disputes, which should make investments with African countries less risky for investors.

AfCFTA currently has 54 signatories, of which 43 have deposited their instruments of ratification by May 2022.

Energy Outlook

Recent oil and gas discoveries, as well as regulatory changes and rapidly expanding consumer markets across the continent, present significant opportunities. Business-as-Usual presents as the development pathway for the African oil and gas sector that would most benefit the continent and its people.

The short-term period of interest for this study is the period between now and 2030, the medium-term period is 2031 to 2040, and the long-term period is 2041 to 2050.

For the purpose of estimating the overall African supply opportunity over the short-, medium-, and long-term, a cumulative approach has been employed that takes into account both the supply opportunity to the international market based on the projected global demand (excluding Africa) and the supply opportunity in an isolated African market (only Africa). It is assumed that Africa's crude oil and natural gas reserves are sufficient to meet continental demand and to serve the international market, thereby maximizing revenue. Furthermore, Africa is assumed to continue to benefit from 4,2% of the global crude oil market, and 1,95% of the global natural gas market, while capturing 100% of the African market, over the outlook periods considered in this study.

Crude Oil

In developing the global supply outlook scenarios for crude oil, two scenarios have been considered: one defined by OPEC in the World Oil Outlook 2021 report (BaU) and the other by the IEA in the Net Zero by 2050 report (NZE).

The total crude oil supply opportunity is comprised of Africa's growing petroleum demand (bolstered by population growth and economic activity, fuel switching from biomass to oil-based products and increased use of diesel and fuel oil for power generation), as well as the international market, and is summarised in Figure 1.

In the BaU scenario, the global supply opportunity gradually increases, but the overall demand shifts from export to intra-continental trade during this period, with global supply (as a portion of the total supply opportunity) decreasing from nearly 50% to 34% over time. Among the main reasons for this trend in the global market are efficiency improvements across all sectors of consumption and the substitution of oil with gas and renewable energy sources. It includes the significant penetration of electric vehicles in the road transportation sector, ongoing electrification in the residential and industrial sectors, and the penetration of alternative fuels in the marine and aviation sectors.

According to the NZE scenario, the global supply opportunity (as a percentage of the total supply opportunity) has decreased significantly from nearly 50% to 7,5%, while the African continent's demand has experienced a compound annual growth rate of 2,7% during the outlook period. Among the main reasons for this trend in the global market are decreased energy intensity and increased production of alternative fuels (advanced biofuels, hydrogen, and synthetic fuels).

The crude oil (petroleum products) market becomes increasingly local in both scenarios. Trade relationships and infrastructure must be built within Africa to facilitate trade on the continent's crude oil market, regardless of the trajectory of international decarbonization.

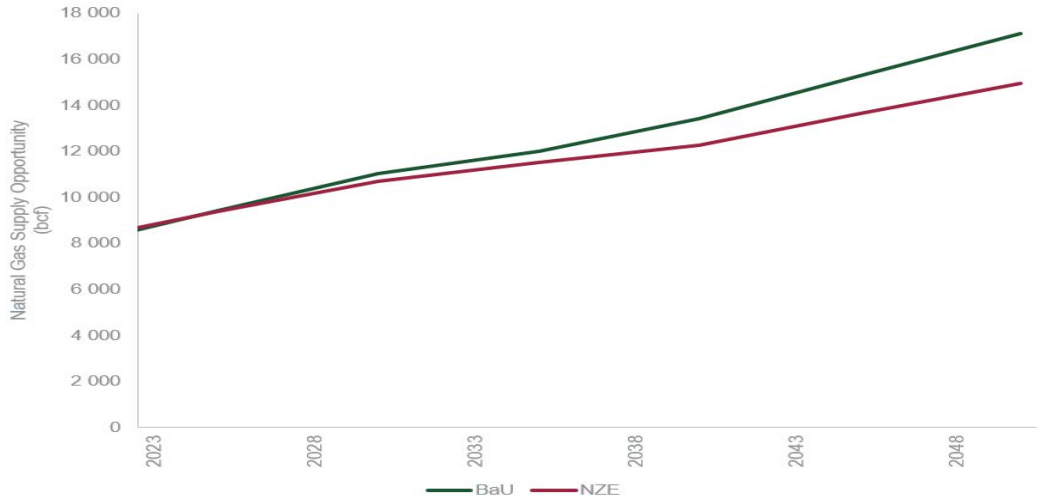

Figure 2 Potential natural gas supply opportunity for Africa (intra-African and international markets)

Natural Gas

In developing the global supply outlook scenarios for natural gas, two scenarios have been considered: one defined by OPEC in the World Oil Outlook 2021 report (BaU) and the other by the IEA in the Net Zero by 2050 report (NZE).

The total natural gas supply opportunity is comprised of Africa's growing natural gas demand (defined by Gas Exporting Countries Forum (GECF) in the Global Gas Outlook 2050 Synopsis report; bolstered by rapid economic growth and a growing urban population, coupled with an unprecedented increase in electricity demand), as well as the international market, and is summarised in Figure 2.

The BaU scenario predicts a gradual increase in global supply, but a shift in demand from exports to intra-continental trade during this period, with global supply decreasing from around 30% to just over 18% over time (as a percentage of the total supply opportunity). Energy efficiency improvements and the increasing penetration of renewable energy are two of the main reasons for this trend on the global market.

The NZE scenario indicates that the global supply opportunity (as a percentage of the total supply opportunity) has declined significantly from around 30% to just over 6%. Natural gas trade as LNG fell by 60% and pipeline trade declined by 65% between 2020 and 2050, primarily as a result of the phase-out of natural gas in the electricity sector. In the same period, African demand experienced a compound annual growth rate of 3,2%.

The natural gas market becomes increasingly localized in both scenarios, similar to crude oil (petroleum products). Regardless of the trajectory of international decarbonization, it is essential to foster intra-African trade relationships and build infrastructure to facilitate trade on Africa's natural gas market.

Development Roadmap: Crude Oil and Petroleum Products

The continent has enough crude oil reserves to meet its growing petroleum demand as well as an increased global market share.

Figure 3 illustrates the anticipated decline in crude oil reserves of the focus countries for this study over the outlook period. Based upon the current conditions of existing crude oil fields, Southern Africa's producing oil fields are expected to deplete in the medium-term and Central Africa's oil fields will deplete gradually over the longer-term.

Investment

A few countries dominate regional oil reserves, including Libya in the north, Nigeria in the west, and Angola in the south. Oil exploration and development in other regional countries should be promoted on a short-, medium- and long-term basis as a risk mitigation strategy.

Countries with sufficient oil reserves should be encouraged to increase production, such as Libya in Northern Africa, Sudan and South Sudan in Eastern Africa, Nigeria in Western Africa and Chad in Central Africa.

Investment in oil field development and associated production facilities in countries that possess oil reserves but do not produce (including but not limited to Mauritania, Uganda, Nigeria, Senegal, Namibia) should be promoted.

Since the exploration process takes time, oil exploration should begin before the country or region's reserves have depleted. Countries with oil reserves expected to deplete in the medium-term (such as Egypt, Angola, Ghana and Equatorial Guinea) and the longer-term (such as Algeria, Gabon, Chad, and Republic of Congo) should be encouraged to shift focus from increasing production to exploration and development of new reserves in the short-term and medium-term respectively.

Investment in new trans-continental pipeline projects, such as LAPSSET, EACOP, AZOP and Niger-Chad pipelines, should be encouraged.[3]

3 LAPSSET connecting Kenya, Ethiopia and South Sudan; EACOP connecting Kabaale, Hoima district in Uganda to the Chongoleani Peninsula near Tanga Port in Tanzania; AZOP connecting Lobito refinery in Lobito, Angola to Lusaka, Zambia; Niger-Chad connecting the Agadem oil field in Niger to the Doba Basin in Chad, where it would be connected to the existing Chad-Cameroon Oil Pipeline, for export through the Port of Kribi in Cameroon.

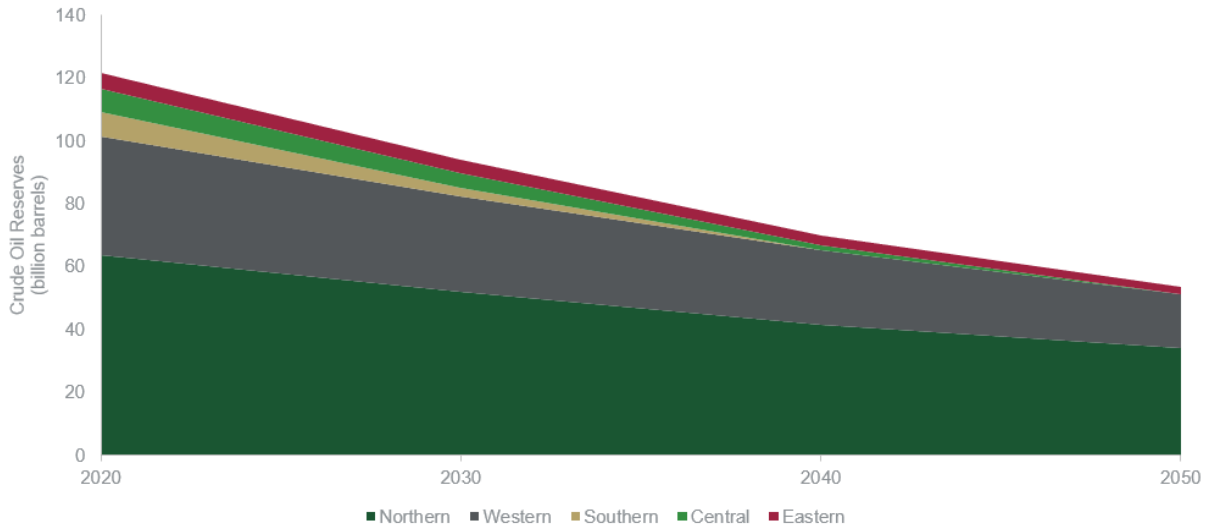

Figure 3 Crude oil reserve outlook

Trade

Increasing production and value addition infrastructure, storage and transmission infrastructure (domestic and international) are essential.

In order to facilitate trade, existing transborder pipelines, such as SUMED, Tazama, Chad-Cameroon and Petrodar, should be fully utilized.[4]

In order to facilitate inter- and intraregional trade between countries, countries in close proximity should be encouraged to evaluate and possibly consolidate economic groups on a regional and continental level. This will avoid the need for each country to increase production of crude oil or petroleum products, instead focusing on achieving regional self-sufficiency. It will be possible to conduct effective trade between all African countries if they are unified into a consolidated economic community (such as AfCFTA).

Countries with existing export terminals could be presented with the opportunity to increase production and expand export terminals, such as Algeria, Egypt and Libya in Northern Africa; Sudan in Eastern Africa; Angola in Southern Africa; Ghana and Nigeria in Western Africa; Chad and Republic of Congo, Equatorial Guinea and Gabon in Central Africa.

Infrastructure

Self-sufficiency in continental refined petroleum demand would require the full utilization of existing refinery capacity as well as the construction of new refineries. The full utilization of continental refining capacity (which will require refurbishment work) has the potential to increase production by up to 1,1 million bpd, which represents 75% of the anticipated additional short-term supply requirement. Furthermore, new refineries will be required (0,35 million bpd in the short term, 1,5 million bpd in the medium term, and 1,58 million bpd in the long term). The construction of new refineries or the expansion of existing refineries should be encouraged in countries with abundant oil reserves and established associated infrastructure, with consideration given towards shared infrastructure developments between neighbouring countries.

Energy Access

Access to modern energy is essential for the provision of clean water, sanitation and healthcare, and for the provision of reliable and efficient lighting, heating, cooking, mechanical power, transport and telecommunication services.

Refined crude oil products such as LPG, paraffin, diesel, heavy fuel oil and gasoline can be used as energy sources to assist certain regions and countries with power generation, transport, cooking, heating and lighting. Sub-Saharan Africa should be prioritised, accounting for three-quarters of the global energy access deficit.

Development Roadmap: Natural Gas

The continent is endowed with abundant natural gas resources that are not only sufficient to meet long-term demand, but also can be enhanced in order to cater to the needs of an expanding market.

Figure 4 illustrates the anticipated decline in natural gas reserves of the focus countries for this study over the outlook period. Due to low production volumes, significant natural gas reserves are expected to exist on the continent for the foreseeable future.

Investment

A few countries dominate regional natural gas reserves, such as Mozambique in the south, Nigeria in the west, Tanzania in the east and Republic of Congo in Central Africa. Natural gas exploration and development in other regional countries should be promoted on a short-, medium- and long-term basis as a risk mitigation strategy.

4 SUMED connecting the Ain Sokhna terminal in the Gulf of Suez, near the Red Sea, to the offshore Sidi Kerir port in Alexandria in the Mediterranean Sea; Tazama connecting the port of Dar-es-Salaam, Tanzania, to the Indeni Petroleum Refinery in Ndola, Zambia; Chad-Cameroon connecting the Doba Oil Field in southern Chad to a floating export facility at Kribi, Cameroon; Petrodar connecting the Upper Nile State (South Sudan) to the Red Sea (Sudan).

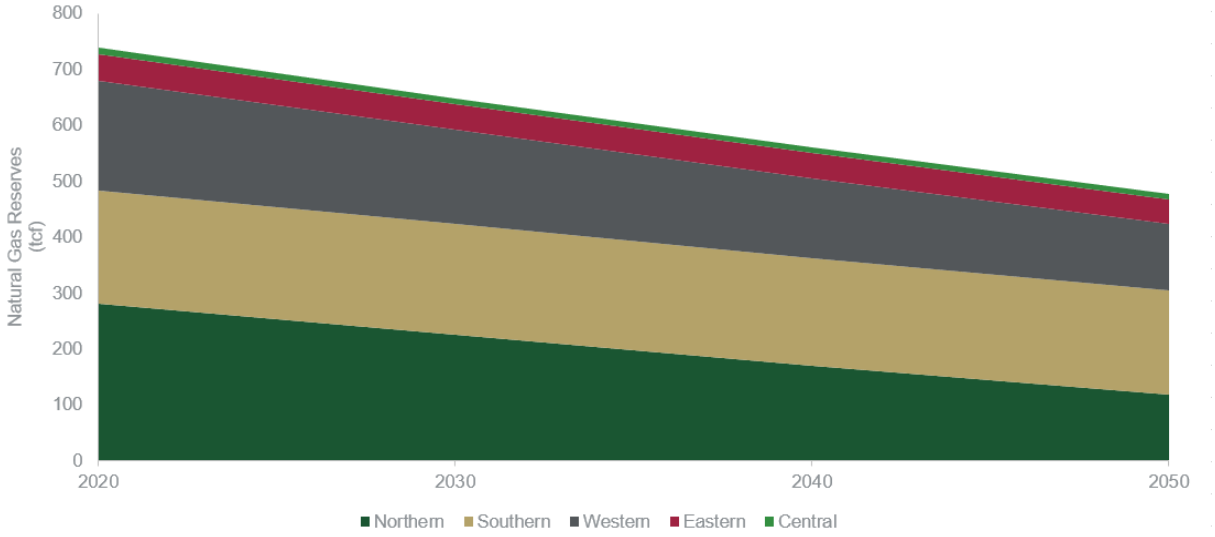

Figure 4 Natural gas reserve outlook

It is encouraged that Northern, Western, Eastern and Southern Africa should continue to increase their gas production and promote gas exports from Northern- and Western Africa to Southern-, Central-, and Eastern Africa.

Investment in various trans-regional pipeline projects, such as WAGP, ARP, ROMPCO, TSGP and Ghana-Côte d'Ivoire, should be encouraged, along with new trans-continental pipeline projects, such as the GALSI pipeline .

Gas production is expected to commence in Mauritania and Mozambique in the near future and the possibility of increasing production should be explored. Recent discoveries of natural gas in South Africa should encourage the country to commence production and continue to exploit the reserves already discovered. Production in Nigeria should be promoted in order to increase regional gas production. The majority of Eastern Africa's natural gas reserves is held by Tanzania, and this country should be encouraged to increase its production as well as promote the proposed LNG export terminal on the Indian Ocean.

Trade

The majority of Africa's natural gas reserves are located in Northern, Southern, and Western Africa. It is desirable to promote intra- and interregional gas trade, focusing on serving Eastern and Central Africa. Mauritania, Tanzania, Libya, Mozambique and Nigeria remain best positioned to meet and sustain long-term gas demand, along with supply from Egypt, Algeria and Republic of Congo. Considering the dwindling reserves in the Western region, intra-regional trade from Nigeria or Gabon to Equatorial Guinea and Ghana should be encouraged to ensure regional security of supply.

Planned production increases are primarily destined for the international market. Thus, it is imperative that intra-regional trade with countries with little or no gas reserves be encouraged, to service existing and future domestic markets.

Medgaz, GME, Trans-Mediterranean, AGP, EMG and Greenstream pipelines capacity utilisation should be increased, if possible, to reach a greater international piped gas market.[5]

Tanzania's LNG terminal might be feasible on the Indian Ocean, which could facilitate trade with other African and international markets. Furthermore, Mauritania and Mozambique are expected to have operational LNG export facilities in the medium-term, that could potentially support increased export volumes.

In the absence of new infrastructure for the supply and transport of natural gas, reductions in flaring and venting of natural gas could make at least 350 bcf of natural gas readily available over the next few years (IEA, 2022) (ACTING, 2021).

Infrastructure

It is imperative that future infrastructure development is directed toward serving the needs of the continental market, which accounts for 88%, 89%, and 97% of the projected growth in the BaU gas market over the short, medium, and long-term, respectively.

Countries with existing export infrastructure (such as Algeria, Angola, Nigeria) should be encouraged to increase gas production, and build new or expand existing LNG export facilities and transmission pipelines (international and domestic), to allow for additional export volumes. Shared infrastructure developments between neighbouring countries should also be encouraged (an LNG export terminal for Algeria and Libya, for example).

Energy Access

Natural gas can be used as energy sources to assist certain regions and countries, with power generation, transport and cooking. Sub-Saharan Africa should be prioritised, accounting for three-quarters of the global energy access deficit.

5 Medgaz connecting Algeria to Spain; GME connecting the Hassi R'Mel gas field in Algeria to Cordoba, Spain, through Morocco, where it is connected to the Spanish and Portuguese gas grids; Trans-Mediterranean connecting Algeria via Tunisia to Sicily and mainland Italy, with an extension to Slovenia; AGP connecting Egypt to Jordan, Syria and Lebanon; EMG connecting the Israeli terminal of Ashkelon to the Egyptian receiving station of Al-Arish; Greenstream connecting Mellitah in Libya to Gela, in Sicily, Italy; ROMPCO connecting the onshore gas fields in Pande and Temane in Mozambique to Gauteng, South Africa; WAGP connecting Nigeria's Escravos region of the Niger Delta area to Benin, Togo and Ghana; ARP connecting Mozambique's gas-rich Rovuma basin to Gauteng, South Africa; Ghana-Côte d'Ivoire connecting the gas processing plant near Atuabo, in the Western region of Ghana, to the border of Cote d'Ivoire; GALSI connecting Algeria to Italy via Sardinia; TSGP connecting Nigeria's resources to Hassi R'Mel in Algeria, linking to a wider regional network of pipelines, including GME, Medgaz, Trans-Mediterranean

Action Plan

As a first step towards a strategic plan, an action plan for the expansion of continental and regional oil and gas markets in Africa is proposed, offering stakeholders with broad actions for consideration.

Public Sector

Regional financial frameworks, as well as joint procurement frameworks at the regional level may be developed by the public sector to facilitate the coordination of fund raising and to ensure economies of scale are achieved. Developing attractive regulatory and fiscal terms, as well as de-risking instruments will be essential to attracting and securing investment in the oil and gas sector. Furthermore, the establishment of energy banks to finance African energy projects and the promotion of investment opportunities may contribute to sustained investment in the continent.

Developing and harmonising oil and gas specifications (standards), along with regional pricing policies (currencies and tariffs) may facilitate cross-border trade.

Infrastructure agreements (general terms and conditions; including third-party access) and construction standards, as well as a public-private partnership (PPP) framework that encourages investment and participation could boost bulk infrastructure projects throughout the continent.

Energy access in Africa may be enhanced by subsidy programs and access to a portfolio of least-cost energy options.

The extension of current exploration licenses and the establishment of strategic reserves/stockpiles for petroleum products and natural gas should be considered as a means of mitigating the impact of the Covid-19 pandemic and the impact of the Russia-Ukraine conflict on global supply chains.

Private Sector

The African oil and gas market would require increased private sector investments in regional value chains and value additions. Engagement programs with the community are crucial for avoiding unreasonable resistance and securing a 'license to operate'. Further, the private sector can play an important role in the establishment of energy banks to finance African energy projects. It may be possible to attract future capital and customers through the decarbonization of existing oil and gas production activities.

For intra-continental trade to increase, the private sector must prioritize intra-African trade, recognizing the growing domestic demand for crude oil, natural gas, and refined petroleum products.

PPPs are essential for infrastructure projects to expedite execution and ensure project viability.

It is possible to improve energy access to the local community through the establishment of local affordable appliances.

Civil Society and Communities

Engaging public and private investors constructively (through NGO's and community forums) may ensure that oil and gas investments benefit the communities in a fair and equitable manner.

Promotional and educational campaigns promoting gas and refined product applications could contribute to the development of markets and trade.

There can be significant benefits to surrounding communities from developments in the oil and gas sector, such as access to electricity, gas, and water, as well as providing goods, services, and labour during project construction and operation.

International and Regional Institutions

By way of pro-active information sharing and advertisement of upcoming projects (investment opportunities and associated investment sizes), provision of investment support (e.g. World Bank and International Monetary Fund), co-investment (e.g. International Finance Corporation), and provision of investment protection (e.g. Multilateral Investment Guarantee Agency), investments can be encouraged in the oil and gas sector. There may be an opportunity to pool resources and facilitate investment in the African hydrocarbon sector by establishing an African energy investment bank (similar to the African Export-Import Bank).

It is possible to boost intra-regional and inter-regional trade by developing and maintaining regional databases (production, consumption, supply, demand, prospects). Transport corridors can serve as a gateway to existing and upcoming markets by creating regional networks of trade routes (traditional as well as virtual). AfCFTA could benefit from the participation and support of international and regional institutions, as well as harmonisation of industry standards and codes.

A regional infrastructure database can be developed and maintained to improve capacity utilization (transmission, distribution, storage, refining, processing, export/import terminals, etc.). Coordination of cross-border infrastructure can ensure the least-cost development of infrastructure. It is imperative that institutional and individual skills, as well as resources, are developed in order to ensure the successful implementation and operation of local labour-based projects.

It is imperative that the development of energy services be coordinated with the development of productive uses in order to create the income base to fund the energy investments.

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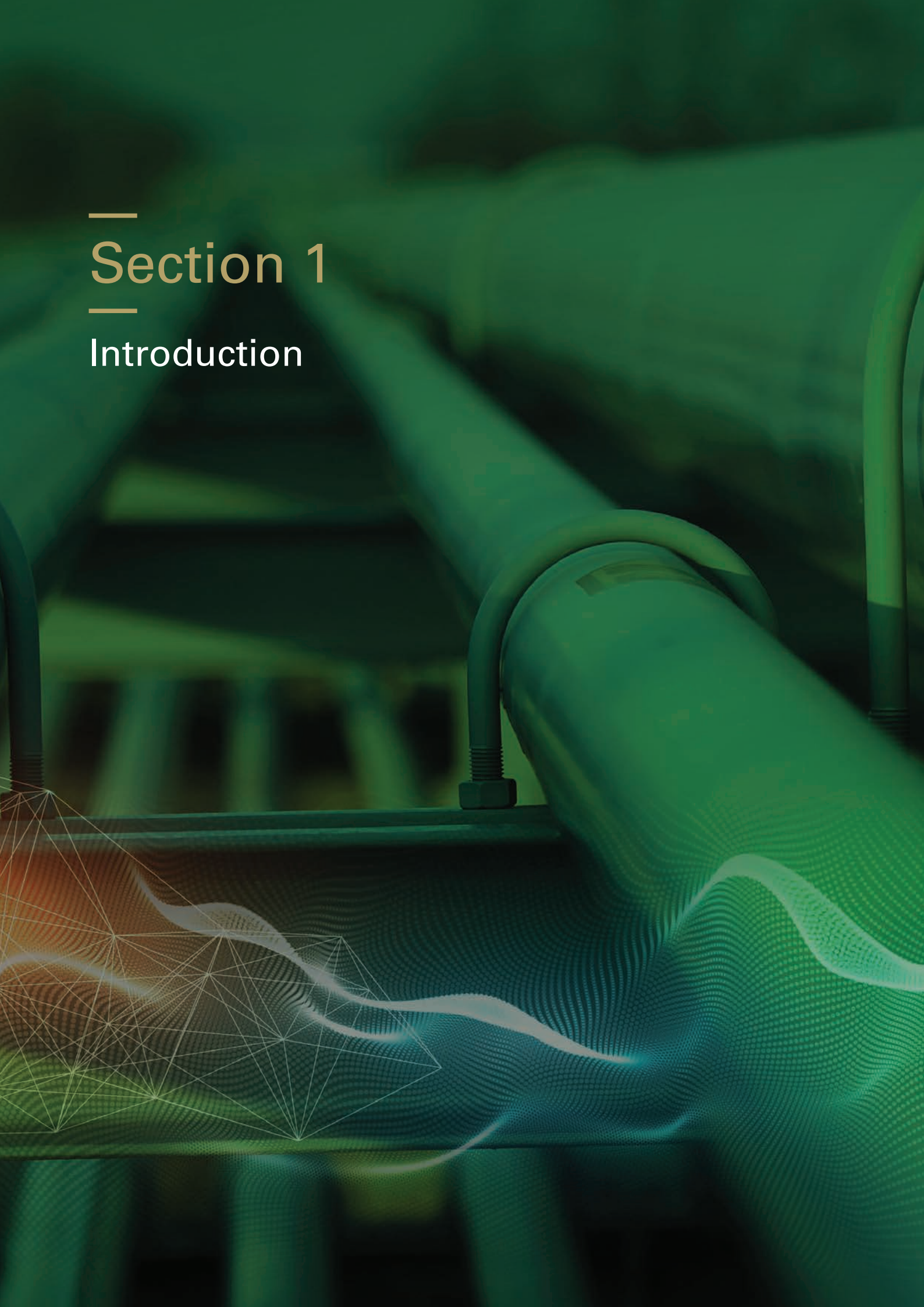
Abbreviations

ACE	Africa Coast to Europe
AfCFTA	African Continental Free Trade Area
AFREC	African Energy Commission
AGOA	African Growth and Opportunity Act
AGP	Arab Gas Pipeline
AMU	Arab Maghreb Union
APPO	African Petroleum Producers Organization
APT	Accelerated Policy and Technology
AZOP	Angola-Zambia Oil Pipeline
B2P3	Buipe and Bolgatanga Pipeline
BaU	Business-as-Usual
B-BBEE	Broad-Based Black Economic Empowerment
BECCS	Bioenergy with Carbon Capture and Storage
BIT	Bilateral Investment Treaties
BOST	Bulk Oil Storage and Transmission
BP	British Petroleum
bpd	Barrels per day
bcf	Billion cubic feet
CAR	Central African Republic
CCGT	Combined Cycle Gas Turbine
CCS	Carbon Capture and Storage
CCUS	Carbon Capture, Utilisation and Storage
CEC	Centrale Électrique du Congo
CED	Centrale Électrique du Djéno
CEMAC	Central African Economic and Monetary Community
CEN-SAD	Community of Sahel–Saharan States
CET	Common External Tariffs
CNG	Compressed Natural Gas
COMESA	Common Market for Eastern and Southern Africa
CTL	Coal-to-Liquids
DACCS	Direct Air Capture with Carbon Capture and Storage
DTT	Double Taxation Treaties
DRC	Democratic Republic of the Congo
EACOP	East African Crude Oil Pipeline
EASSy	Eastern Africa Submarine Cable System
EBA	Everything But Arms
ECCAS	Economic Community of Central African States
ECGLC	Economic Community of the Great Lakes Countries
ECOWAS	Economic Community of West African States
EDZ	Economic Development Zones
EFTA	European Free Trade Association
EG LNG	Equatorial Guinea Liquefied Natural Gas
EGTL	Escravos Gas-to-Liquids
EITI	Extractive Industries Transparency Initiative
EMG	East Mediterranean Gas

EU	European Union
FID	Final Investment Decision
FLNG	Floating Liquefied Natural Gas
FPSO	Floating Production Storage and Offloading
FSRU	Floating Storage Regasification Unit
FTA	Free Trade Agreement
GAFTA	Greater Arab Free Trade Area
GDP	Gross Domestic Product
GECF	Gas Exporting Countries Forum
GHG	Greenhouse Gases
GIP	Société de Gestion des Installations Pétrolières
GME	Gaz-Maghreb-Europe
GNL	Gaslink Nigeria Limited
GNPOC	Greater Nile Petroleum Operating Company
GSP	Generalized System of Preferences
GTA	Grand Tortue Ahmeyim
GTL	Gas-to-Liquids
HARP	Hybrid African Ring Path
HFO	Heavy Fuel Oil
IBRD	International Bank for Reconstruction and Development
ICT	Information and Communication Technology
IEA	International Energy Agency
IGAD	Intergovernmental Authority on Development
IFC	International Finance Corporation
IMF	International Monetary Fund
IMO	International Maritime Organization
IRP	Integrated Resource Plan
ISES	Integrated Sustainable Energy Strategy
km	Kilometre
LAPSSET	Lamu Port South Sudan-Ethiopia Transport
LNG	Liquefied Natural Gas
LOTEG	Luba Oil Terminal Equatorial Guinea
LPG	Liquefied Petroleum Gas
MAP	Mediterranean Action Plan
MEPP	Mauritanienne des Entreposages des Produits Pétroliers
MIGA	Multilateral Investment Guarantee Agency
MMbbl/d	Million barrels per day
MMBtu	Metric Million British Thermal Unit
MMscfd	Million standard cubic feet per day
MTPA	Million Tonnes Per Annum
MW	Megawatt
NBI	Nile Basin Initiative
NCCP	National Climate Change Policy
NDC	Nationally Determined Contribution
NZE	Net-Zero Emissions

NGL	Natural Gas Liquid
NGMC	Nigerian Gas Marketing Company
NLNG	Nigeria Liquefied Natural Gas
NMPP	New Multi-Product Pipeline
NNGIP	National Natural Gas Infrastructure Project
NNPC	Nigerian National Petroleum Corporation
OHADA	Organisation for the Harmonisation of Business Law in Africa
OPEC	Organization of the Petroleum Exporting Countries
PEACE	Pakistan and East Africa Connecting Europe
PESTLE	Political, Economic, Social, Technological, Legal and Environmental factors
PGD	Partnership for Growth and Development
POLMAR	Pollution Maritime
PSA	Production Sharing Agreement
PTA	Preferential Trade Agreement
PV	Photovoltaic
ROMPCO	Republic of Mozambique Pipeline Company
SACS	South Atlantic Cable System
SACU	Southern African Customs Union
SADC	Southern Africa Development Community
SAR	Societe Africaine de Raffinage
SBM	Single Buoy Mooring
SCAPP	Strategy for Accelerated Growth and Shared Prosperity
SEP	Service des Entreprises Petrolieres Congolaises
SEZ	Special Economic Zone
SHARE	Senegal Horn of Africa Regional Express
SMH	Société Mauritanienne des Hydrocarbures
SOE	State-Owned Enterprise
SSTL	States Sponsor of Terrorism List
SUMED	Suez-Mediterranean Pipeline
SWOT	Strengths, Weaknesses, Opportunities, and Threats
TAPP	Tema-Akosombo Pipeline
Tazama	Tanzania-Zambia Crude Oil Pipeline
tcf	Trillion cubic feet
TEN	Tweneboa–Enyenra–Ntomme
TIDCA	Trade, Investment and Development Co-operation Agreement
TIFA	Trade and Investment Framework Agreement
TOR	Tema Oil Refinery
TSGP	Trans-Saharan Gas Pipeline
UAE	United Arab Emirates
US	United States
WACS	West Africa Cable System
WAEMU	West African Economic and Monetary Union
WAGP	West African Gas Pipeline
WARCIP	West African Regional Communication Infrastructure Program
WLGP	Western Libyan Gas Project
WTO	World Trade Organization



Section 1

Introduction

1. Introduction

Africa is endowed with considerable oil and gas reserves and undeveloped resources that can assist the continent's economic growth if they are strategically developed.

There is a need to clarify Africa's position and develop strategies for future supply adequacy, considering current uncertainties about energy supply, the key drivers of future demand, policies of consumer countries (especially alternatives to oil and gas), and expected future global economic growth and technological developments.

Of Africa's 55 countries, 33 have ratified the Paris Climate Accords, pledging to achieve net zero emissions by mid-century. It will be unavoidable that Africa adapts to this new world, but equitable policies, markets, and investments are needed to avoid a growing divide between the developed and the developing worlds.

Figure 5 depicts the global carbon emission intensity per region (Global Carbon Atlas, 2020)

In contrast to the developed world (such as Europe and America, which has contributed 35% of global carbon emissions), the African continent produces less than 4% of cumulative global carbon emissions, putting the continent at a disadvantage if legislation and punitive measures are applied in the same manner. Figure 6 illustrates the carbon intensity of the focus countries in relation to the rest of the world.

One of the key principles of the United Nations Framework Convention on Climate Change (UNFCCC) is that parties should act in accordance with their respective capabilities and responsibilities, while ensuring equity.

1.1 Study Objectives

Through a competitive tender process, EPCM This study aims to assist stakeholders from the African Union (AU) Member States, regional- and sub-regional institutions with developing strategies, policies, regulations, as well as a framework and action plan to:

- Attract investments in oil and gas exploration, development and refining
- Improve transportation, distribution and utilisation infrastructure, including policies, regulations and frameworks
- Improve domestic trade of crude oil, natural gas and refined products
- Facilitate cross-border trading of crude oil and natural gas
- Advance exploration of oil and gas reserves in Africa
- Outline the role of oil and gas in the African Energy Transition.

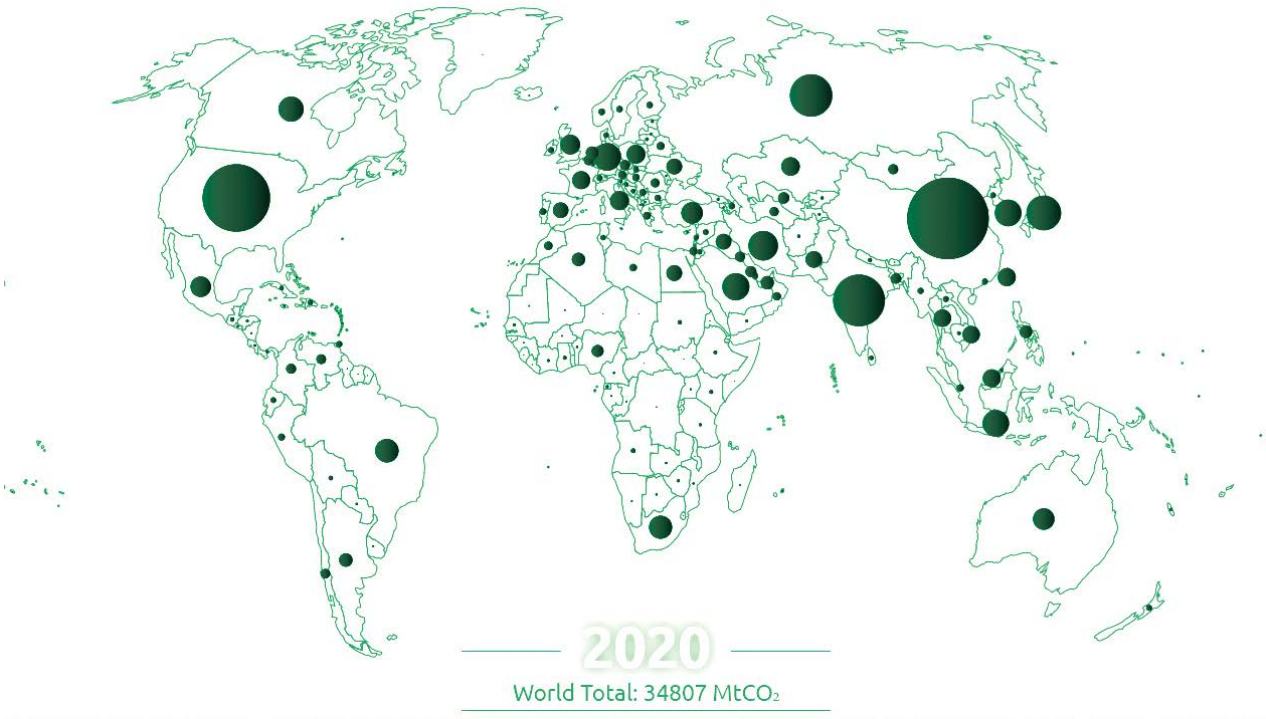


Figure 5 Carbon emission intensity: Global view

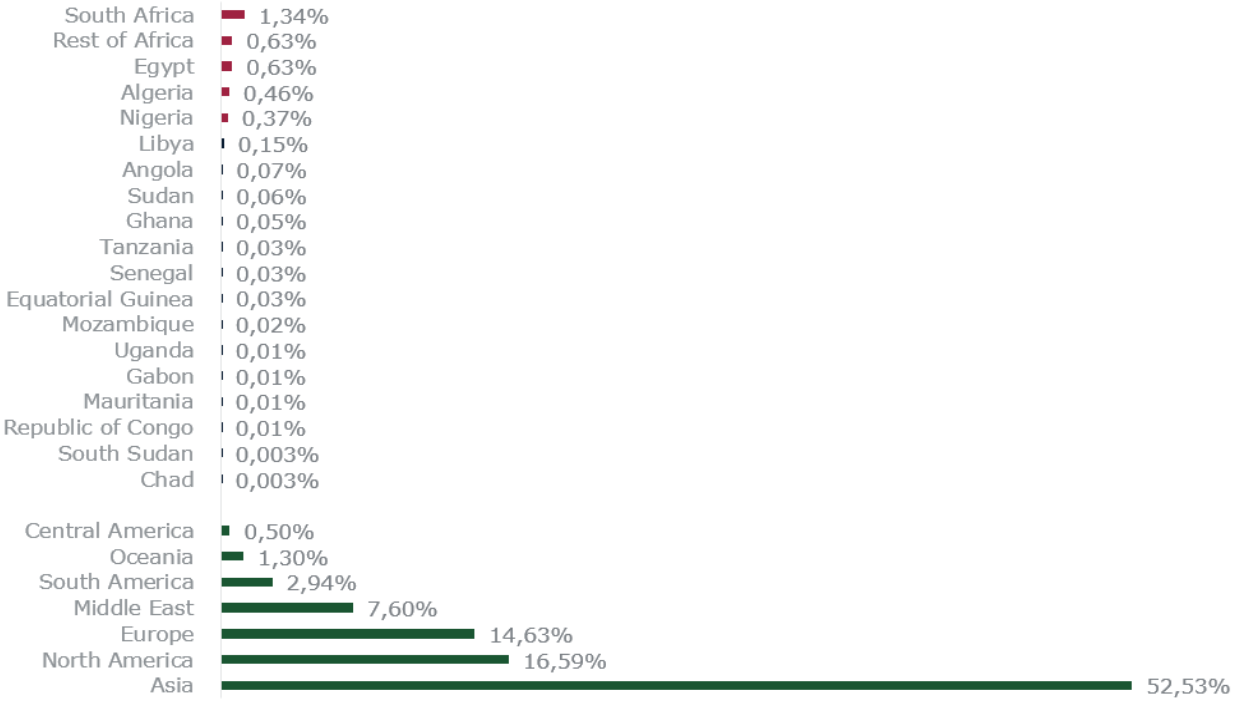
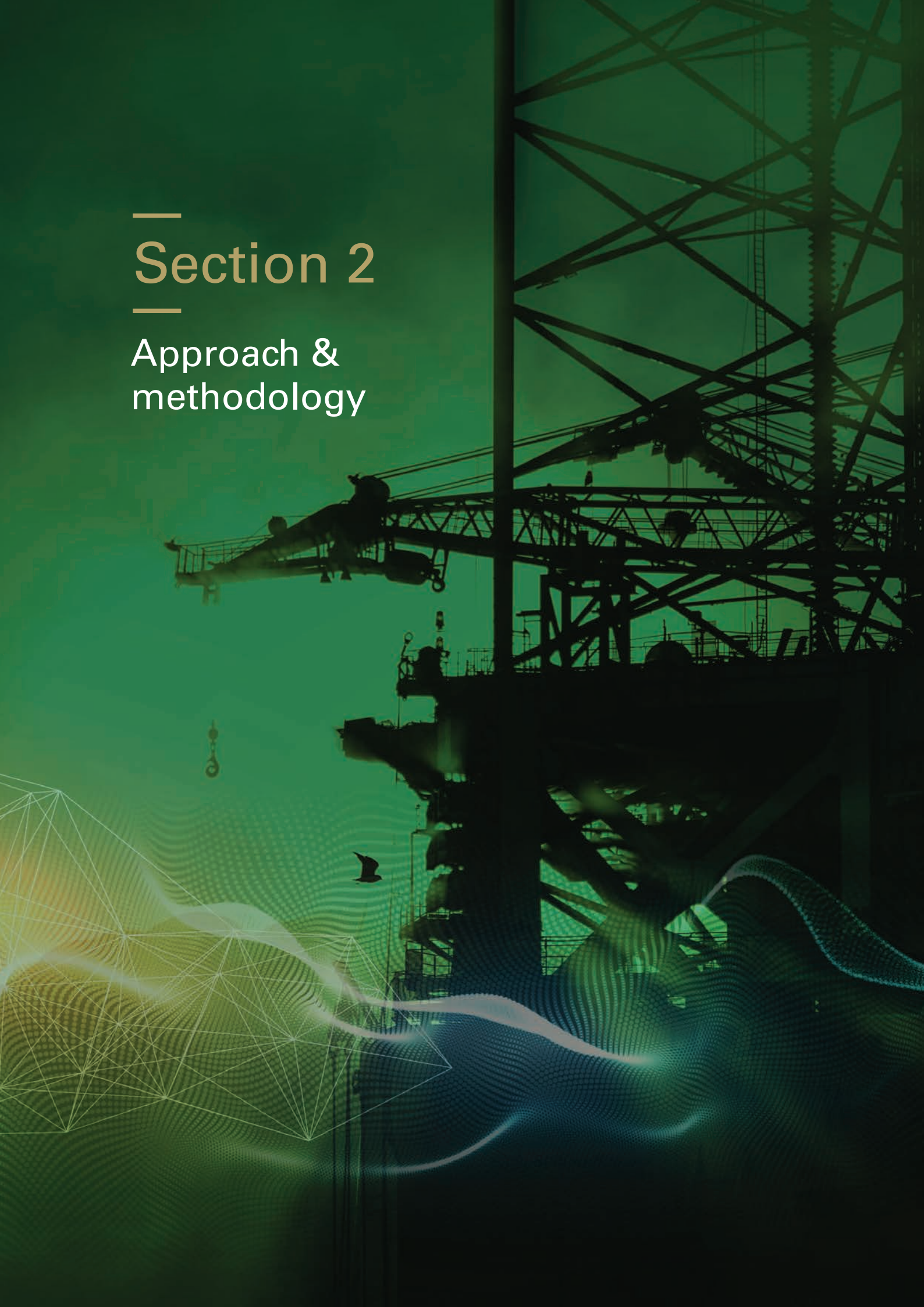


Figure 6 Carbon emission intensity: Africa in relation to the rest of the world

1.2 Purpose of this Report

This report is intended to serve as a guide for strategic, political, and institutional decisions related to oil and gas investments in Africa for the purposes of planning, optimizing, and coordinating investments.



Section 2

Approach & methodology

2. Approach and Methodology

2.1 Focus Countries

African nations have been divided into five geographic regions, namely North, East, South, West, and Central Africa, which together constitute all 55 countries of the continent. The study's scope necessitates an assessment of a limited number of countries based on their contributions to the oil and gas industry, while still allowing for geographic diversity. The countries evaluated as part of this study include Algeria, Angola, Chad, Republic of Congo, Egypt, Equatorial Guinea, Ghana, Gabon, Libya, Mauritania, Mozambique, Nigeria, Senegal, South Africa, South Sudan, Sudan, Tanzania and Uganda.

Although the roadmap for the study is based on the focus countries, exploration and development of crude oil and natural gas (fields and value chains) may also be pursued in countries that are not included in the study.

2.2 Data

This study is based on publicly available data for the focus countries for the year 2020. 2020 is the most recent year with data available that covers most of the data points required for each country.

2.3 Demand Scenarios

In accordance with the terms of reference, demand modelling was not included in the scope of this project. For the purpose of understanding the future demand for oil and gas in Africa, the project team utilized energy outlook scenarios from reputable sources such as OPEC, GECF and the IEA. Figure 7 provides an overview of the reports utilized per scenario.

OPEC, GECF, and IEA analyses used in this study were conducted prior to the invasion of Ukraine in February 2022, and therefore its impact is not accounted for in the energy outlooks presented. In Section 4.5, comments are made regarding the potential impact of the Russia-Ukraine conflict on the African oil and gas market.

Furthermore, the energy outlook scenarios from OPEC, GECF and IEA used in this study only reported on continental demand, and the analyses are therefore limited to a continental perspective, with no assumptions regarding regional or country-level demand made by the consulting firm.

2.4 Time Periods

The short-term period of interest for this study is the period between now and 2030, the medium-term period is 2031 to 2040, and the long-term period is 2041 to 2050.

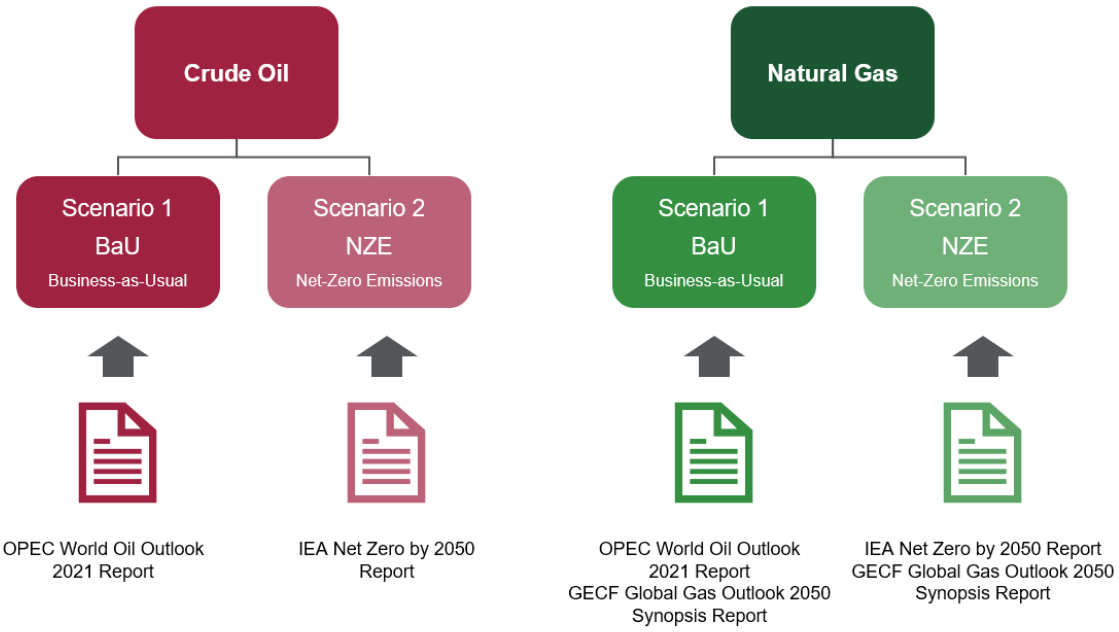
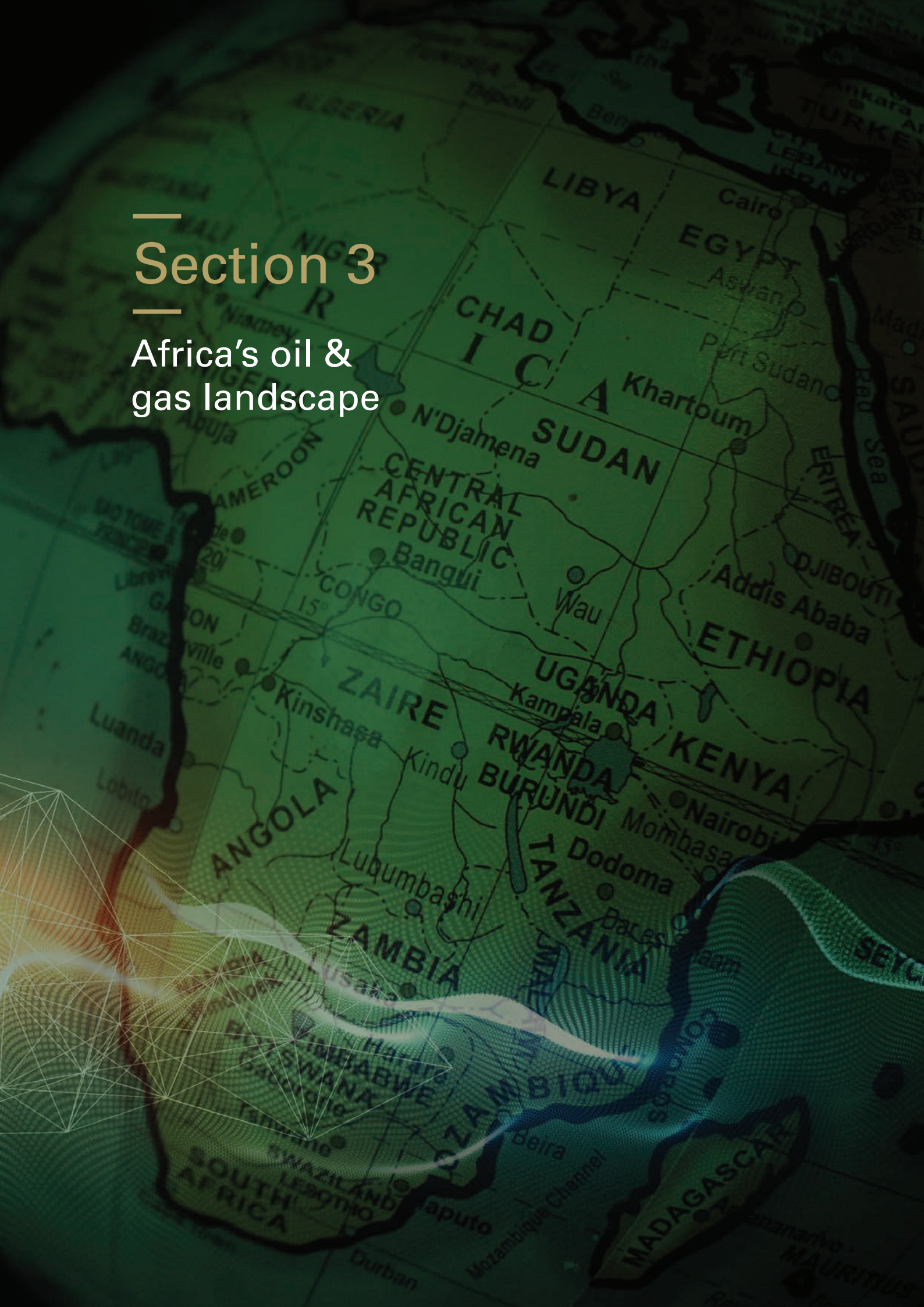


Figure 7 Illustrative view on the energy outlook scenarios used



Section 3

Africa's oil & gas landscape

3. Africa's Oil and Gas Landscape

A wealth of oil and gas resources provides the economic foundations for the sustainable development of many African countries, while the discovery and development of new hydrocarbon fields continue to provide economic leverage through trade and investment.

This study has classified the oil and gas value chain, as shown in Figure 8, in order to ensure that the business focused on upstream, midstream, downstream remain distinct, with clear risk transfer at each stage. Upstream includes all oil and gas field facilities, up to the point where oil and gas are sold or transferred to a transport system. The main drivers for success in the upstream sector are the ability to quantify and manage risk. In the midstream sector of the oil industry, bulk crude oil transport, storage and refinery facilities are included. For gas, the midstream sector encompasses pipeline transport, as well as processing and liquefaction facilities (Liquefied Natural Gas and Gas-to-Liquids). Midstream success is dependent on uptime, cost control and conversion efficiency. The downstream sector encompasses all facilities that handle the refined/processed oil/gas from the midstream processing facilities to final sale or consumption. The downstream sector's success is dependent on logistics, location and marketing.

The purpose of this section is to provide an overview of the existing oil and gas sector in Africa by focusing exclusively on the countries selected for this study, unless specifically stated otherwise. Appendix A provides details on value chains and PESTLE and SWOT analyses of selected countries, while Appendix B contains infographics about crude oil and natural gas flow in the selected countries.

3.1 Crude Oil

3.1.1 Upstream Sector

There are over 125 billion barrels of crude oil reserves in Africa. The continent produced 6,9 million barrels per day (bpd) in 2020, representing 7,8% of global production (BP , 2021). The contribution of this study's focus countries is depicted in Figure 9.

Figure 8 Value chain breakdown

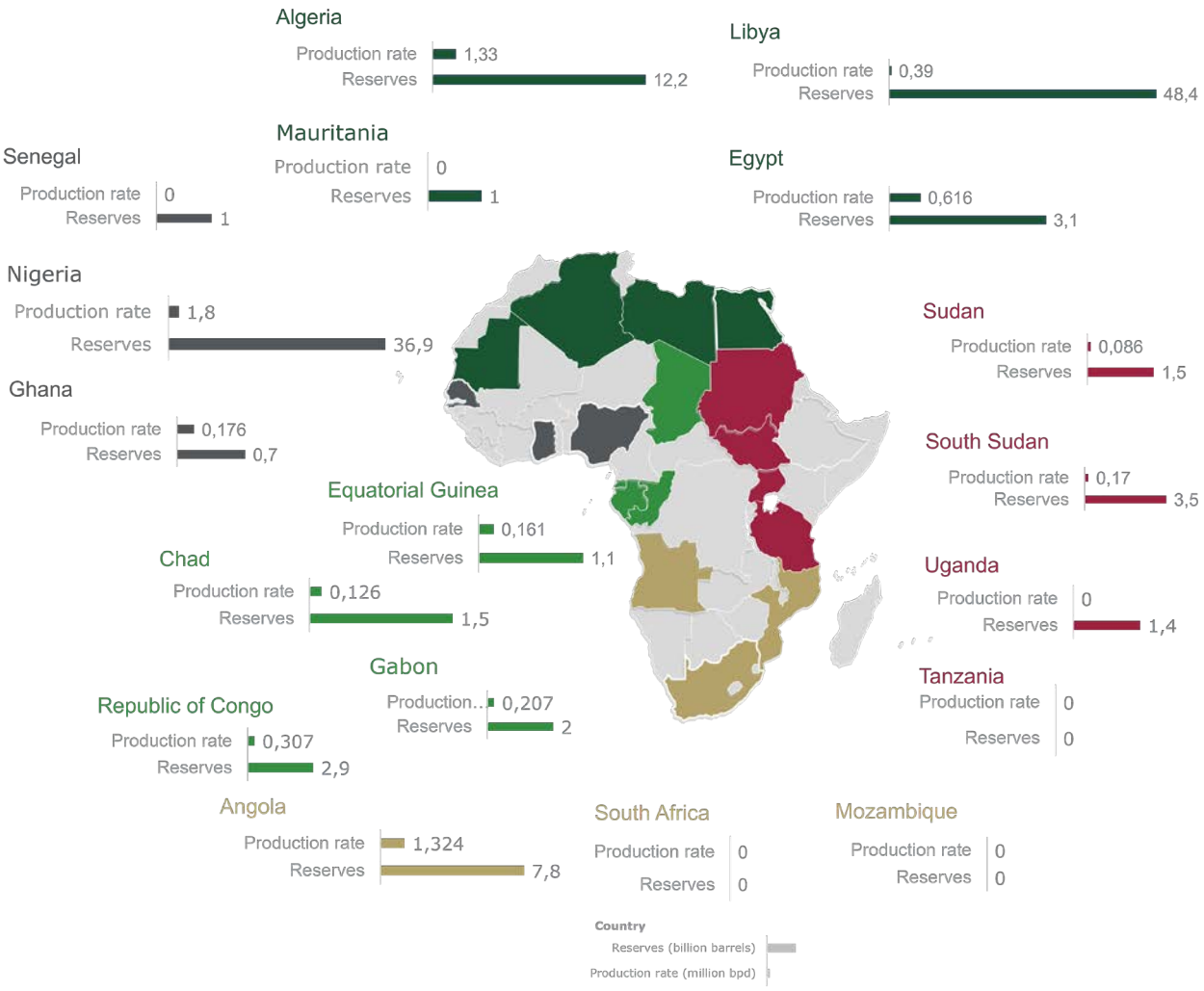


Figure 9 African upstream oil landscape

North and West Africa are home to seven of OPEC's 14 members, while production elsewhere on the continent is minimal. About 87% of the continent's oil reserves are located in five African countries: Nigeria, Libya, Algeria, Angola, and Egypt. Other oil-producing countries include Gabon, Chad, Republic of Congo, Cameroon, Tunisia, Equatorial Guinea, Democratic Republic of Congo, Côte d'Ivoire, Ghana, Sudan, South Sudan and Niger. Exploration was also conducted in Madagascar, Uganda, South Africa, and Namibia, with recent discoveries suggesting significant upstream potential.

The continent is endowed with vast deposits of crude oil reserves. However, crude oil has little practical application and economic value. Therefore, the need arises for the conversion of the unprocessed crude into more valuable products. Africa is the only continent in the world that is both a net exporter of crude oil and a net importer of petroleum products. Sixteen African countries are producers (Morocco, South Africa and Mauritania no longer produce crude oil), fourteen African countries are net exporters, and five African countries are net importers (AFREC, 2018/9). Table 1 provides a list of the respective countries.

Table 1 Crude oil: Producers, net exporters and net importers

Country	Producer	Net Exporter	Net Importer
Algeria	●	●	
Angola	●	●	
Cameroon	●	●	
Chad	●	●	
Republic of Congo	●	●	
DRC	●	●	
Egypt	●	●	
Equatorial Guinea	●	●	
Gabon	●	●	
Ghana	●	●	
Côte d'Ivoire	●		●
Kenya			●
Libya	●	●	
Niger	●		
Nigeria	●	●	
Senegal			●
South Africa			●
South Sudan	●	●	
Sudan	●		
Tunisia		●	
Zambia			●

Despite significant demand across the continent of Africa, trade in crude oil and petroleum products is limited within the continent, with the majority of products being shipped to the international market.

3.1.2 Midstream Sector

African refineries are only capable of refining 3,3 million barrels a day, despite reaching a demand of 4,1 million barrels a day in 2020 (Statista, 2021). Figure 10 illustrates the nameplate capacities of existing refineries in Africa, although not all of these refineries are fully operational at this time (AFREC, 2022).

Several oil export terminals are located in Africa, including Algeria (Arzew, Skikda and Bejaia), Egypt (Melliha, Ras-sider, El-hamra, Ras-Ghareb, Gabal-El-Zeit, Shukheir, Ras-Badran and Ras Firan), Libya (Es-Sider, Brega, Ras Lanuf, Hariga and Zueitina), Sudan (Bashayer Marine Terminal), Nigeria (Forcados, Bonny, Qua Iboe, Escravos, Brass and Pennington), Equatorial Guinea (Luba), Gabon (Cape Lopez and Gambia).

Trans-border crude oil pipelines exist in Africa, including the following:

- SUMED pipeline, connecting the Persian Gulf region to the Mediterranean
- Tazama pipeline, connecting Tanzania and Zambia
- Chad-Cameroon oil pipeline, connecting Chad to Cameroon
- Petrodar (DPOC) pipeline, connecting South Sudan to Sudan (Red Sea)
- Niger-Benin Oil Pipeline, connecting Niger to the Port of Seme Terminal in Benin (under construction)
- LAPSSET pipeline, connecting Ethiopia, South Sudan and Kenya (under consideration)
- EACOP pipeline, connecting Uganda to Tanzania (under consideration)
- AZOP pipeline, connecting Angola to Zambia (under consideration)
- Niger-Chad Oil Pipeline, connecting Niger to Chad (under consideration).

3.1.3 Downstream Sector

Africa consumes a variety of refined petroleum products, with diesel, gasoline, and LPG accounting for 93% of the total (BP , 2021).

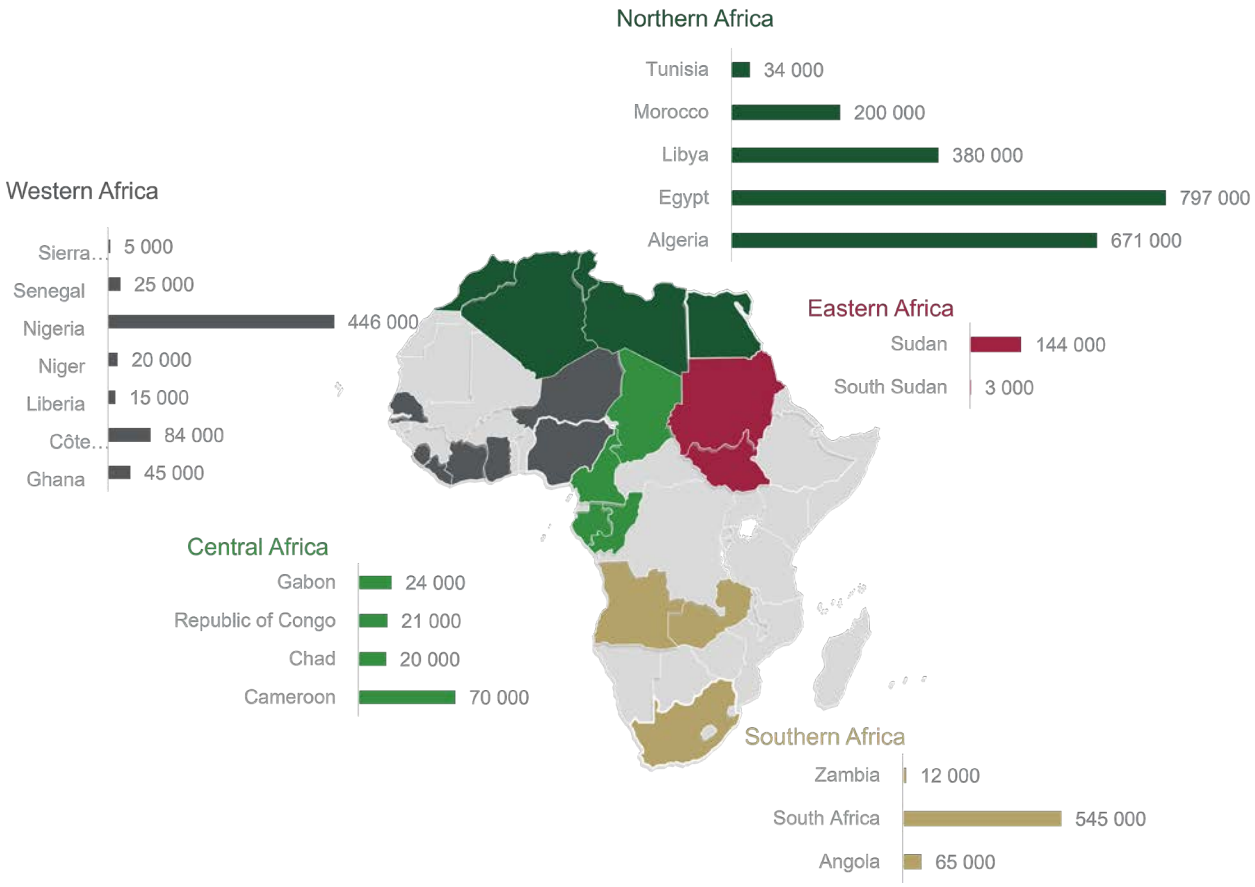


Figure 10 African refining nameplate capacity (bpd)

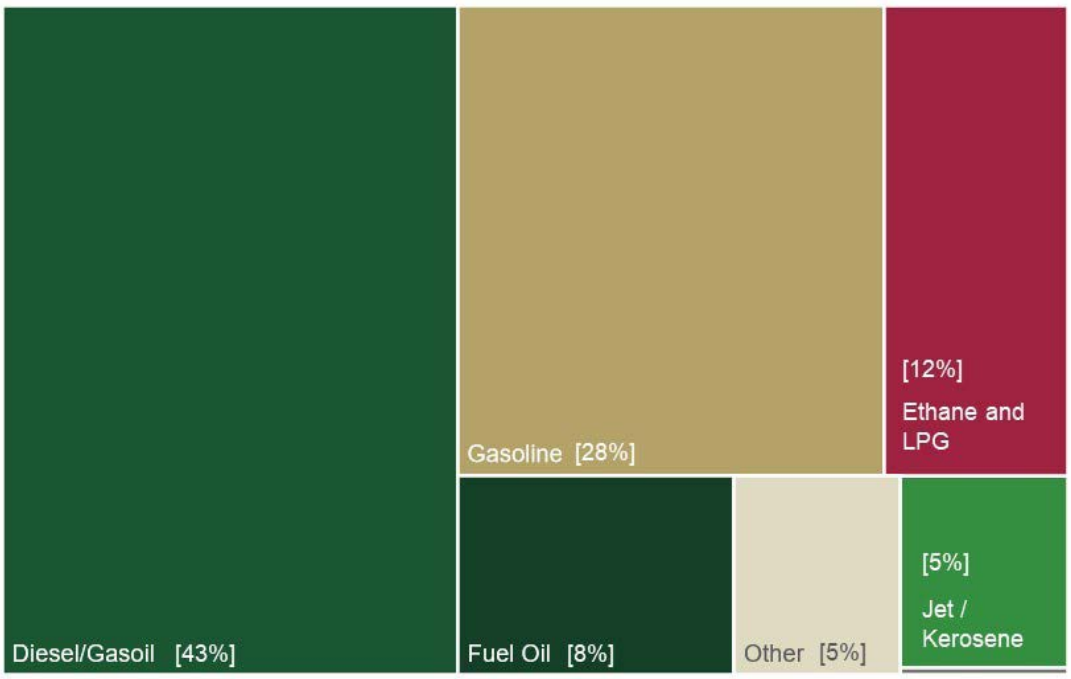


Figure 11 Consumption of refined petroleum products in Africa[6]

6 Others' consist of refinery gas, solvents, petroleum coke, lubricants, bitumen, wax, other refined products and refinery fuel and loss. Numbers presented have been rounded.

3.2 Natural Gas

3.2.1 Upstream Sector

Natural gas reserves in Africa are estimated to be 850 tcf, with an impressive potential to continue tapping into these resources, especially in the regions that have previously been under-explored. The continent produced nearly 8 200 bcf in 2020, representing 6% of global production (BP , 2021). With new fields under development in Mozambique, Mauritania, and Senegal, Africa's share of global gas production is expected to rise to 9% over the next two decades. The contribution of this study's focus countries is depicted in Figure 12.

Gas reserves are considerable in Northern, Western, and Southern Africa, and commercial quantities of natural gas have been found in several African countries, such as Mauritania, Nigeria, Senegal, Côte d'Ivoire, Ghana, Algeria, Egypt, Libya, Equatorial Guinea, Gabon, Cameroon, Republic of Congo, Angola, Tunisia, Morocco, Mozambique, Tanzania, Rwanda, Ethiopia, Namibia and South Africa (ACTING, 2021). Except for Mauritania, Namibia and Ethiopia, all these countries produce and use gas in some shape or form in industry, power, transport, or cooking, although a substantial share of it is exported out of Africa.

Table 2 provides a list of the respective producing countries (AFREC, 2018/9).

Recent developments demonstrate that increased efforts are being made to encourage investment in the development of upstream capacities and gas infrastructure, especially in countries with oil and gas resources, like Algeria and Nigeria, which have recently implemented new hydrocarbon laws designed to encourage investment in this sector. The Egyptian government has implemented reforms to open the gas sector and encourage competition, and it has accelerated the bidding rounds for gas exploration and development, particularly in deep waters and in the west.

In Africa, operational LNG export terminals had a combined capacity of 75 MTPA (ACTING, 2021). Algeria is the continent's largest exporter of LNG with a capacity of 29,3 MTPA, followed by Nigeria with a capacity of 22,2 MTPA. As a result of the projects currently in the proposal stage, the export capacity in Western Africa is expected to grow to nearly 30 MTPA in the near future. An overview of Africa's LNG export facilities can be found in Figure 13 (Statista, 2022).

Table 2 Natural gas: Producers, net exporters and net importers

Country	Producer	Net Exporter	Net Importer
Algeria	●	●	
Angola	●	●	
Benin			●
Cameroon	●		
Republic of Congo	●		
Egypt	●	●	
Equatorial Guinea	●		
Gabon	●		
Ghana	●		●
Côte d'Ivoire	●		
Libya	●	●	
Morocco	●		●
Mozambique	●	●	
Nigeria	●	●	
South Africa	●		●
Tanzania	●		
Togo			●
Tunisia	●		●

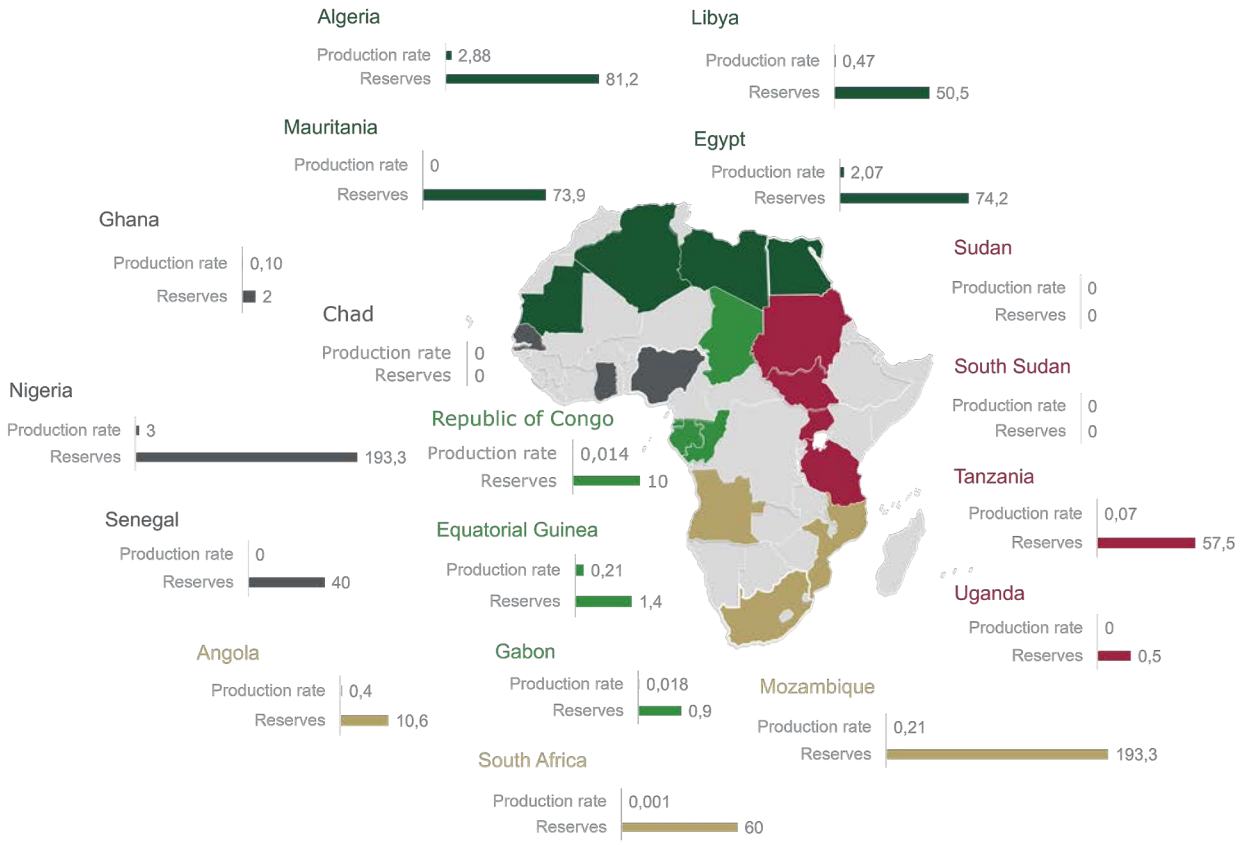


Figure 12 African upstream gas landscape (tcf)

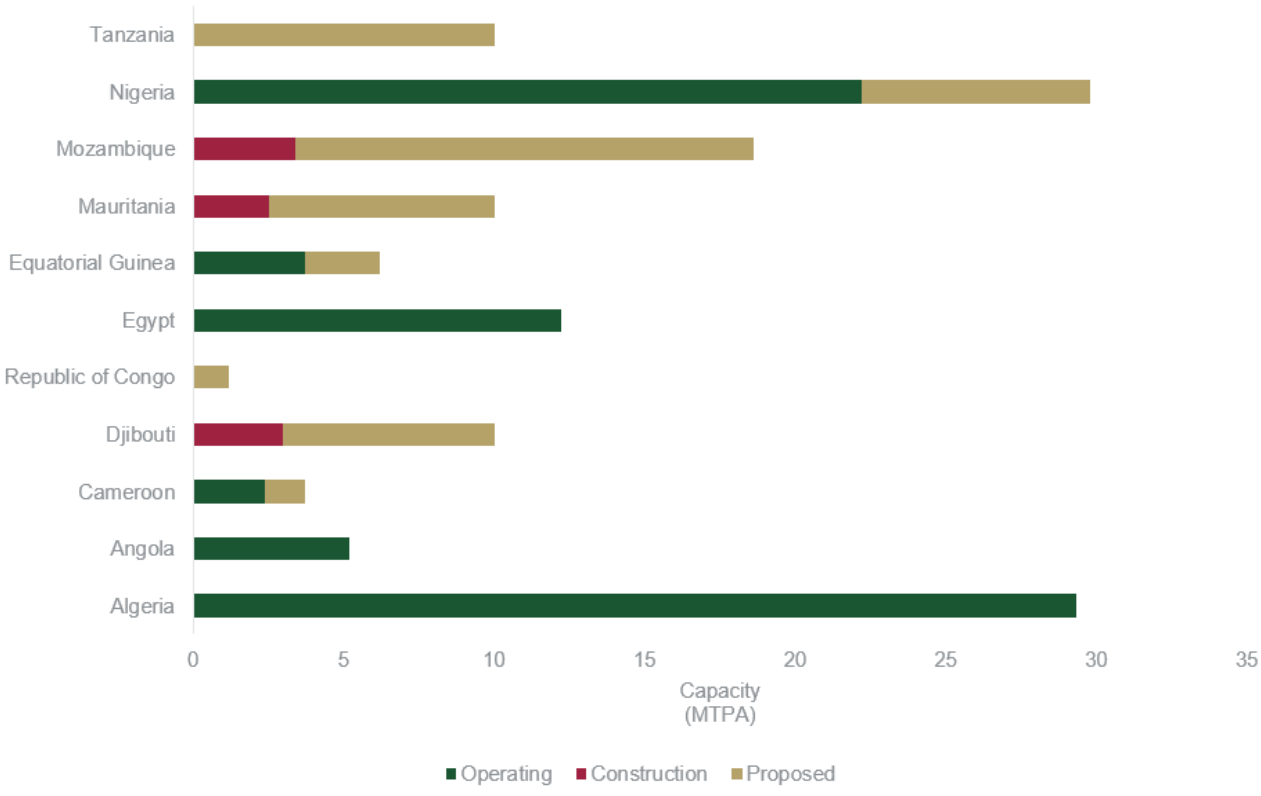


Figure 13 Africa's LNG export landscape

3.2.2 Midstream Sector

Trans-border natural gas pipelines exist in Africa, including the following:

- Medgaz pipeline, connecting Algeria to Spain
- Gaz-Maghreb-Europe (GME) pipeline, connecting Algeria to Spain and Portugal
- Trans-Mediterranean pipeline, connecting Algeria to Italy, via Tunisia and Sicily
- Arab Gas Pipeline (AGP), connecting Egypt to Jordan, Syria and Lebanon
- East Mediterranean Gas (EMG) pipeline, connecting Israel to Egypt
- Greenstream, connecting Libya to Italy
- ROMPCO, connecting Mozambique to South Africa
- West African Gas Pipeline (WAGP), connecting Nigeria to Benin, Togo and Ghana
- African Renaissance Pipeline Project (ARP), connecting northern Mozambique to South Africa (under consideration).
- Ghana-Côte d'Ivoire Gas Pipeline, connecting Ghana and Côte d'Ivoire (under consideration).
- GALSI, connecting Algeria to Sardinia and further northern Italy (under consideration)
- Trans-Saharan Gas Pipeline (TSGP), connecting Nigeria to Algeria, via Niger, before connecting to existing European gas supply pipelines (under consideration).

Existing pipeline infrastructure is primarily concentrated in Northern Africa, with very few or no trans-border pipelines serving Central, Western, Eastern, and Southern Africa.

In terms of global adoption, gas-to-liquids applications are not well established, however, Africa is home to two plants, both of which are located in South Africa (PetroSA's GTL and Sasol's converted CTL plant).

3.2.3 Downstream Sector

More information is provided in Section 4.2.1 regarding natural gas' role in the African market.

Africa continues to promote gas as a key fuel to meet its growing baseload power generation (e.g. Nigeria), substitute oil products (e.g. South Africa), encourage industrial development (e.g. Algeria, Egypt), monetize associated and flared gas (e.g. Nigeria), and replace coal (e.g. South Africa). Several countries, including Mozambique, Tanzania, Mauritania, and Senegal, are actively marketing the use of natural gas to capitalize on recent discoveries.

Despite gas-supporting policies, several challenges may hinder the development of natural gas in Africa. The restraints include lack of infrastructure, restrictions on funding gas projects and infrastructures imposed by some banks and financial institutions, the lack of capabilities and technology, political and regulatory barriers affecting attractiveness in various countries and the volatility of international gas prices that inhibit investments.

In order to address these challenges, several regional initiatives have been launched. The SADC Regional Gas Master Plan, backed by the Development Bank of Southern Africa (DBSA), aims to promote and integrate natural gas into the regional energy mix and to increase universal access to energy as well as industrial development by guiding the exploitation of the region's vast natural gas resources (SADC). Due to growing international pressure to abandon oil and gas development projects, the African Energy Chamber is calling on African states and the private sector to establish energy banks (African Energy Chamber, 2022). By signing government-to-government LNG sale and purchase agreements and terminal use agreements as a basis for LNG exchange, LNG2Africa facilitates an intra-African LNG industry, which enables power and industrial development (LNG2Africa, 2022).

3.3 Trade

Africa has made significant progress in recent decades in raising living standards and reducing poverty, but increased trade can boost productivity and job creation, thereby reducing poverty even further.

By pivoting from an extractive exportation structure with oil and gas, the continent can ensure more sustainable and inclusive trade that is not dependent on fluctuations in global commodity prices.

African Continental Free Trade Area (AfCFTA) and more favourable intra-regional trading terms will enable the continent to consolidate its position in the oil and gas sector.

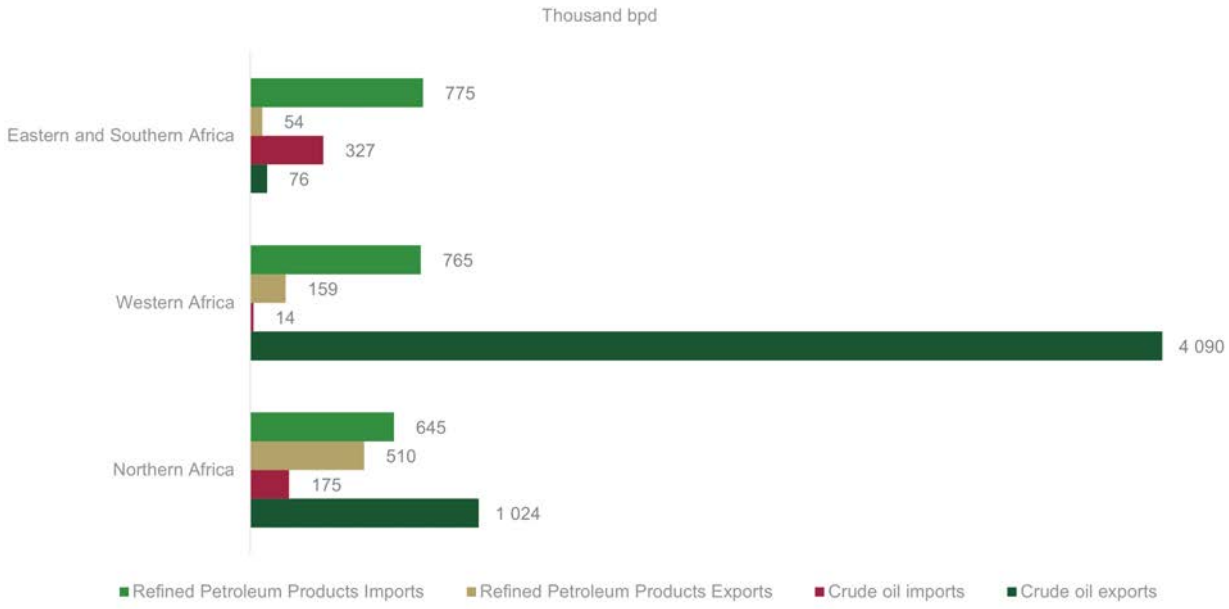


Figure 14 Trade in African crude oil and refined petroleum products

3.3.1 Market Landscape for Trade

3.3.1.1 Crude Oil

Regional trade information on African crude oil and refined petroleum products is provided in Figure 14. Two of the world's leading oil producers are located on the continent: Nigeria in Western Africa and Angola in Southern Africa. Africa's crude oil exports are primarily directed to Europe, Asia and America.

The majority of refined petroleum products are exported from North African countries, although refined petroleum products are imported in large quantities throughout all regions of Africa.

3.3.1.2 Natural Gas

Regional trade information on African natural gas is provided in Figure 15.

It is estimated that Africa exported nearly 3 360 bcf of natural gas in 2020, dominated by Algeria and Nigeria (Statista, 2021). Approximately 60% of the total natural gas exported from Africa is shipped to Europe (35% as LNG and 27% via pipeline). Asia Pacific represented another leading destination of African natural gas exports, making up 23% of the export trade. At present, a portion of the gas exported from Nigeria and Mozambique is destined for African markets.

In 2020, nearly 335 bcf of natural gas were imported into Africa (Statista, 2021). Africa's natural gas imports (from international and domestic suppliers) in 2020 were primarily directed to Tunisia, followed by South Africa. Nigeria and Mozambique currently partake in intra-Africa gas export trade.

3.3.2 Regional Economic Communities

Through regional integration, African countries have the opportunity to exploit regional value chains and expand their markets, which would otherwise be small and fragmented. In turn, regional value chains are important anchors for industrialization and broader economic transformation. Recently discovered oil and gas deposits in several African countries provide a great opportunity for African economies to undergo a rapid industrialization process.

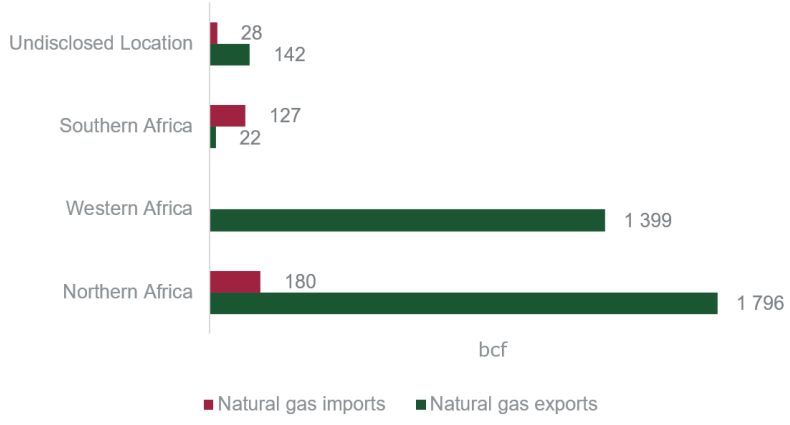


Figure 15 Trade in African natural gas

Africa's current integration landscape contains an array of Regional Economic Communities (RECs). Eight RECs are recognised as the building blocks of the African Union, namely the Arab Maghreb Union (AMU), the Common Market for Eastern and Southern Africa (COMESA), the Community of Sahel-Saharan States (CEN-SAD), the East African Community (EAC), the Economic Community of Central African States (ECCAS), the Economic Community of West African States (ECOWAS), the Intergovernmental Authority on Development (IGAD), and the Southern Africa Development Community (SADC).

There is a general tendency for member states to belong to more than one regional economic community for either historical, political, or economic considerations. Figure 16 illustrates the various combinations of overlapping memberships in the RECs across the continent.

3.3.3 African Continental Free Trade Agreement

AfCFTA provides a unique opportunity for African countries to integrate competitively into the global economy, reduce poverty, and promote inclusion. Growing intracontinental oil and gas trade will provide countries with a

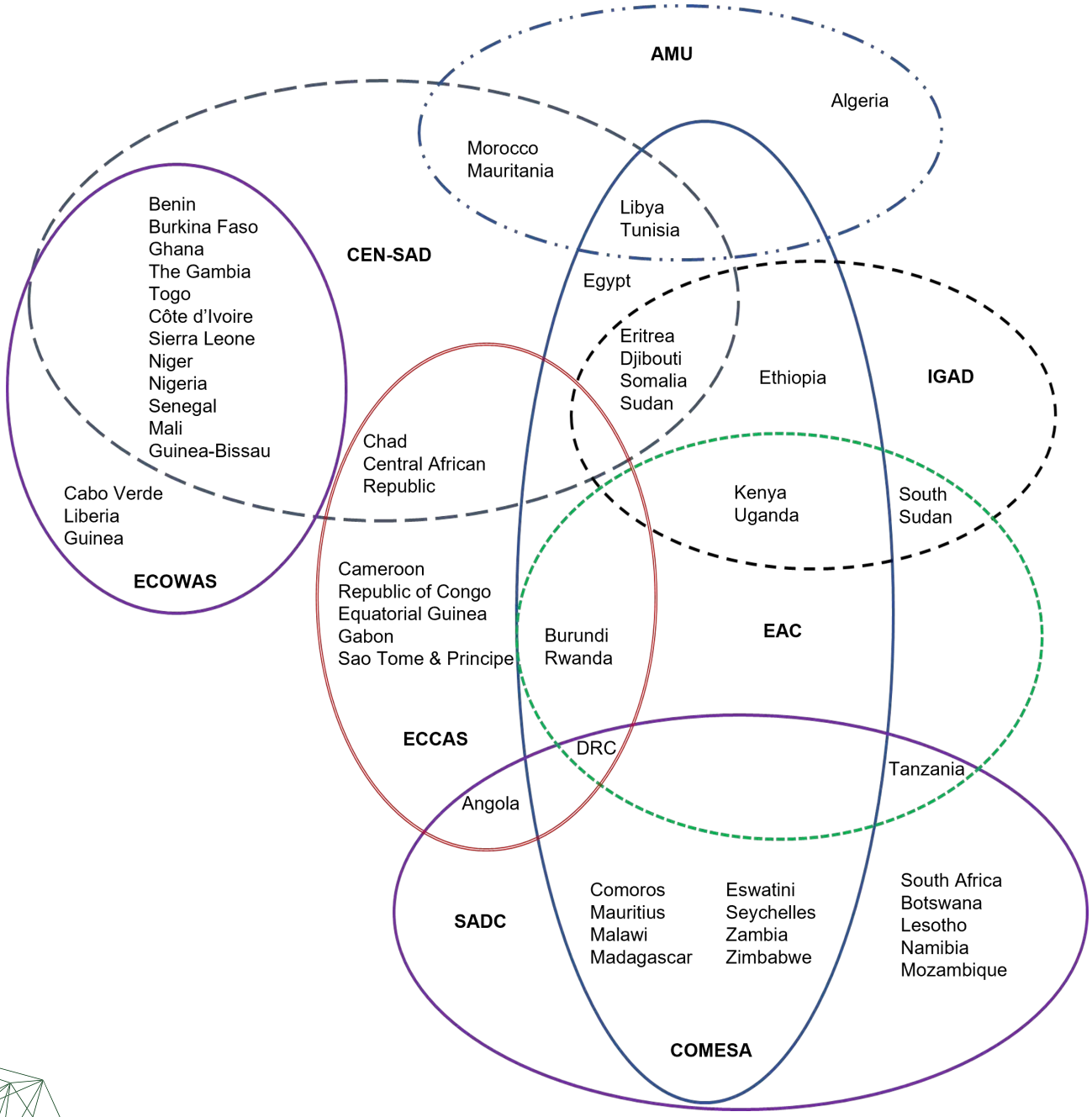


Figure 16 RECs and member states

greater degree of autonomy over their international trade agreements, which have often been detrimental to African countries.

AfCFTA has the potential to provide solutions to regional challenges through the creation of regional economies of scale.

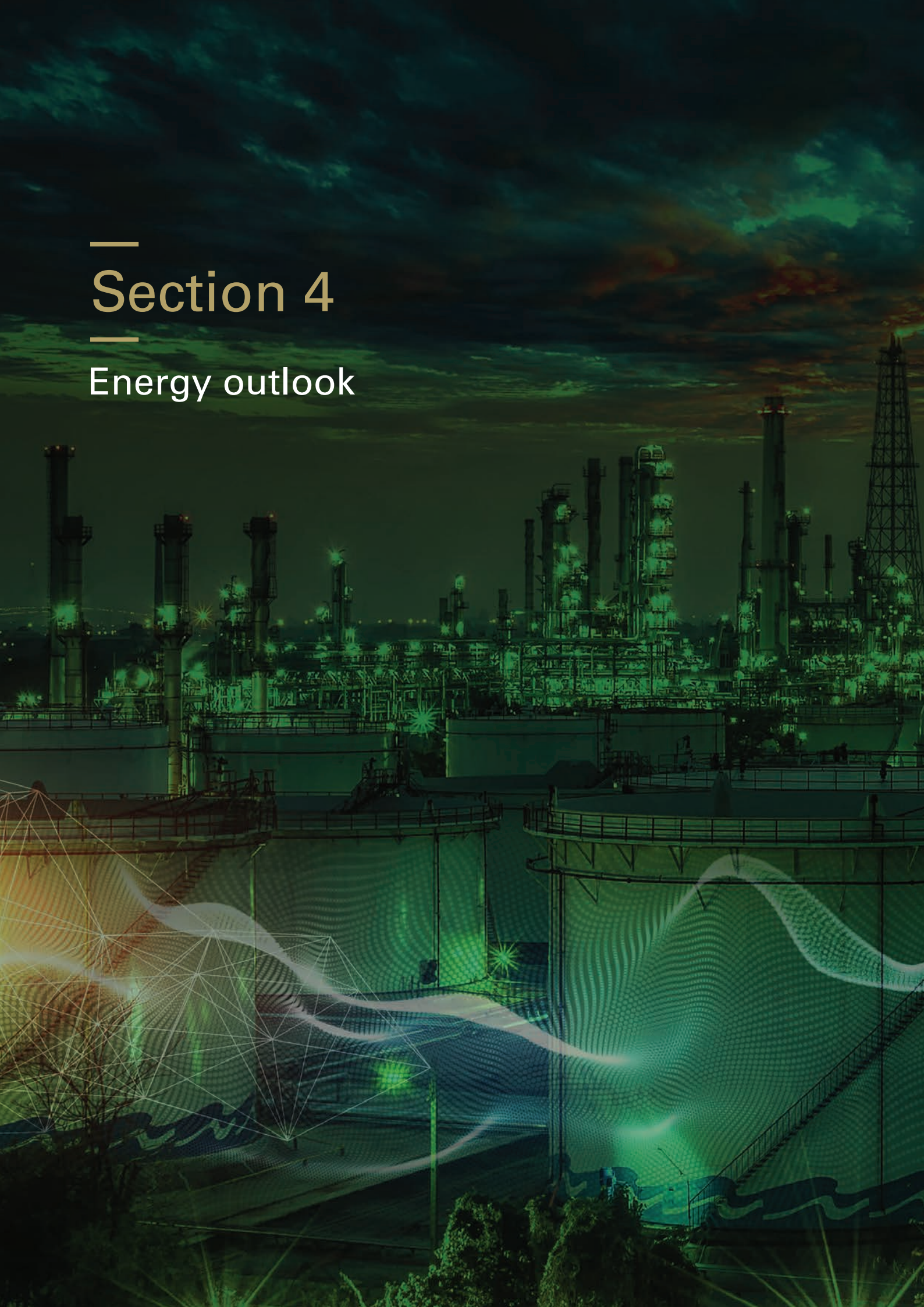
In the oil and gas industry, the AfCFTA is expected to trigger substantial investment from countries overseas, such as the United States and other European countries, mainly because it provides investors with a larger market with lower risk. AfCFTA expands the market by providing a single market with fewer cross-border barriers, which allows investors to undertake larger revenue projects on a regional rather than national scale. By taking advantage of economies of scale offered by the AfCFTA to develop regional solutions, the market for exports could grow considerably. Among other things, the AfCFTA provides a protocol for the reasonable resolution of investor-state disputes, which should make investments with African countries less risky for investors as well as African countries.

An overview of the ratification status of the AfCFTA Agreement is provided in Figure 17 (Tralac, 2022). 43 of the 54 signatories to the AfCFTA have deposited their instruments of ratification.

Figure 17 AfCFTA ratification status (3 May 2022)

Section 4

Energy outlook



4. Energy Outlook

Recent oil and gas discoveries, as well as regulatory changes and rapidly expanding consumer markets across the continent, present significant opportunities. In everyday modern society, oil and gas products and services provide fuel for industry, heat and electricity, as well as transport fuel. Plastics, medical equipment, clothing, and personal care products are also manufactured using refined oils.

Leading international institutions such as the International Energy Agency (IEA) and British Petroleum (BP) use a scenario-based approach to develop an energy outlook. The majority of the scenarios that are currently being analysed in the global dialogue regarding the energy outlook focus on clean and green energy.

In the context of this study, two energy outlook scenarios were examined, Business-as-Usual (BaU) and Net-Zero Emissions (NZE). This study assumes BaU for Africa as a basis for both energy outlook scenarios, only considering the impact of decarbonization in a global context for the NZE scenario. BaU, in line with the AU common position on energy access and transition, presents a development pathway for the African oil and gas sector that would most benefit the continent and its people.

Africa as Part of the Global Market

African oil and gas reserves and potential production capabilities enable Africa to be a net oil and gas exporter.

When the global demand for oil and natural gas is not met by current production, there is opportunity for increased African exports. By acting on market opportunities and consequently increasing oil and gas production, Africa, as a net exporter of crude oil and natural gas, can contribute to alleviating the global deficit by selling oil and gas on an international market.

Africa as an Isolated Market

Africa's oil demand directly correlates with petroleum products demand due to the need to refine crude oil for consumption. In light of Africa's growing demand for petroleum products, it is imperative that future supplies increase. Increasing a country's supply is only possible if it has enough crude oil and refineries to process the crude oil.

Natural gas resources are abundant on the African continent. Besides being an important source of liquid fuels such as propane, natural gas is also an important component of many industrial products, including fertilizers, plastics, and pharmaceuticals. It is also used for the manufacture of glass, cement, ceramics, and many other products. Due to this flexibility, in addition to the abundance of natural gas resources in Africa, the continent's increasing energy demand, and its commitment to universal access to electricity and cleaner energy, the development of African gas has gained increased attention.

4.1 Crude Oil

4.1.1 Price Development

Any future price forecasting for oil should take into account the precipitous decline in oil and gas investments, the challenges associated with an accelerated energy transition, geopolitical events in the Middle East becoming increasingly frequent, the normalization of Libyan and Iranian oil production, and a possible breakdown of the OPEC agreement (GECF, 2022).

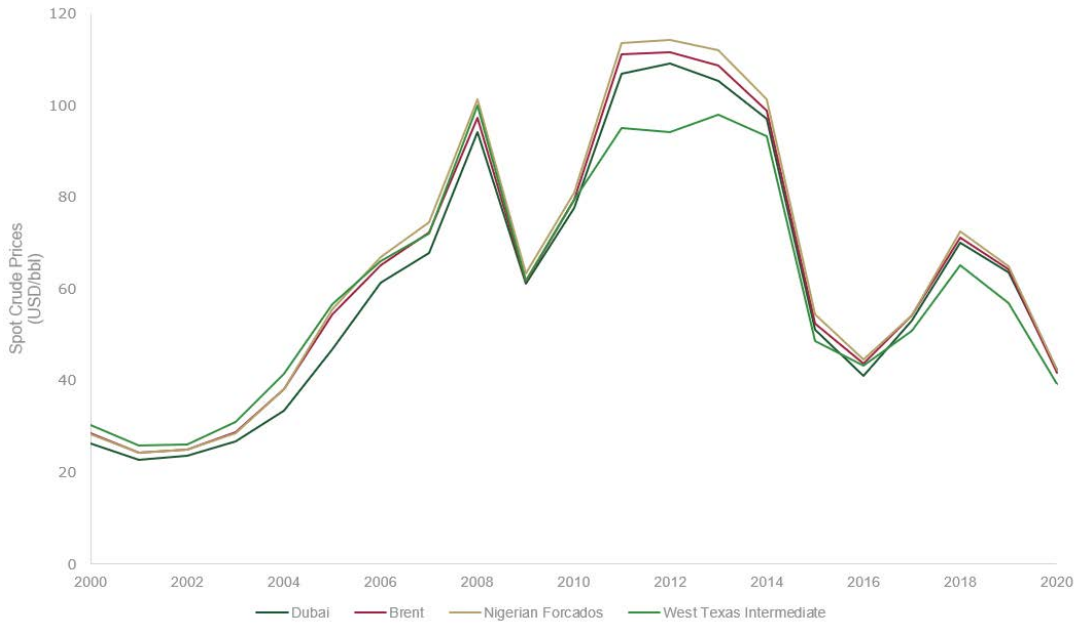


Figure 18 Historical prices: Crude oil

It is expected that the crude oil market will stabilize over the medium-term, as stated by GECF in its Global Gas Outlook 2050 Synopsis report, and that the price will follow the long-term trend price of USD 60 per barrel beyond 2026, reflecting the Covid-19 effect and also taking efficiency savings into consideration. Assuming a Brent crude oil price of USD 60 per barrel for the long-term is consistent with its historical average price over the last thirty years from 1990 to 2019 (GECF, 2022).

Figure 18 illustrates the historical price of crude oil.

4.1.2 Approach

For the purpose of estimating the overall African supply opportunity over the short-, medium-, and long-term, a cumulative approach has been employed that takes into account both the supply opportunity to the international market based on the projected global demand (excluding Africa) and the supply opportunity in an isolated African market (only Africa). It is assumed that Africa's crude oil reserves are sufficient to meet continental demand and to serve the international market, thereby maximizing revenue.

4.1.3 Global Supply: Reference Cases and Baseline Data

In developing the global supply outlook scenarios for crude oil, two scenarios have been considered: one defined by OPEC in the World Oil Outlook 2021 report (BaU) and the other by the IEA in the Net Zero by 2050 report (NZE). Figure 19 illustrates the global crude oil demand under both scenarios.

4.1.3.1 BaU Scenario

The BaU scenario predicts an international market rebound by the year 2035, followed by a plateau by 2045. Among the main reasons for this trend are efficiency improvements across all sectors of consumption and the substitution of oil with gas and renewable energy sources. It includes the significant penetration of electric vehicles in the road transportation sector, ongoing electrification in the residential and industrial sectors, and the penetration of alternative fuels in the marine and aviation sectors.

Figure 20 summarizes the anticipated oil demand trends in key sectors at the global level. There is virtually no growth in oil demand during the mid- and long-term, pointing to a rela-

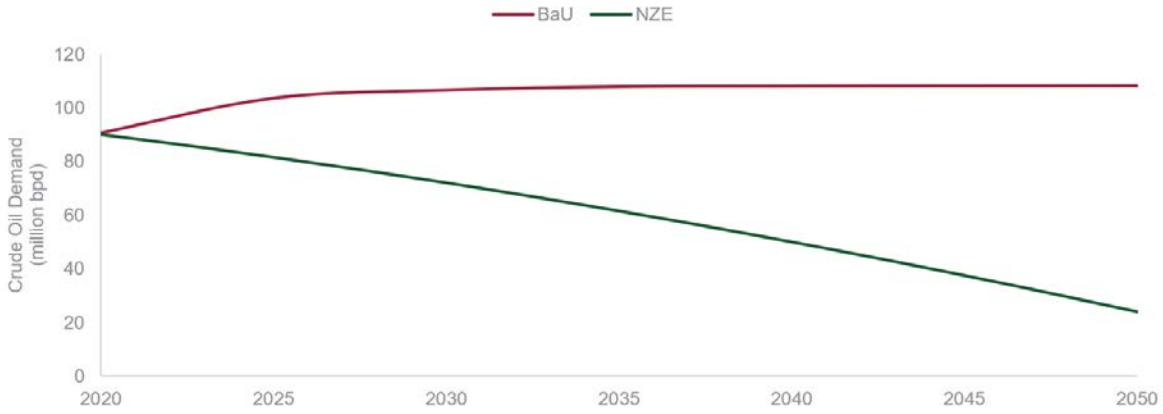


Figure 19 Global outlook scenarios: Crude oil

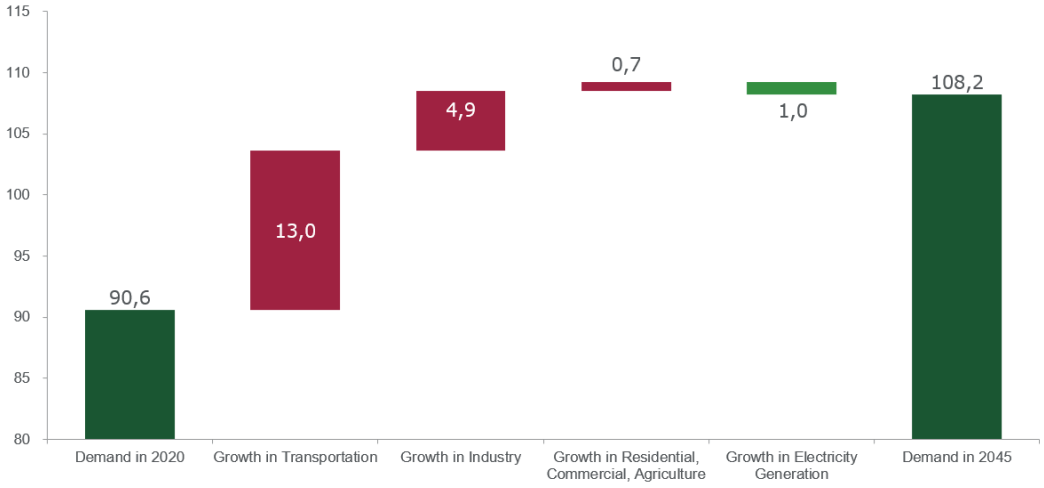


Figure 20 BaU: Oil demand growth per sector (million bpd)

tively long period of plateauing demand at the global level, driven by both energy policies and technological development, which will play an increasingly important role in diversifying the future energy mix.

4.1.3.2 NZE Scenario

In the NZE scenario, fossil fuel consumption is greatly reduced. It is estimated that crude oil's share of total energy supply will decline from 80% in 2020 to just over 20% in 2050. Even in 2050, the use of crude oil will not decrease to zero: significant amounts will still be used to manufacture non-energy goods, in plants with Carbon Capture, Utilisation and Storage (CCUS), and in the heavy industry and long distance transportation sectors where emissions are difficult to reduce. By 2050, all remaining emissions will be offset by Bioenergy with Carbon Capture and Storage (BECCS) and Direct Air Capture with Carbon Capture and Storage (DACCS).

During the short-term (2030), NZE predicts that the energy intensity will decrease by 4% on average each year due to a combination of electrification, the pursuit of all energy and material efficient options, behavioural changes that reduce the demand for energy services, and a significant shift away from traditional bioenergy sources. Further electrification of end-use sectors will help to reduce energy intensity in the medium-term (2040), as well as an increase in the production of alternative fuels (advanced biofuels, hydrogen, and synthetic fuels). As the economy continues to grow (three times larger) and the population increases (nearly 3 billion more people), the expected rate of decline in energy intensity will slow to 2,7% per year in the medium- and long-term (2050).

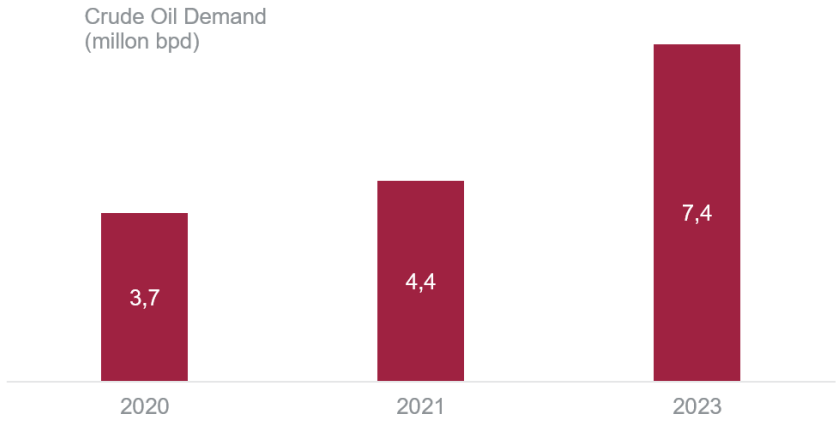


Figure 21 Continental outlook scenario: Crude oil

Further, Africa's role in production and export of oil was considered in the development of the oil scenarios. In 2020 Africa's share of global oil production was 7,8%, with the continent's share of global oil exports reported at 8,9%, primarily from North Africa (2,4%) and West Africa (6,5%) (Statista, 2021) (Statista, 2021). It was assumed that Africa would continue to leverage its existing export market share over the short-, medium- and long-term.

4.1.4 Intra-Africa Supply: Reference Case and Baseline Data

In developing the intra-Africa supply outlook scenarios for crude oil, only one scenario, as defined by OPEC in the World Oil Outlook 2021 report (BaU), was considered. BaU presents a development pathway for the African oil and gas sector that would be of the greatest benefit to the continent and its people in line with the AU's common position on energy access and transition. Figure 21 illustrates the African continent's crude oil demand under the BaU scenario.

As shown in Figure 21, the demand for oil in Africa is expected to grow from 3,7 million bpd in 2020 to 4,4 million bpd by 2025, and to 7,4 million bpd by 2045. As a result, the share of oil in Africa's energy mix is expected to increase from 22% in 2020 to 27% by 2045.

Long-term demand for oil will be bolstered by population growth and economic activity, as well as fuel switching from solid biomass to oil-based products and an increase in the use of diesel and fuel oil for power generation.

Based on the above, the following two energy outlook scenarios for crude oil in Africa were defined.

4.1.5 Demand Scenario 1

In Scenario 1, demand for crude oil at the global and continental levels assumes BaU conditions.

The global oil demand is expected to rise from 90,6 million bpd in 2020 to 108,2 million bpd in 2045, an increase of 17,6 million bpd. In order for Africa to continue to benefit from 4,2% of the global market over the short-, medium-, and long-term, it was assumed that it would be able to service the continental demand while taking advantage of these global market opportunities.

Figure 22 illustrates Africa's total crude oil supply opportunity under BaU conditions. Global supply gradually increases, but the demand shifts from export to intra-continental trade during this period, with global supply (as a portion of the total supply opportunity) decreasing from nearly 50% to 34% over time.

4.1.6 Demand Scenario 2

The NZE pathway is assumed to govern crude oil demand on a global level in Scenario 2, while BaU conditions continue to govern demand on a continental level.

From 2020 to 2050, global oil demand will decline by more than 4% per year on average, falling from 90 million bpd in 2020 to 72 million bpd in 2030 and 24 million bpd in 2050. In order for Africa to continue to benefit from 4,2% of the global market over the short-, medium-, and long-term, it was assumed that it would be able to service the continental demand while taking advantage of these global market opportunities.

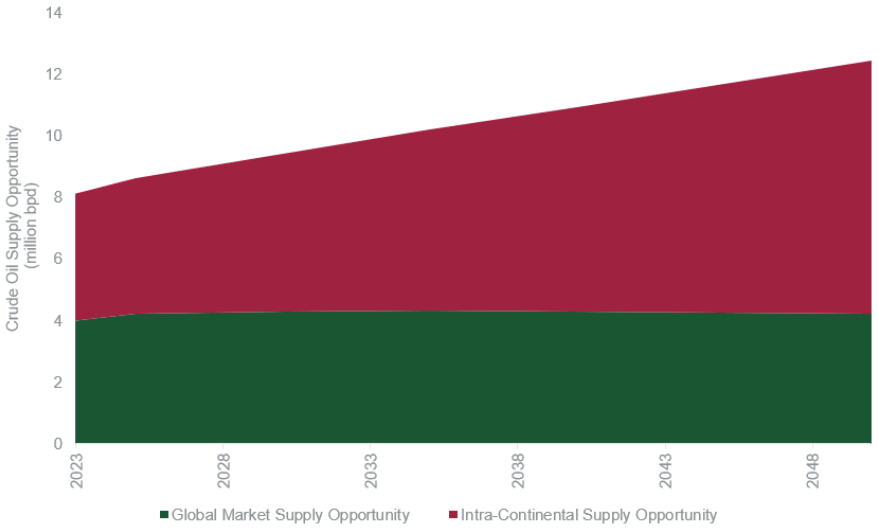


Figure 22 BaU scenario: Crude oil supply opportunity

Figure 23 illustrates Africa's total crude oil supply opportunities under global NZE conditions, assuming continental demand follows the BaU pathway. In the long term, the global supply opportunity (as a portion of the total supply opportunity) has decreased significantly from nearly 50% to 7,5%. Consequently, there is a greater emphasis placed on developing well-functioning infrastructure within Africa, including storage and distribution infrastructure, to meet the domestic demand for transport fuels and LPG.

4.1.7 Major African Oil Projects

There are several major African oil projects set to come online in the short-term as illustrated in Figure 24 (Johnson, 2022)

4.2 Natural Gas

Stakeholders and policymakers have been debating the role that natural gas can play in the world's energy future as climate change and greenhouse gas reductions have become a central topic in global energy dialogues. As part of a just transition, Africa requires gas, and when global environmentalists call for an immediate end to fossil fuel utilization, developing countries in Africa will suffer economically and socially.

The United States, China, and large parts of Asia and Europe all recognise gas as an important component of their energy futures. Shutting out gas consumption for African countries just because they are late adopters with limited financing, is politically risky and ethically unacceptable.

Despite being driven by the desire to accelerate global transition to cleaner energy, a ban on new pipelines, gas-fired power plants, or gas-consuming industries in Africa isn't sound environmental and socio-economic policy either. Financially restricting all fossil fuels would result in slowed poverty reduction, high energy prices for the most vulnerable, and suppression of incomes and job creation.

4.2.1 Current Role of Gas in Africa

There are a number of sectors in Africa that consume natural gas, including industry, trans-

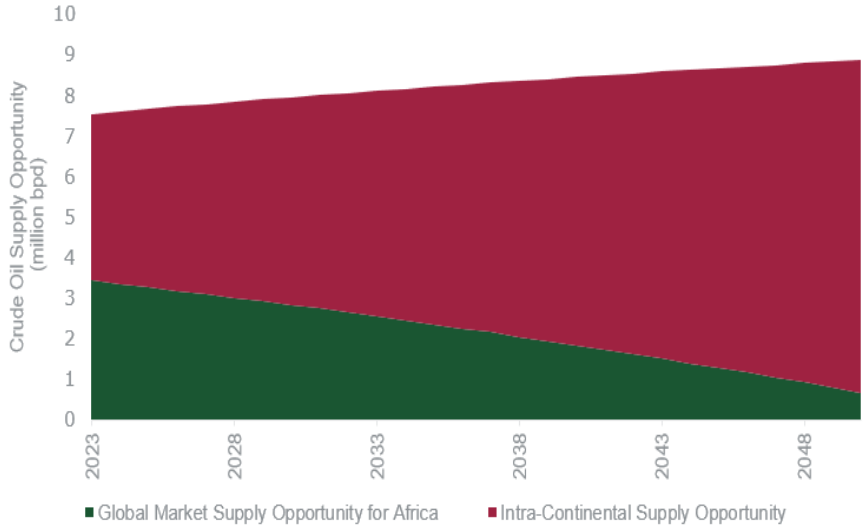


Figure 23 NZE scenario: Crude oil supply opportunity

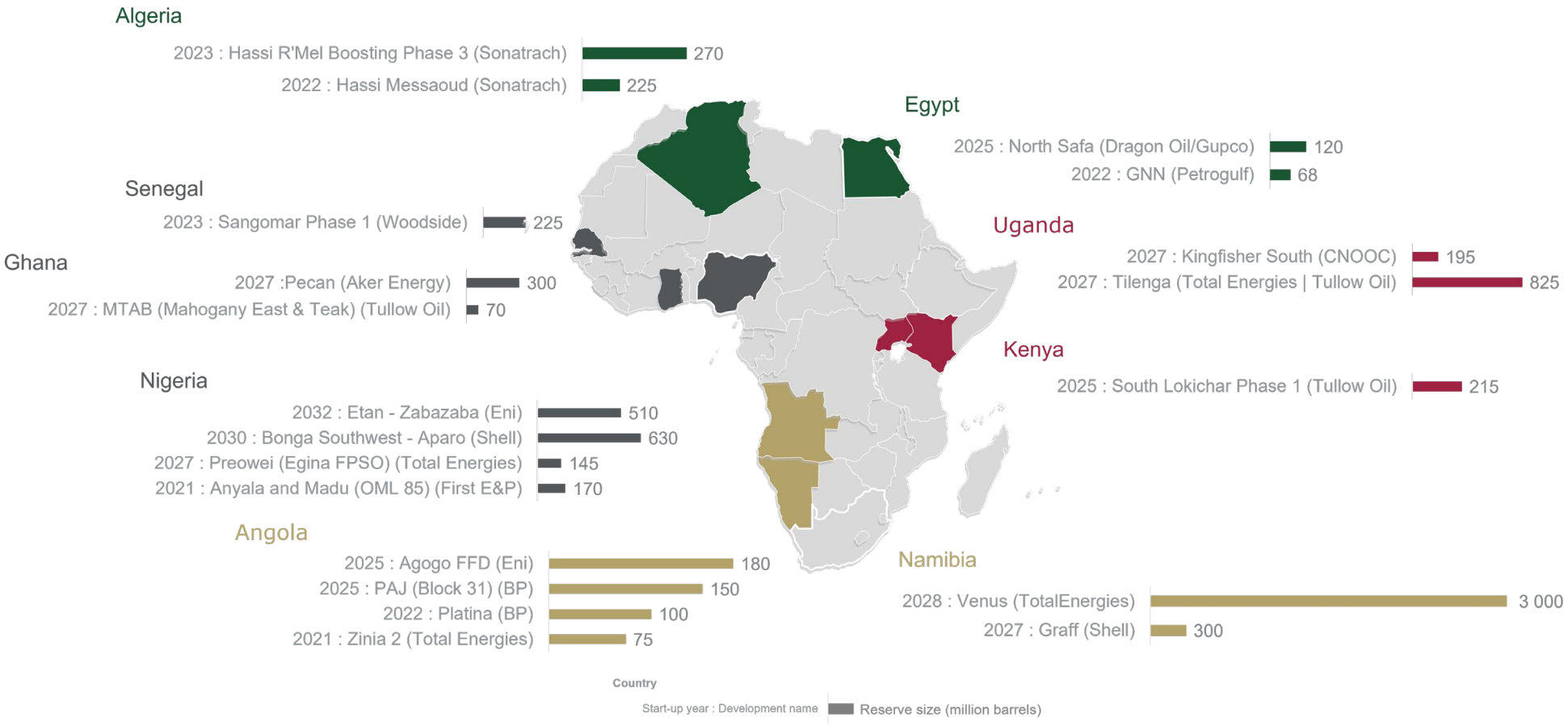


Figure 24 Major African projects: Crude oil

port, power, agriculture, commercial and residential, as shown in Figure 25 (AFREC, 2018/9). The majority of natural gas consumed in Africa is however used for power generation purposes despite its various applications.

An appreciable level of the continent's total power supply comes from natural gas (29,7%), even though there are regional disparities, particularly in Eastern and Southern Africa, where there is limited integration of gas in the energy mix (BP , 2021).

In Africa, natural gas is mostly integrated in the energy system through 15 countries, all of which have some level of natural-gas production activity that enables the use of gas in energy. The use of gas in non-producing African countries' energy mix is minimal to non-existent, despite the increasing international and regional supplies at lower prices, improved technology for delivering gas and the global supply chain.

4.2.2 Future Role of Gas in Africa

Africa has seen sizeable discoveries of natural gas reserves across the continent, notably in Egypt, Mauritania, Senegal, Tanzania, South Africa and Mozambique, potentially supplementing the existing supply in Algeria, Benin, Cameroon, Republic of Congo, Côte d'Ivoire, Gabon, Ghana, Libya, Morocco, Nigeria and Tunisia.

Natural gas is a resource that has a significant role to play in bringing about socio-economic development and mitigating climate change through its ability to reduce greenhouse gas emissions when substituting coal, oil and biomass.

Solar, wind, and hydro energy, with natural gas playing a stabilising role, are expected to drive the future direction of the African energy sector.

Renewable energy technologies have reaped significant benefits in terms of innovation and cost reduction, but investment is still necessary for sustainable energy supply in Africa to cover both generation and sector reforms as well as grid and utility expansion and strengthening.

Africa will need to double its capacity for energy production by 2030 and fivefold it by 2050 to meet its Sustainable Development Goals (PWC, 2021). In the absence of addressing the energy demand-supply gap, Africa's standard of living will deteriorate, and economic growth will be stunted. The country's ambitious social and economic goals can only be met by accelerating progress on expanding the energy infrastructure, aided by the rapid uptake of natural gas.

Gas is proven for a range of applications, including power generation (a flexible source to manage long-duration intermittent power, which battery storage cannot provide current-

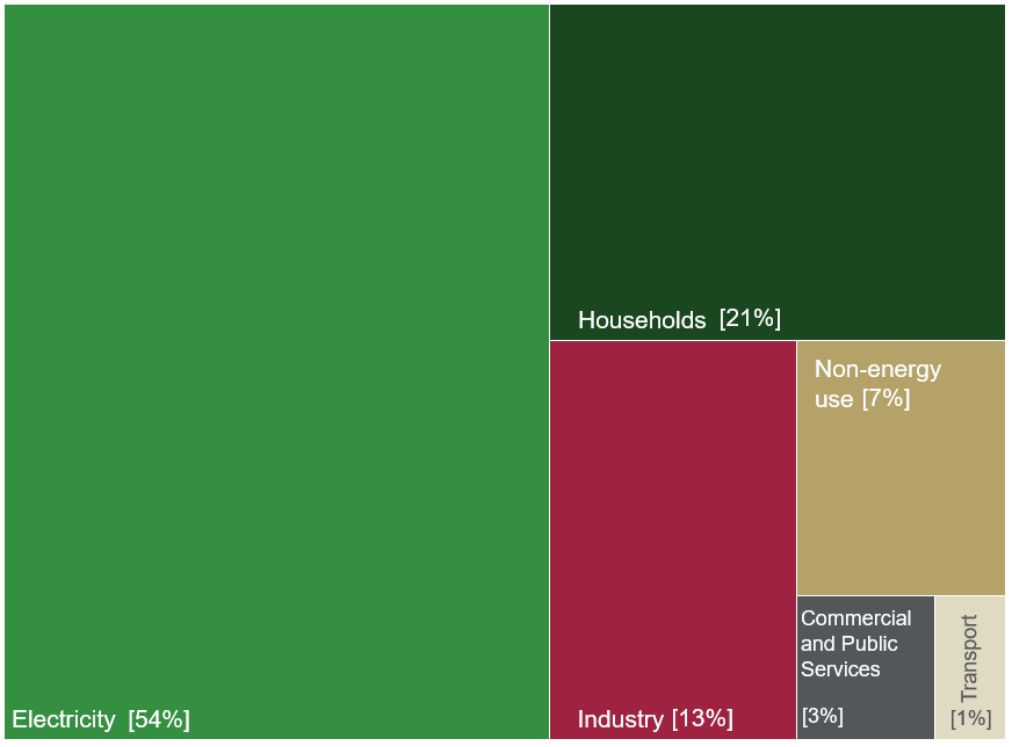


Figure 25 Current role of gas in Africa

ly), synfuels (phase-out of carbon-intensive coal and oil feedstock for liquid fuel production), industry (phase-out of higher emitting coal and diesel for industrial heat generation and other processes) and transport (phase-out of diesel and petrol).

A gas ban would also hinder African countries as they try to adapt to the major impacts of climate change like droughts, floods and rising temperatures. As an energy-intensive adaptation technology, gas excels in steel and concrete for resilient infrastructure, desalination for increased freshwater supply, as well as refrigeration and air conditioning.

The energy sector of Africa is critical to the continent's economic future, but it has yet to meet the demands of its people and businesses when it comes to reliable energy supply. It is estimated that only 58% of the continent's population has access to electricity, with more than 600 million people living in energy poverty. North Africa has reached an acceptable electricity access rate, reported at 98% according to World Bank 2020 data, with the lowest access rate (30%) reported for Central Africa, followed by West Africa (47%), Southern Africa (51%) and East Africa (53%), as depicted in Figure 26 (IEA, 2019). A sustainable energy transition for Africa should focus on expanding the generation of power with the cleanest source of energy available locally, which is usually natural gas.

Gas is an ideal baseload fuel that complements the rapid uptake of renewables. Without battery storage, renewables are inherently intermittent and natural gas provides a low cost, low emitting source over a long duration. Unlike coal, hydro, nuclear or geothermal power, gas-fired power can remain financially viable even when wind and solar are meeting power demand most of the time. The low-fixed-cost/high-variable-cost nature of gas-fired power enables it to balance renewable sources with the local weather. Emerging technologies for CCS might also allow gas-fired power plants to operate with a low or zero carbon footprint. According to Rystad Energy's analysis, depicted in Figure 27, Africa's potential CO2 storage capacity in depleted oil and gas fields, and saline aquifers is approximately 445 gigatonnes (SNAM, IGU, & Rystad Energy, 2022).

The exposure to air pollution resulting from the combustion of coal, kerosene or traditional biomass for cooking, is damaging to human health and the World Health Organization estimates that indoor air pollution leads to approximately 4 million premature deaths each year. A stagnant access rate combined with rapid population growth have led to a rise in the number of people without access to clean cooking, as depicted in Figure 28 (United Nations, 2021). There are approximately 970 million people living in Africa who do not have access to clean cooking fuels and technologies (IEA, 2022). Introducing gas for cooking (piped gas in urban areas and LPG in rural areas) could significantly reduce indoor air pollution, contributing to a reduction in premature deaths in Africa, and improve quality of life for the most vulnerable.

Fertilizer production is one of the most significant industrial applications of natural gas as a feedstock. According to the United Nations' 2019 State of Food Security and Nutrition in the World, hunger is on the rise in almost all African subregions, making the continent the region with the highest prevalence of undernourishment, at nearly 20%. Africa is still unable to feed itself, and agricultural productivity must be improved urgently. Fertilizer is one of the most important inputs in agriculture, yet its use (reported to be 15 kilograms per hectare in 2017) continues to fall below the 2006 Abuja Declaration objective of at least 50 kilograms of nutrient-dense fertilizer per hectare of arable land (African Development Bank Group, 2020). The following countries have natural gas deposits that can be used to produce fertilizers: Algeria, Angola, the Democratic Republic of the Congo, Egypt, Equatorial Guinea, Gabon, Ethiopia, Madagascar, Mozambique, Namibia, Nigeria, Tanzania, and Tunisia (African Union, 2019).

Among the largest contributors to anthropogenic greenhouse gas emissions is the transportation sector. A low-carbon transportation future relies heavily on natural gas, which offers a variety of advantages, including clean

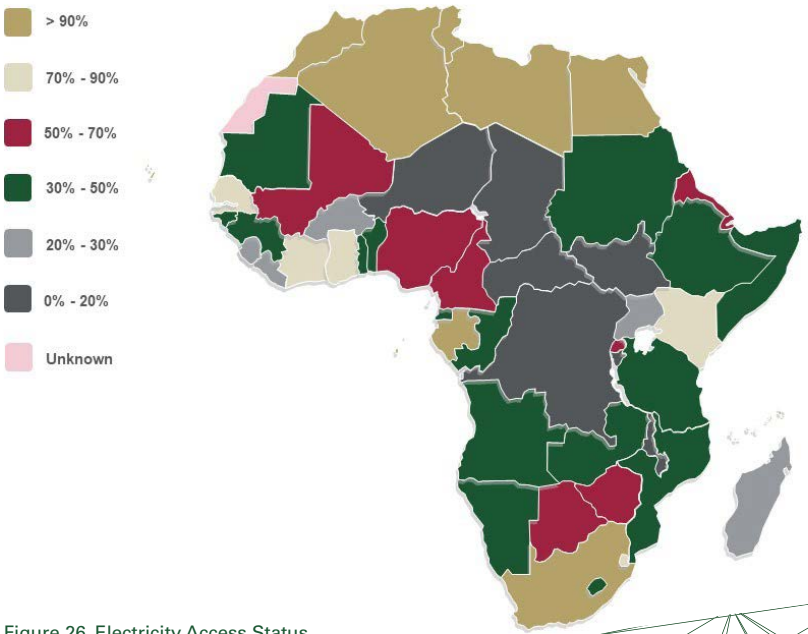


Figure 26 Electricity Access Status

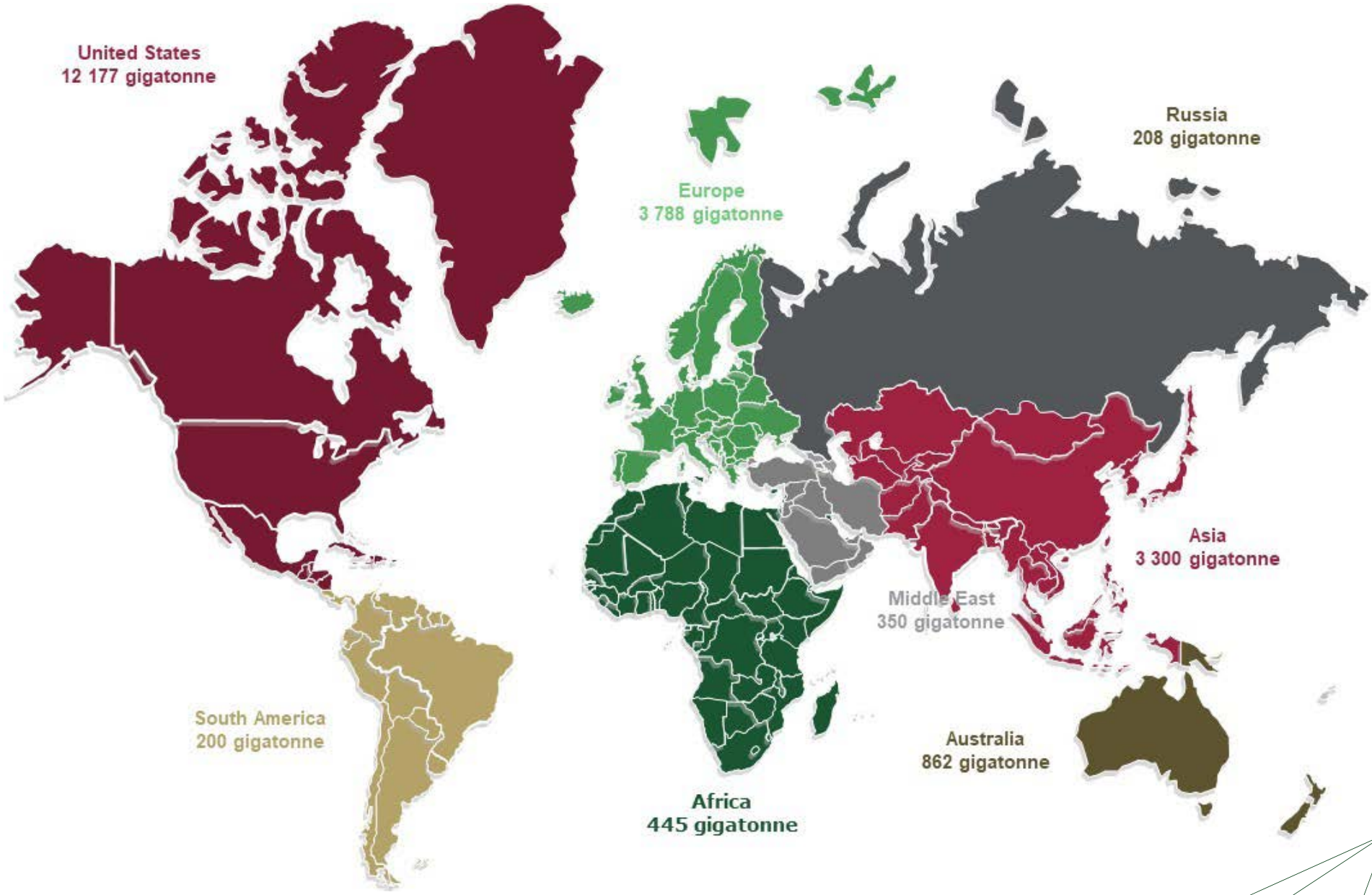


Figure 27 Global CO2 storage capacity potential

combustion, a low carbon dioxide emission level, technology maturity, availability, and a competitive fuel cost. A wide range of applications can be supported by compressed natural gas (CNG) and liquefied natural gas (LNG), including small city vehicles, long-haul trucks and ships. Several African countries use natural gas in the transportation sector, including Algeria, Cote d'Ivoire, Egypt, Equatorial Guinea, and South Africa, with interest growing from other countries such as Nigeria, Kenya, Mozambique, and Mauritania.

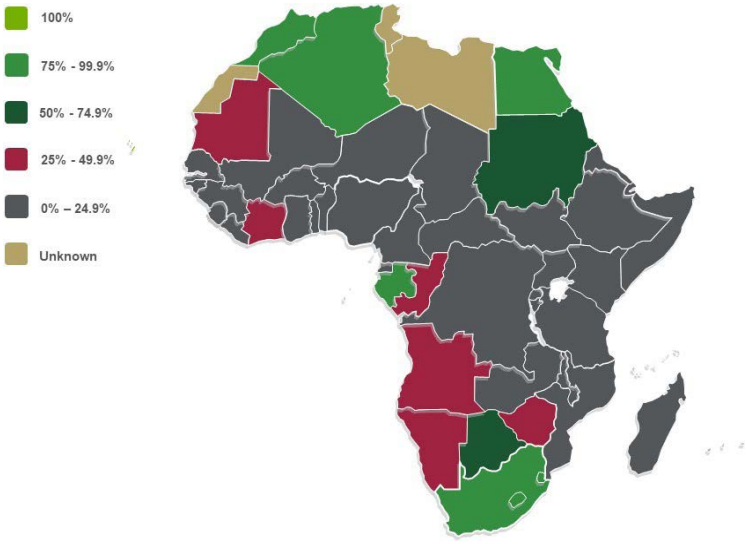


Figure 28 Access to clean cooking systems

4.2.3 Price Development

A combination of a post-Covid rebound in LNG demand, low storage utilization in Europe, a tight LNG shipping market and a cold winter in 2020-2021 caused a strong recovery in demand and, as a consequence, in prices across the globe in 2021.

It is expected that gas prices will remain structurally high. Volatility will continue due to LNG investment cycles, but the increasing globalization of trade will help to maintain competitive inter-regional prices. Europe will remain the balancing market for LNG despite the challenges of energy transition and decarbonization. It is anticipated that the natural gas market will remain largely geographically segmented over the outlook period.

Henry Hub (HH) prices in real terms are currently estimated to reach USD 3,5/MMBtu in 2030, USD 3,9/MMBtu in 2040, and USD 4,7/MMBtu in 2050, as stated by GECF in its Global Gas Outlook 2050 Synopsis report.

It is anticipated that regional gas markets, which are currently less connected, will become more integrated post-2035, due to the rapid development of LNG capacity, as well as the development of transportation and trading networks, including large-scale export pipeline projects, that will stimulate market integration. It is expected that until at least 2035, the American and European markets, as well as Asian and Latin American markets, will remain the most liquid natural gas markets, whereas after that date it is predicted that a global gas market will begin to emerge, with regional differences being less pronounced.

Figure 29 illustrates the historical price of natural gas.

4.2.4 Approach

For the purpose of estimating the overall African supply opportunity over the short-, medium-, and long-term, a cumulative approach has been employed that takes into account both the supply opportunity to the international market based on the projected global demand (excluding Africa) and the supply opportunity in an isolated African market (only Africa). It is assumed that Africa's natural gas reserves are sufficient to meet continental demand and to serve the international market, thereby maximizing revenue.

4.2.5 Global Supply: Reference Cases and Baseline Data

In developing the global supply outlook scenarios for natural gas, two scenarios have been considered: one defined by OPEC in the World Oil Outlook 2021 report (BaU) and the other by the IEA in the Net Zero by 2050 report (NZE). Figure 30 illustrates the global natural gas demand under both scenarios.

Figure 29 Historical prices: Natural gas

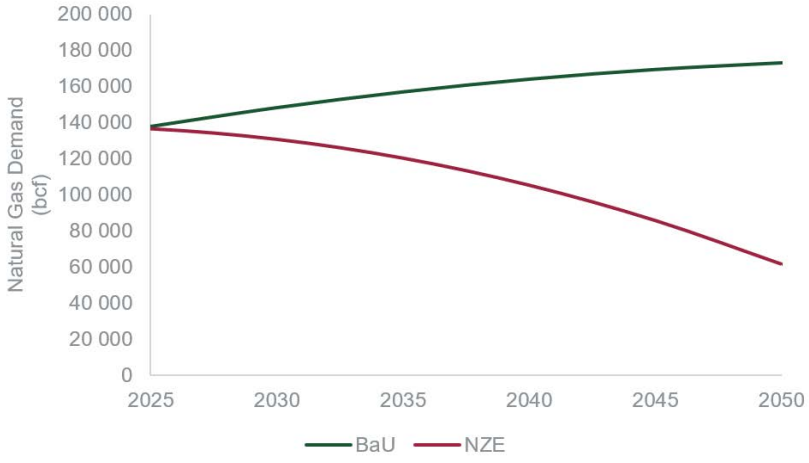


Figure 30 Global outlook scenarios: Natural gas

Detailed information regarding key market drivers associated with these scenarios is provided below.

4.2.5.1 BaU Scenario

In the BaU scenario, it is expected that natural gas will continue to grow in the medium- to long-term as economies expand and energy consumption increases. A significant portion of this is due to the increasing use of gas both in power generation and in industry (including non-energy uses).

Policy support and accessibility in some regions will contribute to the sustained growth of natural gas, as well as expanding infrastructure and market mechanisms that favour gas over coal. From 2020 to 2045, gas is expected to experience the second largest growth, following renewable energy. In light of the rising penetration of renewable energy and efforts to improve energy efficiency, growth is expected to decelerate throughout the outlook period.

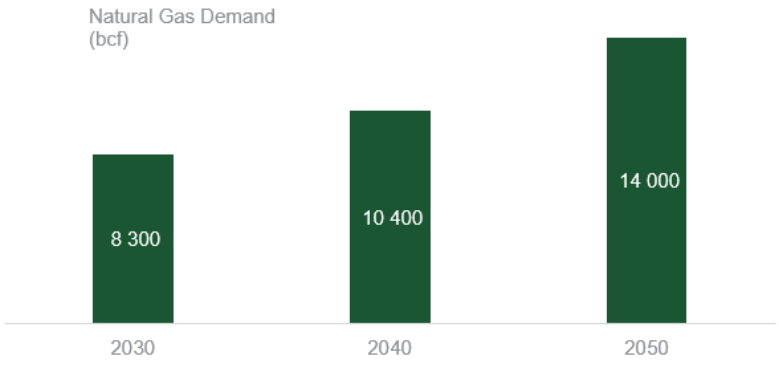


Figure 31 Continental outlook scenario: Natural gas

4.2.5.2 NZE Scenario

It is estimated that the amount of natural gas used will drop to 130 610 bcf in 2030, and 61 775 bcf in 2050 - an annual average decline of just under 3% from 2020 to 2050. A 60% decline in natural gas traded as LNG and a 65% decline in pipeline trade is expected between 2020 and 2050. This decline is primarily due to the phase out of natural gas in the electricity sector.

Further, Africa's role in production and export of natural gas was considered in the development of the scenarios. In 2020 Africa's share of global natural gas production was 4%, with the continent's share of global natural gas exports reported at 6%. It was assumed that Africa would continue to leverage its existing export market share over the short-, medium- and long-term.

4.2.6 Intra-Africa Supply: Reference Case and Baseline Data

In developing the intra-Africa supply outlook scenario for natural gas, only one scenario, as defined by GECF in the Global Gas Outlook 2050 Synopsis report (BaU), was considered. BaU presents a development pathway for the African oil and gas sector that would be of the greatest benefit to the continent and its people in line with the AU's common position on energy access and transition. Figure 31illustrates the African continent's natural gas demand under the BaU scenario. Numbers presented have been rounded.

It has been predicted that by 2050, the African continent will have the highest growth rate in natural gas demand among all regions, which will rise by 155% to nearly 14 000 bcf (GECF, 2022).

Rich gas reserves and a positive outlook for indigenous production offer significant opportunities for increased domestic consumption. There is a possibility that infrastructure expansion could pose a barrier, but many countries are planning pipeline construction and network developments in order to stimulate local consumption. Rapid economic growth and a growing urban population, coupled with an unprecedented increase in electricity demand, will be the main drivers of this growth.

Based on the above, the following two energy outlook scenarios for natural gas in Africa were defined.

4.2.7 Demand Scenario 1

In Scenario 1, demand for natural gas at the global and continental levels assumes BaU conditions.

The assumption was that Africa would be able to service the continental demand while taking advantage of these global market opportunities in order to maximize revenue collection over the short, medium, and long term.

Figure 32 illustrates Africa's total natural gas supply opportunity under BaU conditions. Global supply gradually increases, but the demand shifts from export to intra-continental trade during this period, with global supply (as a portion of the total supply opportunity) decreasing from around 30% to just over 18% over time.

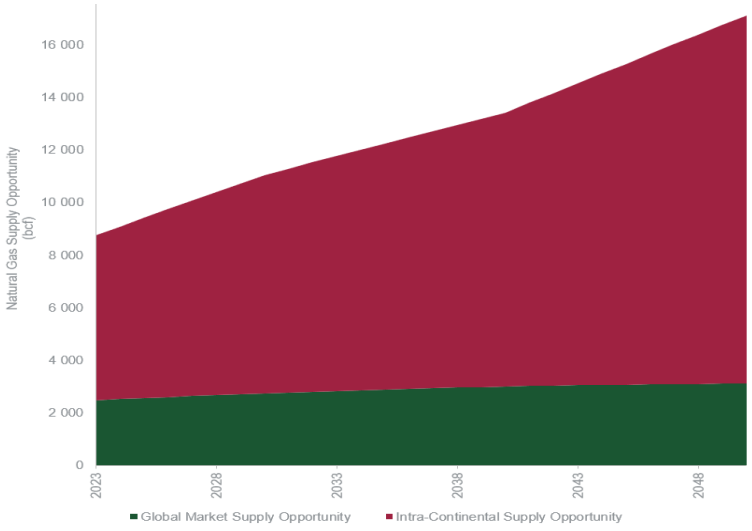


Figure 32 BaU scenario: Natural gas supply opportunity

4.2.8 Demand Scenario 2

The NZE pathway is assumed to govern natural gas demand on a global level in Scenario 2, while BaU conditions continue to govern demand on a continental level.

The assumption was that Africa would be able to service the continental demand while taking advantage of these global market opportunities in order to maximize revenue collection over the short, medium, and long term.

Figure 33 illustrates Africa's total natural gas supply opportunities under global NZE conditions, assuming continental demand follows the BaU pathway. In the long term, the global supply opportunity (as a portion of the total supply opportunity) has decreased significantly from around 30% to just over 6%, indicating the need for intra-continental trade to be expedited.

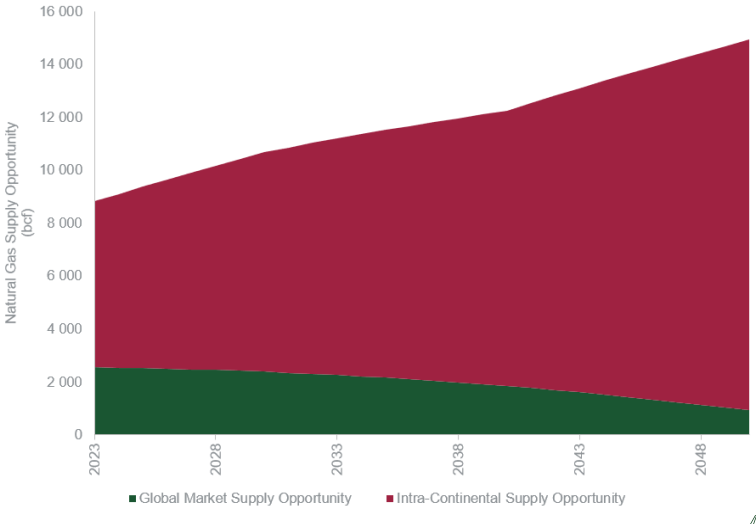


Figure 33 NZE scenario: Natural gas supply opportunity

4.2.9 Major African Natural Gas Projects

There are several major African natural gas projects set to come online in the short-term as illustrated in Figure 34 (Johnson, 2022) (Upstream Energy Explored, 2022)

4.3 Socio-Economic Impact of Oil and Gas Developments

There is a natural expectation that the discovery and development of oil and gas resources in a country will translate into economic growth and upliftment of the population, through the attraction of foreign investment in these projects, development of associated infrastructure and the generation of a revenue stream which governments can use to support the development of other sectors in the economy, with resulting domestic growth and job creation. This expectation would seem to be supported by the observation of a positive relationship between energy consumption and economic activity (GDP growth), however the causal nature of this relationship is uncertain (World Bank Group, 2016).

History has shown that positive socio-economic development following oil and gas developments has seldom been realised, however, with many examples, particularly in Africa, where the exploitation of a country's oil resources has rather led to an increase in poverty, inequality and corruption (Nanok & Onyango, 2017) (Karl, 2007). The failures observed are often associated with poor governance with limited capacity in the public sector and ineffective institutions, and a movement of labour and finance away from other sectors of the economy to the oil and gas sector.

The utilisation of revenue generated by oil and gas developments and the investment allocation decisions made by governments are critical in the success of having a lasting positive social and economic impact. One such investment choice, for instance, is to create a mechanism to save a portion of the revenue for future generations – this may be difficult in poor countries with short-term development needs. Many poor, oil rich countries, for example, subsidise their domestic consumption of oil and gas products heavily, thereby depriving other development priorities from investment.

Oil and gas developments do not generate a large number of direct employment opportunities, except during the construction and decommissioning phases (these jobs are short-term) compared to other sectors in the economy. The real opportunity lies in the indirect jobs resulting from sectors in the supply chain of oil and gas projects, from economic activities downstream of the oil and gas sector, and in sectors stimulated by government's investment allocations (from oil and gas revenue). The magnitude and effectiveness of this multiplier effect depends on the development state and structure of the domestic economy.

It is evident that the socio-economic impact of oil and gas resource development will be country specific, depending on a country's state of development, economic structure and strengths of government and institutions. Nevertheless, a number of factors may play a role in securing positive impacts:

- Corruption must be eliminated and prevented through strict laws and regulations, which must be enforced in a visible manner.
- The equitable, transparent, fair, and stable sharing of resource rent between the government and private investment, which is typically embodied in license terms and production sharing contracts.
- The ability to attract foreign investment in oil exploration and development. The poor countries do not have the resources to undertake these projects alone, and even those countries with a strong oil revenue stream may wish to invest their money in other sectors of the economy where the social return on investment may be greater and the risks may be lower. Having transparent, stable, and competitive fiscal and regulatory conditions is essential to attracting investment.
- Balance should be struck between exporting oil and gas and using them domestically, with exports serving as a revenue generator and domestic uses serving as a stimulus for economic activity. Additionally, oil and gas processing should be maximized at the domestic level.
- Achieving cost-equitable participation of domestic workers and service providers in oil and gas projects, and the development of capacity and transfer of skills that follow.
- The involvement of nongovernmental organizations can be helpful in pursuing development outcomes when government is weak or lacking capacity.

4.4 Oil and Gas Markets in Africa: Implications of the Paris Agreement

As of May 2022, 53 African countries have submitted a Nationally Determined Contribution (NDC) and 12 African countries, that represent over 40% of the continent's total CO2 emissions, have committed to reach net zero emissions by around mid-century. If fully implemented, African NDCs would reduce CO2 emissions by about 550 million tonnes by 2030, which is approximately 40% of the continent's current emissions (IEA, 2022). In addition to

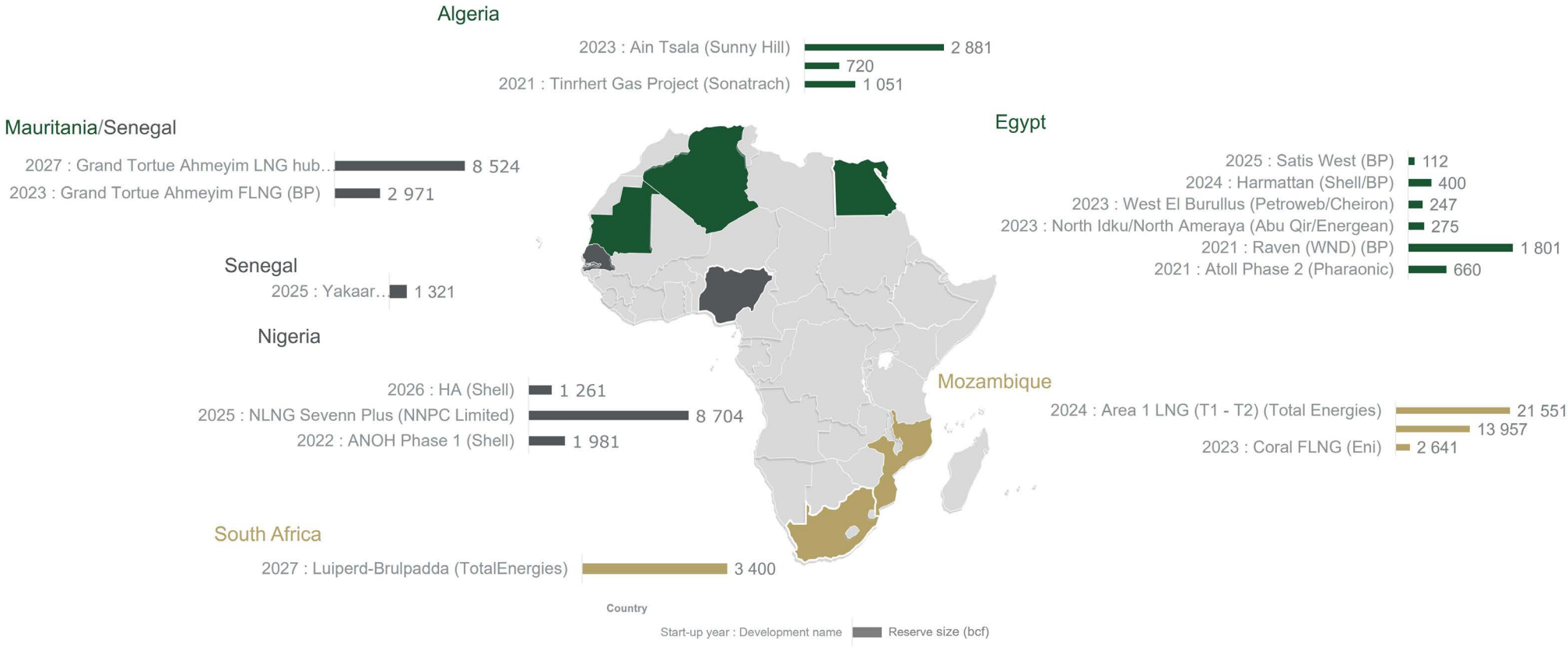


Figure 34 Major African projects: Natural Gas

varying in specificity and coverage, most of the NDCs submitted by African countries are conditional, notably on the availability of financial resources (approximately USD 1 200 billion by 2030) (IEA, 2022).

As a result of these commitments, Africa's pathway for energy development would be profoundly impacted. Several aspects would be positive, including improved affordability and availability of clean energy technologies, increased demand for the region's critical mineral resources and increased levels of climate finance through international commitments, in addition to averting the worst effects of climate change. On the other hand, the impact on Africa would be notable for increasing uncertainty about fossil fuel production prospects.

As new opportunities arise and as the global energy context continues to change, energy investment decisions over the next decade will be increasingly influenced. The achievement of Africa's energy and climate goals requires the doubling of energy investment in this decade, with two thirds of the investment going towards clean energy sources (IEA, 2022).

Governments and lenders have been under increasing pressure to discontinue funding for fossil fuel projects. Additionally, some major banks, sovereign wealth funds, and multilateral financing institutions have committed to cease funding new fossil fuel developments. Nevertheless, certain regulations or commitments provide exceptions for natural gas for transitional purposes, such as the EU's Green Taxonomy. Based on the current global investment climate, Section 7.2 discusses considerations for attracting increased investments within the oil and gas sector.

It is important to understand that the energy transition risk, also known as revenue risk, refers to the risks that may impact revenue through reduced prices or volume. There is a great deal of asset-specificity associated with the economic value at risk. This is due to the varying risks associated with different geographies, costs, and revenue streams. In

Figure 35, the different risks are illustrated schematically (Rystad Energy, 2022).

4.5 Oil and Gas Markets in Africa: Impact of Russia-Ukraine Conflict

The Russia-Ukraine conflict increased the strain on African economies already crippled by the Covid-19 pandemic as prices for commodities, food, and energy have been soaring since hostilities erupted. These two back-to-back crises with their cumulative detrimental effect, have created even more urgency for continental self-sufficiency through the utilization of African oil and gas resources.

The Russia-Ukraine conflict has distorted global financial and energy markets, causing oil prices to soar above USD 100 per barrel, the highest since 2014. Although Africa is not dependent on Russian oil exports it is however confronted with the steep increase in prices which has a distressing impact on the affordability of electricity. As many African countries are dependent on diesel generators, the increasing price of petroleum products has a direct impact on the affordability of power across the continent. The same impact is observed in the rise of utility scale electricity generation powered by natural gas. There is now, more than ever, the proverbial burning platform to invigorate African petroleum and gas production for do-

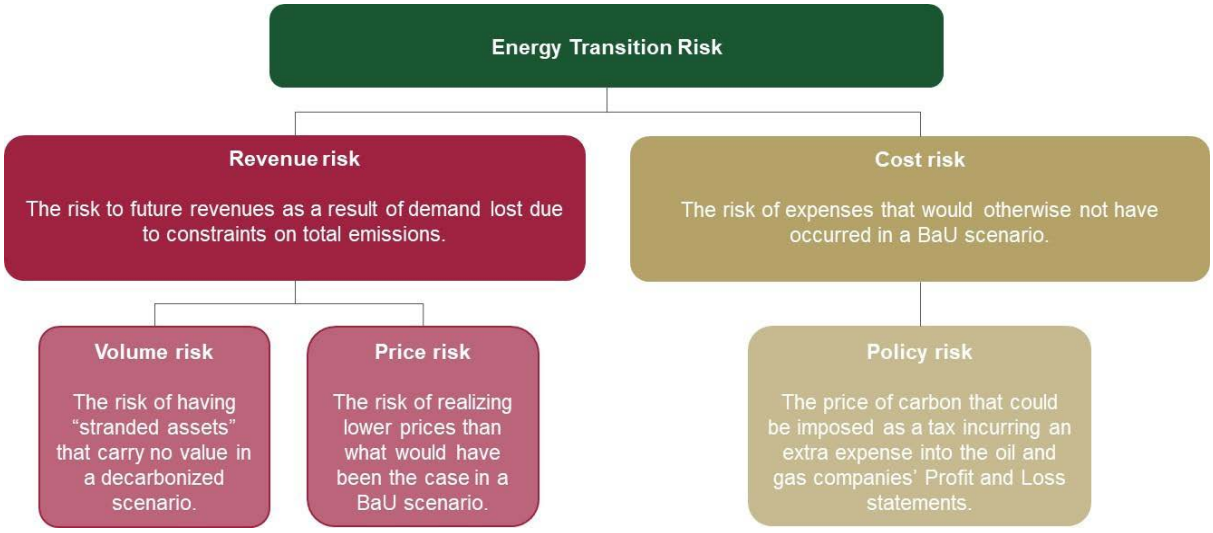


Figure 35 Energy transition risk for the oil and gas industry

mestic use to hedge against detrimental global market developments and attain continental self-sufficiency.

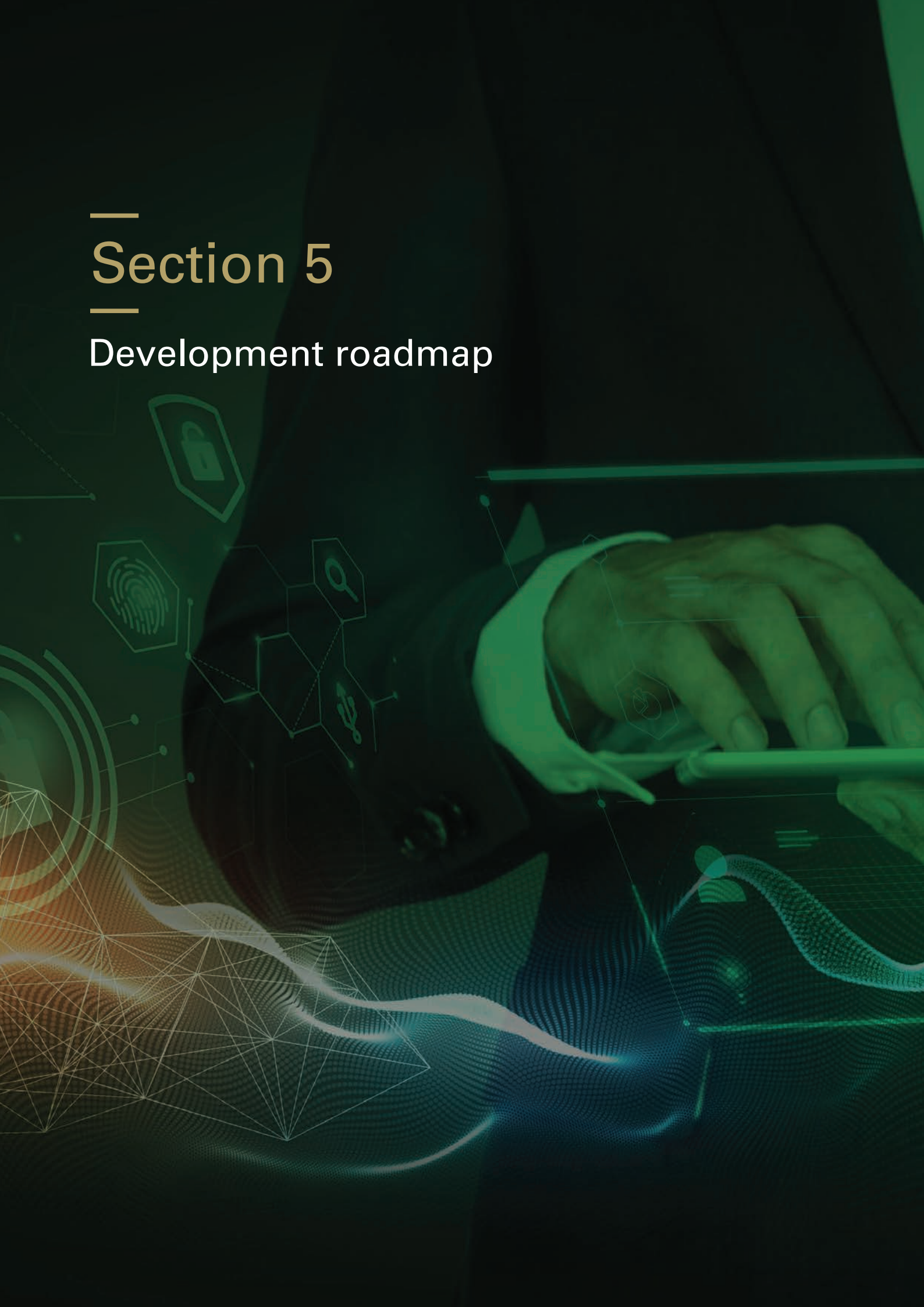
In terms of the natural gas market, the Russia-Ukraine conflict has called for the urgent diversification of European natural gas supply. Africa is now well-positioned to respond to the supply gap created by the conflict. First and foremost, Africa has an abundance of natural gas resources, with countries such as Senegal, Mauritania, Nigeria, Mozambique and Tanzania being able to take advantage of this opportunity. Additionally, Africa has the potential to use its geographical proximity to Europe to its advantage. For example, parts of North Africa are very close to Europe, and even gas-rich countries in the south already have some connections via established maritime routes. Lastly, some African countries have been delivering gas to Europe for years through pipelines and LNG export terminals and have already demonstrated their reliability as suppliers. To fulfil this objective, investments in gas-export infrastructure, such as additional LNG export terminals or continental gas pipeline projects, should be encouraged and actively pursued.

In the wake of the Russia-Ukraine conflict, the European Union's decision to include some specific uses of natural gas and nuclear energy in its taxonomy of sustainable sources of energy has created an opportunity for African countries to gain international investment in African gas projects. Therefore, despite the global trend toward decarbonization, African governments should continue to promote investment in oil and gas exploration to ensure long-term energy security through the utilization of their own resources whilst harnessing the potential of renewables. This will require access to financing in competition with other potential sources of gas. Africa will also have to address concerns related to political instability, corruption and internal conflicts, and demonstrate that investment in the development of its resources and infrastructure will not result in stranded investments in light of the transition away from fossil fuels.

Furthermore, African countries should utilize gas resources for industrialization and diversification of their own economies. The current soaring prices of fertilizers brought on by the Russia-Ukraine conflict underscore the importance of self-sufficiency in growing and fertilizing crops and securing a food basket for Africa. Increasing the production of nitrogen fertilizer by using African natural gas as a feedstock should therefore be a priority for the continent.

Section 5

Development roadmap



5. Development Roadmap

Based on the preceding analyses and leveraging market understanding, two alternative scenarios (BaU and NZE) to expand the African market for crude oil, petroleum products and natural gas were explored.

The short-term period of interest for this study is the period between now and 2030, the medium-term period is 2031 to 2040, and the long-term period is 2041 to 2050.

5.1 Objectives

The four pillars outlined in Figure 36 provide a framework for the development pathways discussed below.

5.2 Oil and Gas Roadmap

Based on the energy outlook scenarios discussed in Section 4, the oil and gas roadmaps discussed in this section provide potential development options to achieve the desired outcome. These options should be read as directional, noting that the potential technical and commercial viability in each case, and each country's developmental circumstances and requirements are not included here.

The data presented in this section pertains only to the focus countries selected for this study, based on the data for the year 2020.

Investment

Attracting investment throughout the oil and gas business chain, with a specific focus on advancing exploration and production activities and increasing value-added processing (beneficiation).

Trade

Improving intra-continental and inter-continental trade of crude oil, natural gas and associated products.

Infrastructure

Improving transportation and distribution infrastructure across the continent, to aid development of the African oil and gas consumer market.

Energy Access

Attracting investment and improving access to energy, products, and services provided by the oil and gas sector to enable sustainable lifestyles that will lift millions out of poverty.

Figure 36 The four pillars of the development pathway

5.2.1 Crude Oil and Petroleum Products

Crude oil cannot be consumed in its natural state by end users and needs to be refined into petroleum products. Therefore, crude oil and petroleum products must be viewed as an integrated value chain, leading to an integrated development strategy.

5.2.1.1 Current Situation

Africa's oil reserves per region, as well as the distribution of reserves amongst the selected producing countries, are illustrated in Figure 37, with current production rates summarised in Figure 38. Countries that aren't featured in Figure 37 and Figure 38, but have been included as part of this study, are either those that do not have oil reserves or those that do have oil reserves but did not produce in 2020. Tanzania, Mozambique, and South Africa do not have oil reserves, while Mauritania, Senegal, and Uganda have reserves but do not produce.

Figure 37 clearly indicates that there are certain countries that dominate regional oil reserves, such as Libya in the north, Nigeria in the west, and Angola in the south. If any of these countries face a situation in which their reserves cannot be exploited, it could be problematic for the region and other countries depending on them (both domestic and international).

The reserve-to-production ratios, presented in Figure 39, provide an estimate of the number of years that operational crude oil fields will continue to be productive based on 2020 production rates. Focus countries which do not have crude oil reserves (such as Tanzania, Mozambique and South Africa) and those that were not producing in 2020 (such as Mauritania, Uganda and Senegal) have been omitted from Figure 39.

As shown in Figure 39, crude oil reserves, based on the number of production years estimated, are not only sufficient for long-term supply of crude oil, but are also capable of supporting increased production rates to meet the needs of a larger market.

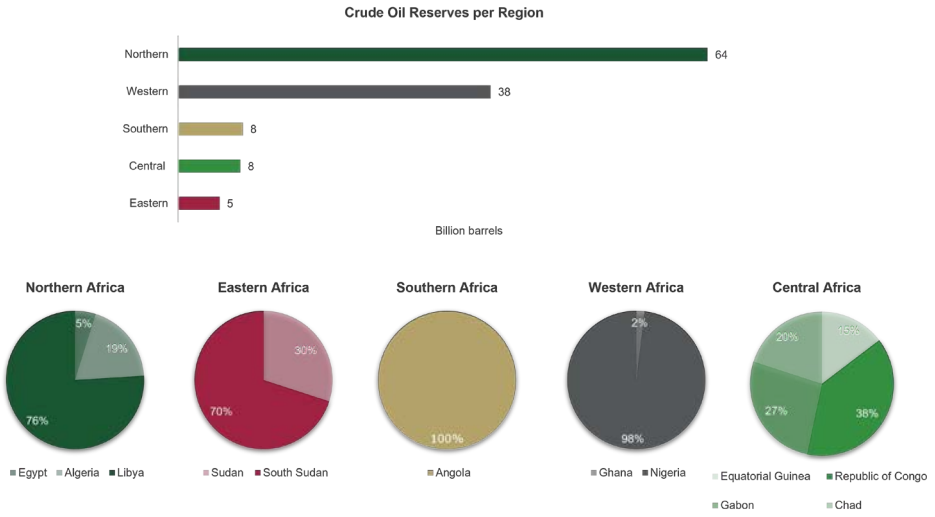


Figure 37 Regional crude oil reserves and weighted breakdown of producing countries per region

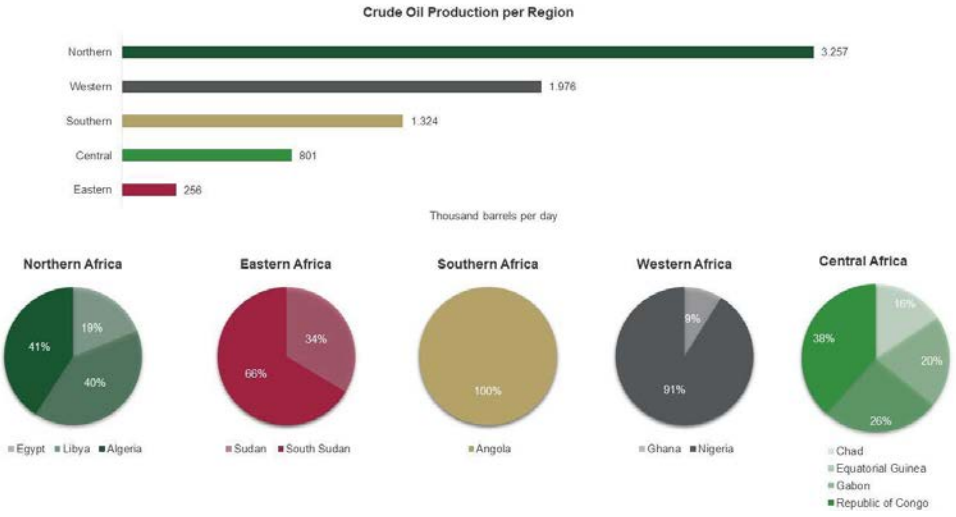


Figure 38 Regional crude oil production and weighted breakdown of producing countries per region

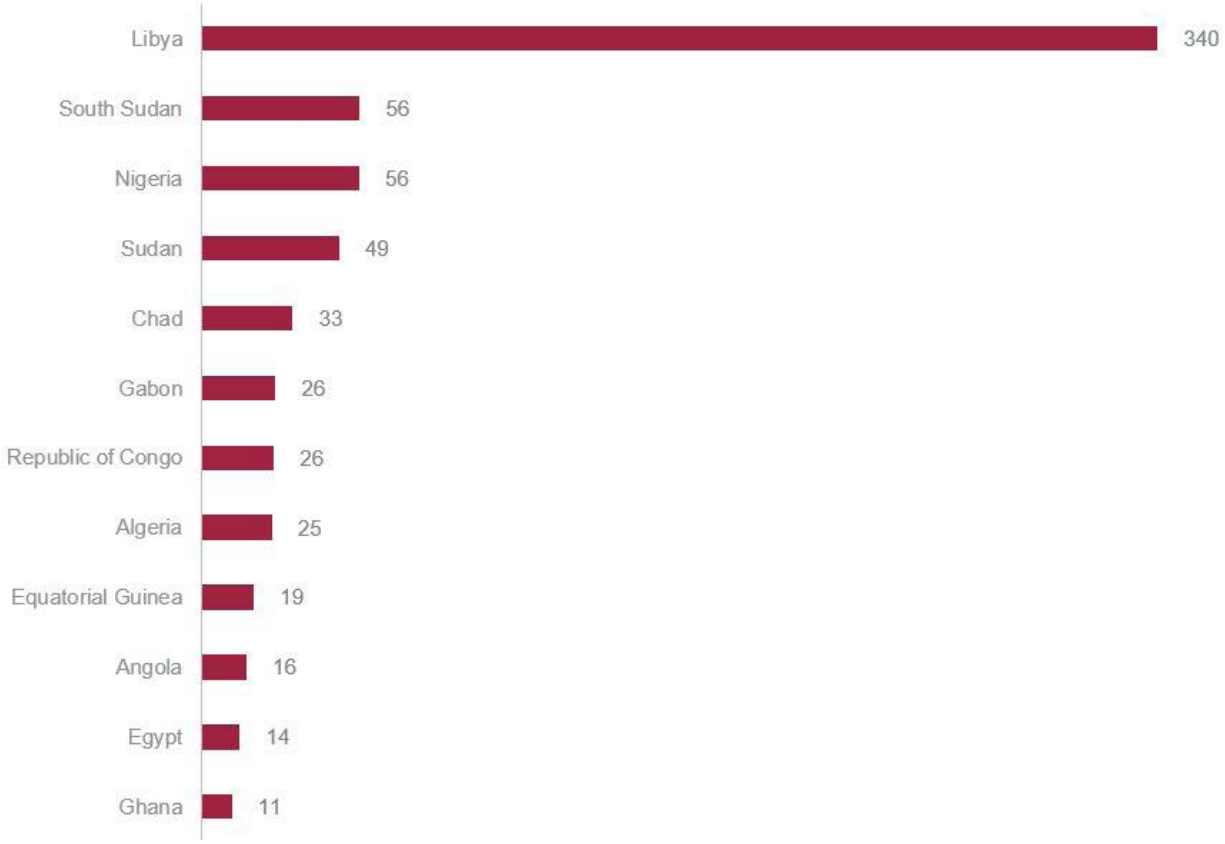


Figure 39 Reserve-to-production ratio: Crude oil (years)

5.2.1.2 Short-, Medium- and Long-Term Reserve Outlook

Based on current production rates (illustrated in Figure 38), and assuming no increase in reserves beyond the 2020 numbers, Figure 40 illustrates the anticipated decline in crude oil reserves over the outlook period. Details per period are provided in Appendix C.

Based upon the current condition of existing crude oil fields, Southern Africa's producing oil fields are expected to deplete in the medium term, and Central Africa's oil fields will deplete gradually over the longer term.

5.2.1.3 Development Roadmap: Scenario 1 (BaU)

Based on the preceding analyses and leveraging market understanding, a scenario to expand the African market for crude oil (and petroleum products), under BaU conditions, were explored.

Table 3 provides short-, medium- and long-term development options for consideration to expand the African market for crude oil (and petroleum products).

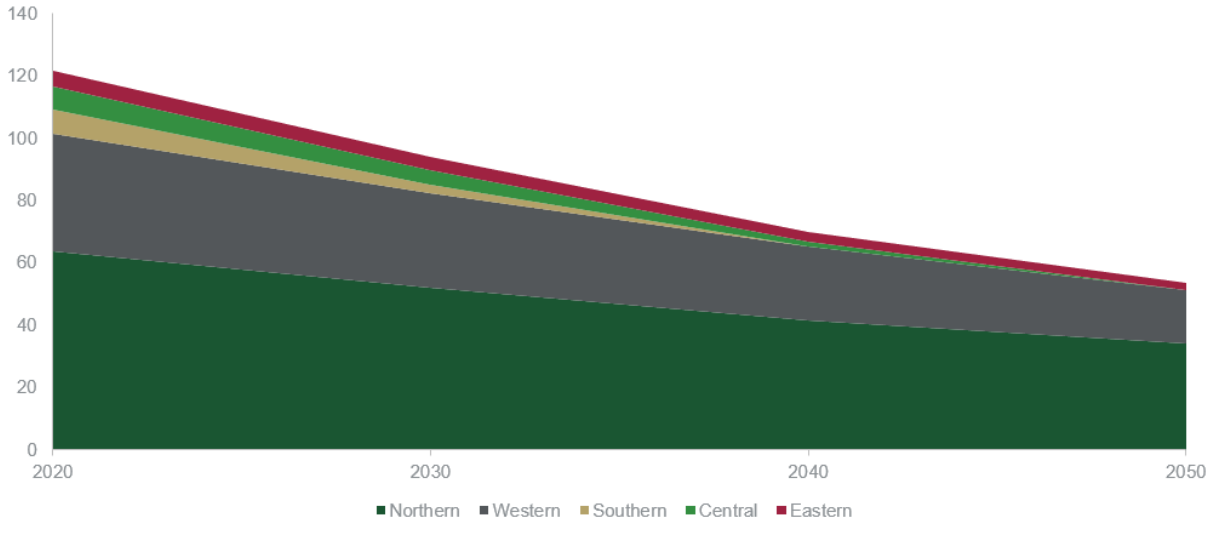
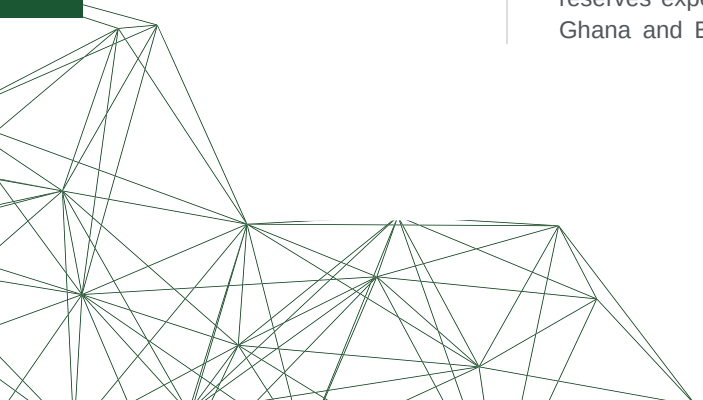


Figure 40 Regional reserve outlook: Crude oil

Table 3 Crude oil development roadmap: Scenario 1 (BaU)

Overview	
Short-term (current – 2030)	• The total market demand is predicted to reach 106,6 million bpd in 2030. • The total oil supply opportunity for Africa on a continental and global level is expected to reach 9,42 million bpd in 2030. • Each region is projected to have sufficient oil reserves, with Northern and Western Africa holding more than 82% of the continent's reserves. • Libya will remain the dominant country in Northern Africa, and Nigeria in Western Africa. • A country's ability to support the global oil demand depends on the size of its reserves and its infrastructure. Countries with ample reserves, existing oil production facilities and export terminals, should be encouraged to expand facilities based on available spare capacity and expansion potential.
Medium-term (2031 – 2040)	• The total market demand is expected to be 108,1 million bpd in 2040. • The total oil supply opportunity for Africa on a continental and global level is expected to reach 10,92 million bpd in 2040. • The following countries' oil reserves are anticipated to be depleted in the medium-term: Egypt in Northern Africa, Angola in Southern Africa, Ghana in Western Africa, and Equatorial Guinea in Central Africa. • Countries with reserves that are expected to deplete in the long-term, should shift focus from increasing production to exploration and development of new reserves in the medium-term. These countries include Gabon, Republic of Congo and Algeria.
Long-term (2041 – 2050)	• The total market demand is expected to remain constant at 108,1 million bpd in 2050. • The total oil supply opportunity for Africa on a continental and global level is expected to be 12,43 million bpd in 2050. • Gabon and Republic of Congo in Central Africa and Algeria in Northern Africa are expected to deplete their oil reserves in the long-term based on current production rates.
Investment	
Short-term **(current – 2030)**	• Attract investment for exploration in regions where a single country dominates reserves and production, such as Northern, Southern and Western Africa, by promoting exploration in countries such as Mauritania, Egypt, Ghana, Senegal, South Africa, Mozambique and Namibia. • Promote investment in oil field development and associated production facilities in countries that possess oil reserves but do not produce, such as Mauritania, Uganda and Senegal. • Since the exploration process takes time, oil exploration should begin before the country or region's reserves have been depleted. Countries with oil reserves expected to deplete in the medium-term (such as Egypt, Angola, Ghana and Equatorial Guinea) should be encouraged to shift focus from



	increasing production to exploration and development of new reserves in the short-term. • Investment in new trans-continental pipeline projects, such as LAPSSET, EACOP, AZOP and Niger-Chad pipelines, should be encouraged.
Medium-term (2031 – 2040)	• The depletion of Angola's reserves creates substantial risk to Southern Africa, as it is the only producing country in the region. Therefore, promoting exploration and development of oil fields in selected Southern African countries should be encouraged if no investments were made in the short-term. • Countries with sufficient oil reserves should be encouraged to increase production, such as Libya in Northern Africa, Sudan and South Sudan in Eastern Africa and Nigeria in Western Africa. • Since exploration takes time, oil exploration should commence before the country or region's reserves run out. Countries with oil reserves expected to deplete in the longer-term (such as Algeria, Gabon, Chad, and Republic of Congo) should be encouraged to invest in additional oil exploration in the medium-term.
Long-term (2041 – 2050)	• If no investments were made in the previous period, oil exploration in the Central African region should be encouraged due to the region's anticipated dwindling supply. • Those countries whose oil reserves have depleted in the short- or medium-term should continue exploring for new oil fields.
Trade	
Short-term (current – 2030)	• Increasing production and value addition infrastructure, storage and transmission infrastructure (domestic and international) are essential. • In order to facilitate trade, existing trans-border pipelines, such as SUMED, Tazama, Chad-Cameroon and Petrodar, should be fully utilized. • In order to facilitate inter- and intra-regional trade between countries, countries in close proximity should be encouraged to evaluate and possibly consolidate economic groups on a regional and continental level. This will avoid the need for each country to increase production of crude oil or petroleum products, instead focusing on achieving regional self-sufficiency. • It will be possible to conduct effective trade between all African countries if they are unified into a consolidated economic community (such as AfCFTA). • Countries with existing export terminals could be presented with the opportunity to expand export terminals, such as Algeria, Egypt and Libya in Northern Africa; Sudan in Eastern Africa; Angola in Southern Africa; Ghana and Nigeria in Western Africa; and Chad, Republic of Congo, Equatorial Guinea and Gabon in Central Africa. • Countries that are best positioned for global export should be selected based on their available reserves and production capacity, existing infrastructure and geographic location. Geographic location plays an important role in exporting to the global market due to ease of transportation and associated costs.

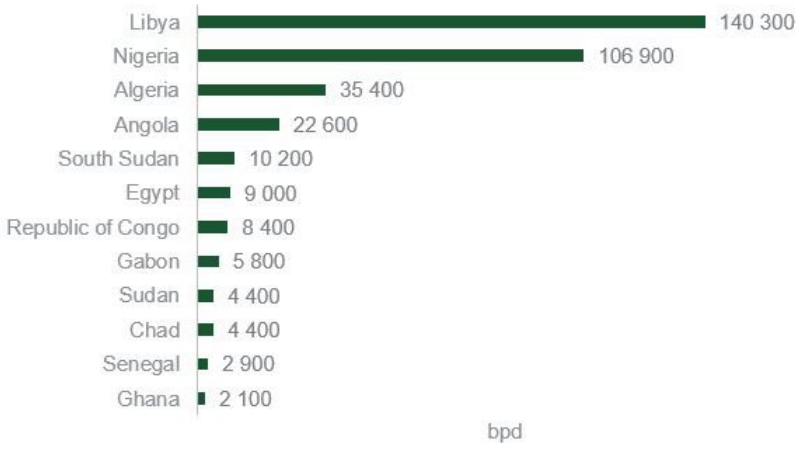
	• Algeria and Libya both possess abundant oil reserves and are coastal nations, making them ideal exporting countries. Oil exports from these countries are ideally suited for destinations in Europe, Asia and the Middle East. In light of the fact that these countries are neighbours, it might make sense only to expand the export terminal in one of consider the development of a shared export terminal. • Nigeria offers abundant reserves in addition to an ideal location to export to the United States and South America. It should be recommended that Nigeria increase its oil production and expands its export terminal. • Chad (via the Chad-Cameroon pipeline), Republic of Congo and Gabon are among the Central African oil exporting countries, ideally positioned to promote increased exports. • As a coastal country, Sudan has easy access to the global market, especially markets to the east of Africa, which enables the country to increase oil production and expand export terminals.
Medium-term (2031 – 2040)	• The global market supply has reached its plateau during this period and focus shifts from the international market to the domestic market. • It is essential to establish and maintain intra-regional trade between Nigeria and other countries in Western Africa. • Libya still has a large amount of oil reserves in the near future, and it should be encouraged to increase its production and export to surrounding countries in need, such as Egypt. • Development of intra-continental trade should be encouraged to enable countries with abundant reserves to assist countries projected to fall into deficits in the long-term. • The establishment of trade between Chad, South Sudan and coastal countries such as Gabon should be encouraged since Chad and South Sudan have sufficient oil reserves but are landlocked countries. • In the absence of new oil field developments, the reserves of several African countries will be depleted in the longer-term, excluding Nigeria, Libya, South Sudan, Sudan and Chad. • Nigeria, Libya, South Sudan, Sudan and Chad should be encouraged to increase production to increase intra-continental trade volumes.
Long-term (2041 – 2050)	• The global market supply starts to decline during this period and focus increases on serving the domestic market. • In the absence of new oil field developments, the reserves of several African countries will be depleted in the longer-term, excluding Nigeria, Libya, South Sudan, Sudan and Chad. Nigeria, Libya, South Sudan, Sudan and Chad should be encouraged to increase production to increase intra-continental trade volumes. • It should be recommended that Libya, the country with the most oil reserves in Africa, support Algeria by promoting oil trade between the two neighbouring countries (Egypt and Algeria) in the longer-term.

Infrastructure

Short-term (current – 2030)

- Africa's petroleum products demand is estimated to reach over 5 million bpd in the short-term, exceeding the countries' current refining capacity (1,42 million bpd deficit).
- Furthermore, refining facilities in Africa are underutilized and in need of refurbishment.
- Countries should be encouraged to invest in their underutilized refineries in order to increase production capacity.
- Refurbishment of underutilised refining facilities will however not suffice to meet the entire African demand. The construction of new refineries or the expansion of existing refineries in countries that produce oil should therefore also be encouraged.
- In order to meet 75% (1,07 million bpd) of the additional petroleum products required in the short-term, all countries with underutilized refinery capacities should be encouraged to refurbish refineries to fully utilize existing capacity. These countries include Senegal, Gabon, Republic of Congo, Angola, Sudan, Egypt, Algeria, Libya and Nigeria.
- 25% (0,35 million bpd) of the additional production needed in the short-term should be supplied by countries with immediate access to oil reserves.
- One of the following options could be considered to provide the additional 0,35 million bpd refined petroleum market:[7]

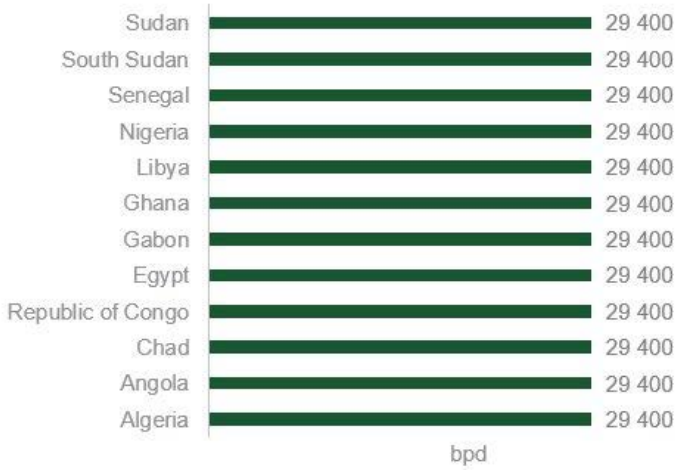
Option 1:



7 *Option 1: Distributes the required refining capacity among the countries with the ability to assist, based on each country's reserve level*
Option 2: Equally distributes the required refining capacity between the four countries with the largest reserves
Option3: Distributes the refining capacity in an equal manner amongst all those countries that have adequate reserves and existing refineries

Option 2:

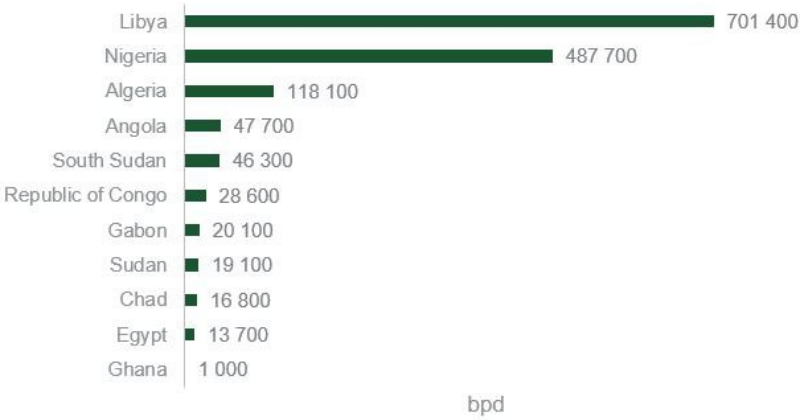
Option 3:



Medium-term (2031 – 2040)

- Africa requires an additional production of 1,5 million bpd to meet the domestic refined petroleum product demand in the medium-term, provided the short-term demand was met.
- The construction of new refineries or the expansion of existing refineries should be encouraged in countries with abundant oil reserves and established associated infrastructure.
- The additional demand of 1,5 million bpd can be reached by pursuing one of the following options:

Option 1:



Option 2:

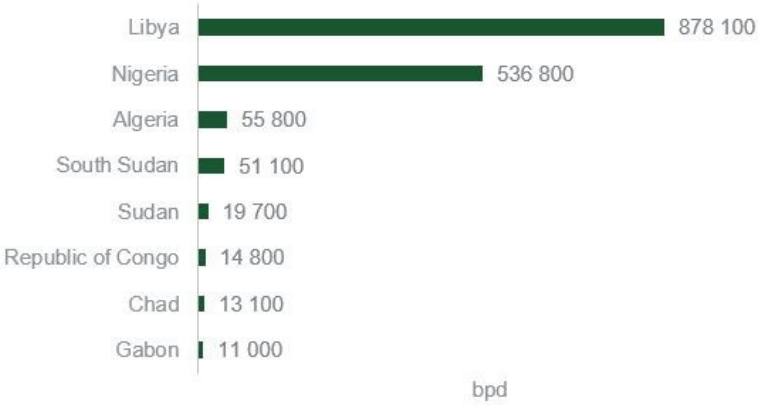
Option 3:

It is not feasible to evenly increase production amongst all the identified countries since this would deplete some reserves.

Long-term
(2041 – 2050)

- Africa requires an additional production of 1,58 million bpd to meet the domestic petroleum product demand in the long-term, provided short- and medium-term demand were met.
- The construction of new refineries or the expansion of existing refineries should be encouraged in countries with abundant oil reserves and established associated infrastructure.
- One of the following options could be considered:

Option 1:



Option 2:

Option 3:

It is not feasible to evenly increase production amongst all 8 countries since this would deplete some reserves.

Energy Access	
Short-term (current – 2030)	• Access to modern energy is essential for the provision of clean water, sanitation, and healthcare, and for the provision of reliable and efficient lighting, heating, cooking, mechanical power, transport and telecommunication services. • Refined crude oil products such as LPG, paraffin, diesel, heavy fuel oil and gasoline can be used as energy sources to assist certain regions and countries with power generation, transport, cooking, heating, and lighting. • Sub-Saharan Africa should be prioritised, accounting for three-quarters of the global energy access deficit.
Medium-term (2031 – 2040)	• Sustained efforts to achieve and maintain universal energy access, prioritising Sub-Saharan Africa.
Long-term (2041 – 2050)	• Sustained efforts to achieve and maintain universal energy access, prioritising Sub-Saharan Africa.

5.2.1.4 Development Roadmap: Scenario 2 (NZE)

Based on the preceding analyses and leveraging market understanding, a scenario to expand the African market for crude oil (and petroleum products), under NZE conditions, were explored.

According to the NZE pathway, the global crude oil demand will decrease significantly in the short-, medium-, and long-term, while Africa's reliance on crude oil will continue, leading to greater opportunities for intra-continental trade.

Table 4 provides short-, medium- and long-term development options for consideration to expand the African market for crude oil (and petroleum products).

5.2.1.5 Potential Barriers to Increasing Refining Capacity

Refining capacity is determined by the energy outlook. In order to achieve the required refining capacity, African governments need to identify and promote bankable projects for investment. It should be noted, however, that the development of OPEC quotas, ongoing unrest, security issues, and the state of current infrastructure could pose serious barriers to the achievement of the desired and required refining capacity. It is therefore necessary to conduct a feasibility study to determine the current capacity and utilization, as well as the expansion potential and the need for upgrades in the refinery industry in Africa.

Table 4 Crude oil development roadmap: Scenario 2 (NZE)

Overview	
Short-term (current – 2030)	• In 2030, the total market demand for the NZE scenario is estimated at 72 million bpd, compared to 106,6 million bpd for the BaU scenario. • The total oil supply opportunity for Africa on a continental and global level is expected to reach 7,95 million bpd in 2030, with nearly 36% of the total supply earmarked for global export. • A greater opportunity for intra-continental trade in Africa is resulting from the NZE pathway being followed by the rest of the world. In 2030, there is a potential supply opportunity of 5,12 million bpd for intra-continental trade.
Medium-term (2031 – 2040)	• In 2040, the total market demand for the NZE scenario is estimated at 50 million bpd, compared to 108,1 million bpd for the BaU scenario. • The total oil supply opportunity for Africa on a continental and global level is expected to reach 8,46 million bpd in 2040, with nearly 22% of the total supply earmarked for global export. • There is an increasing opportunity for intra-continental trade in Africa, with the supply opportunity estimated at 6,62 million bpd for 2040.
Long-term (2041 – 2050)	• In 2050, the total market demand for the NZE scenario is estimated at 24 million bpd, compared to 108,1 million bpd for the BaU scenario. • The total oil supply opportunity for Africa on a continental and global level is expected to be 8,87 million bpd in 2050, with merely 7,5% of the total supply earmarked for global export. • There is an increasing opportunity for intra-continental trade in Africa, with the supply opportunity estimated at 8,2 million bpd for 2050.
Investment	
Short-term (current – 2030)	• Refer to Table 3. Recommendations made in the case of BaU can also be applied to the case of NZE.
Medium-term (2031 – 2040)	• Refer to Table 3. Recommendations made in the case of BaU can also be applied to the case of NZE.
Long-term (2041 – 2050)	• Refer to Table 3. Recommendations made in the case of BaU can also be applied to the case of NZE.
Trade	
Short-term (current – 2030)	• Refer to Table 3. Recommendations regarding trade made in the case of BaU can also be applied to the case of NZE.

Medium-term (2031 – 2040)	• Refer to Table 3. Recommendations regarding trade made in the case of BaU can also be applied to the case of NZE.
Long-term (2041 – 2050)	• Refer to Table 3. Recommendations regarding trade made in the case of BaU can also be applied to the case of NZE.
Infrastructure	
Short-term (current – 2030)	• Refer to Table 3. Recommendations regarding domestic refining made in the case of BaU can also be applied to the case of NZE, since both scenarios assume BaU for the African market.
Medium-term (2031 – 2040)	• Refer to Table 3. Recommendations regarding domestic refining made in the case of BaU can also be applied to the case of NZE, since both scenarios assume BaU for the African market.
Long-term (2041 – 2050)	• Refer to Table 3. Recommendations regarding domestic refining made in the case of BaU can also be applied to the case of NZE, since both scenarios assume BaU for the African market.
Energy Access	
Short-term (current – 2030)	• Refer to Table 3. Recommendations made in the case of BaU can also be applied to the case of NZE.
Medium-term (2031 – 2040)	• Refer to Table 3. Recommendations made in the case of BaU can also be applied to the case of NZE.
Long-term (2041 – 2050)	• Refer to Table 3. Recommendations made in the case of BaU can also be applied to the case of NZE.

5.2.2 Natural Gas

5.2.2.1 Current Situation

Africa's natural gas reserves per region, as well as the distribution of reserves amongst the selected producing countries, are illustrated in Figure 41, with current production rates summarised in Figure 42. Countries that aren't featured in Figure 41 and Figure 42, but have been included as part of this study, are either those that do not have oil reserves or those that do have oil reserves but don't produce. Chad, Sudan and South Sudan do not have natural gas reserves, while Mauritania, Senegal, South Africa and Uganda have reserves but do not produce.

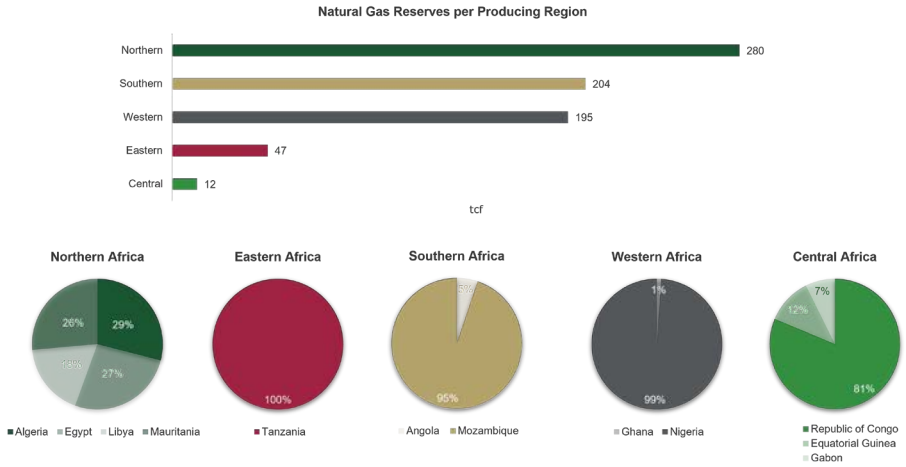


Figure 41 Regional natural gas reserves and weighted breakdown of producing countries per region

Figure 41 clearly indicates that there are certain countries that dominate regional natural gas reserves, such as Mozambique in the south, Nigeria in the north, Tanzania in the east and Republic of Congo in Central Africa. If any of these countries face a situation in which their reserves cannot be exploited, it could be problematic for the region and other countries depending on them (both domestic and international).

Furthermore, Mozambique holds 95% of Southern Africa's gas reserves, but only produces 35% of the region's natural gas, with Angola accounting for the production difference; Republic of Congo holds 81% of Central Africa's gas reserves, but only produces 8% of the region's natural gas, whereas Equatorial Guinea accounting for merely 12% of the region's reserves, currently produces 85% of Central Africa's natural gas.

The reserve-to-production ratios, presented in Figure 43, provide an estimate of the number of years that operational natural gas fields will continue to be productive based on 2020 production rates and assuming no increase in reserves beyond the 2020 numbers. Focus countries which do not have natural gas reserves (such as Chad, Sudan and South Sudan) and those that were not producing in 2020 (such as Mauritania, Uganda, South Africa and Senegal) have been omitted from Figure 43.

As shown in Figure 43, natural gas reserves, based on the number of production years estimated, are not only sufficient for long-term supply of natural gas, but are also capable of increasing production rates to meet the needs of a larger market.

5.2.2.2 Short-, Medium- and Long-Term Reserve Outlook

Based on current production rates (illustrated in Figure 42), Figure 44 illustrates the anticipated decline in natural gas reserves over the outlook period. Details per period are provided in Appendix C.

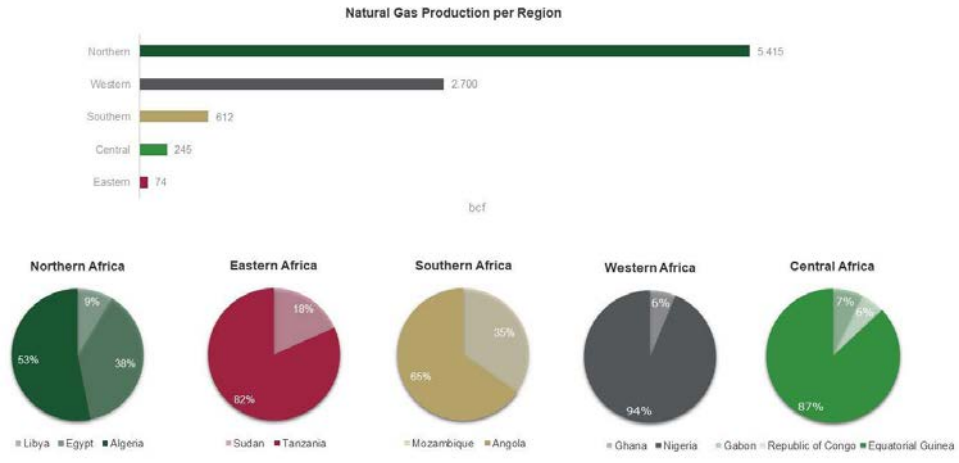


Figure 42 Regional natural gas production and weighted breakdown of producing countries per region

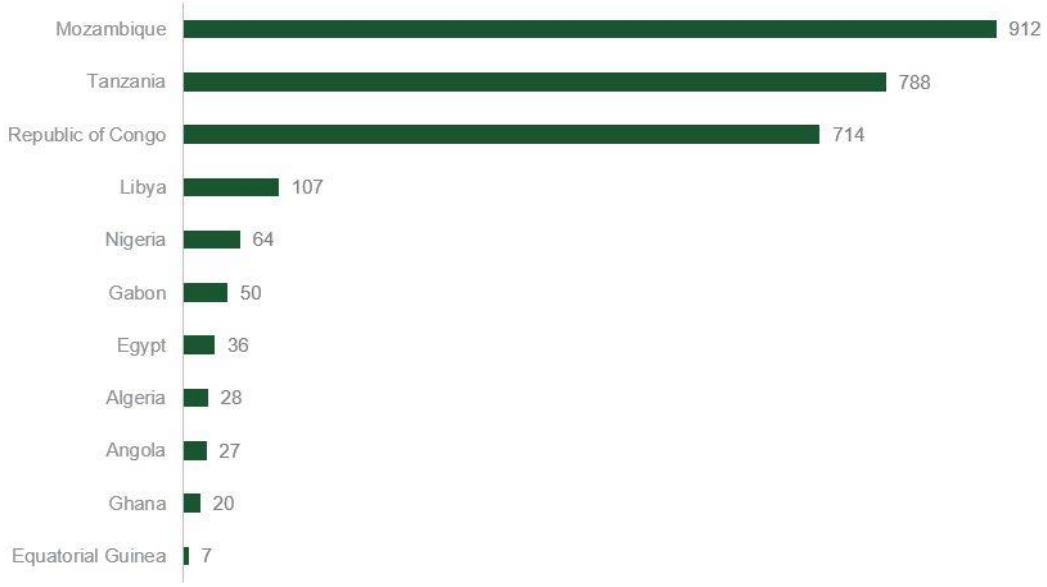


Figure 43 Reserve-to-production ratio: Natural gas (years)

Due to low production volumes, significant natural gas reserves are expected to exist on the continent for the foreseeable future provided current production rates are maintained and no new field developments are undertaken.

5.2.2.3 Development Roadmap: Scenario 1 (BaU)

Based on the preceding analyses and leveraging market understanding, a scenario to expand the African market for natural gas, under BaU conditions, was explored.

Table 5 provides short-, medium- and long-term development options for consideration to expand the African market for natural gas.

5.2.2.4 Development Roadmap: Scenario 2 (NZE)

Based on the preceding analyses and leveraging market understanding, a scenario to expand the African market for natural gas, under NZE conditions, were explored.

In accordance with the NZE pathway, Africa's global market supply opportunity is expected to grow minimally for the remainder of the outlook period, while Africa's gas demand, which is underdeveloped, is expected to grow significantly, providing greater opportunities for intracontinental trade.

Table 6 provides short-, medium- and long-term development options for consideration to expand the African market for crude oil (and petroleum products).

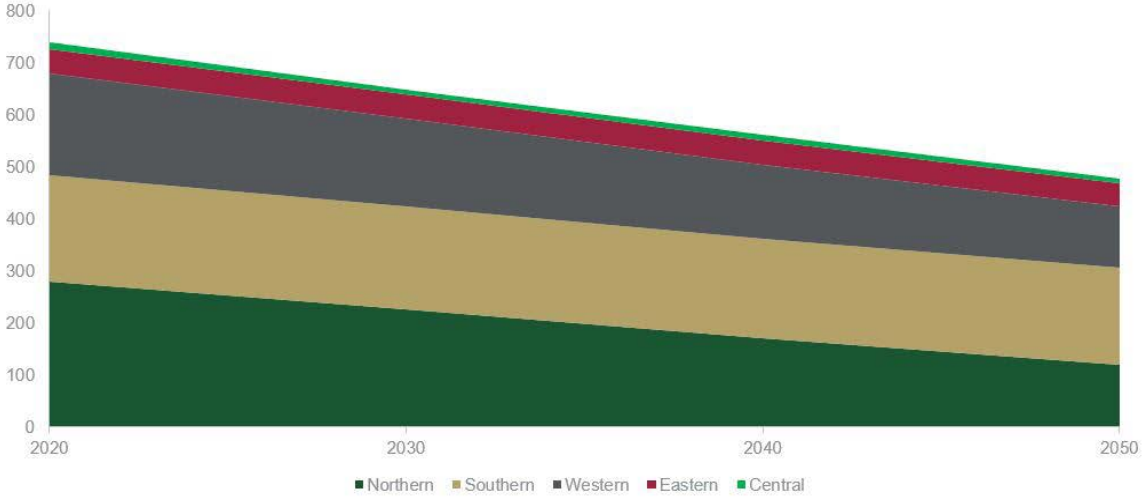


Figure 44 Regional reserve outlook: Natural gas

Table 5 Natural gas development roadmap: Scenario 1 (BaU)

Overview	
Short-term (current – 2030)	• The total natural gas supply opportunity for Africa on a continental and global level is expected to reach around 11 030 bcf in 2030, with nearly 25% earmarked for the global market.
Medium-term (2031 – 2040)	• The total natural gas supply opportunity for Africa on a continental and global level is expected to reach nearly 13 400 bcf in 2040, with just over 22% earmarked for the global market
Long-term (2041 – 2050)	• The total natural gas supply opportunity for Africa on a continental and global level is expected to reach around 17 100 bcf in 2050, with around 18% earmarked for the global market
Investment	
Short-term (current – 2030)	• Investment in various trans-regional pipeline projects, such as WAGP, ARP, ROMPCO, TSGP and Ghana-Côte d'Ivoire, should be encouraged. • Investment in new trans-continental pipeline projects, such as the GALSI pipeline, should be encouraged. • Northern Africa holds the largest available gas reserves on the continent and should be encouraged to increase production in selected countries in the region. • Gas production is expected to commence in Mauritania in the near future and the possibility of increasing production should be explored. • Most of Southern Africa's reserves are located in Mozambique. Exploration and development in other Southern African countries should be encouraged. • Mozambique is anticipated to start additional offshore gas production in the short-term, and increased production ability should be explored. • South Africa made recent discoveries of natural gas that have not yet been recognized as reserves. South Africa should be encouraged to start production and continue with further exploitation of known reserves. • In Western Africa, Nigeria possesses the majority of the region's natural gas reserves. Production in Nigeria should be promoted in order to increase regional gas production, in addition to supplementing Ghana's dwindling supply in the medium-term. • Exploration in Ghana should be encouraged in the short-term since Ghana's reserves are expected to deplete in the medium-term (based on current production rates). • Tanzania holds the majority of Eastern Africa's natural gas reserves and increased production in Tanzania should be encouraged. • Tanzania's plan for an LNG export terminal on the Indian Ocean should also be promoted. • Exploration in other Eastern African countries should be encouraged to mitigate security of supply risks.

	• Central Africa has the lowest gas reserves on the continent and exploration and gas production should be encouraged in selected countries. • According to projections, Equatorial Guinea's gas reserves will be depleted before 2030. Therefore, it should be recommended that focus shifts to exploration and development rather than increasing production. • Republic of Congo holds the majority of the natural gas reserves in Central Africa and should be encouraged to increase its gas production to supplement the dwindling supply of Equatorial Guinea.
Medium-term (2031 – 2040)	• It is encouraged that Northern, Western, Eastern and Southern Africa should continue to increase their gas production and sustain gas exports from Northern- and Western Africa to Southern-, Central-, and Eastern Africa. • Ghana's natural gas reserves are predicted to deplete in the medium-term. Ghana should be encouraged to explore and develop new gas fields, as well as to engage in intra-regional trade with Nigeria. • Algeria and Angola will likely deplete their gas reserves over the long-term. It should be encouraged to focus on exploration and development of new gas fields in these countries rather than increasing production, if no new field developments occurred in the short-term.
Long-term (2041 – 2050)	• Exploration and development of new gas fields should be encouraged in Algeria and Angola to mitigate security of supply risks.
Trade	
Short-term (current – 2030)	• Figure 41 shows that the majority of Africa's reserves are located in Northern, Southern, and Western Africa. It is desirable to promote intra- and interregional gas trade, focusing on serving Eastern and Central Africa. • Planned production increases are primarily destined for the international market. Thus, it is imperative that intra-regional trade with countries with little or no gas reserves be encouraged, to service existing and future domestic markets. • Medgaz, GME, Trans-Mediterranean, AGP, EMG and Greenstream pipelines capacity utilisation should be increased if possible, to reach a greater international piped gas market. • Tanzania’s LNG terminal might be feasible on the Indian Ocean, which could facilitate trade with other African and international markets. • Countries such as Mozambique, Egypt, Algeria and Nigeria, should be encouraged to increase gas production and prioritise export to African countries instead of global market. • Equatorial Guinea’s reserves are expected to deplete before 2030. Intra-regional trade from Nigeria or Gabon is proposed. • In the absence of new infrastructure for the supply and transport of natural gas, reductions in flaring and venting of natural gas could make at least 350 bcf of natural gas readily available over the next few years (IEA, 2022) (ACTING, 2021).

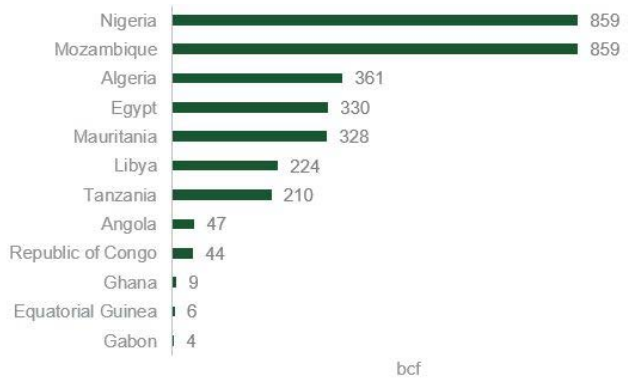
Medium-term (2031 – 2040)	• Libya, Algeria, Mauritania, Nigeria, Tanzania, Republic of Congo and Mozambique have adequate gas reserves and should be encouraged to expand gas production over the medium-term in order to increase trade volumes (international and intra-Africa). • Mauritania and Mozambique are expected to have operational LNG export facilities in the medium-term, that could potentially support increased export volumes. • Ghana's reserves are expected to deplete in the medium term. Intra-regional trade from Nigeria is encouraged.
Long-term (2041 – 2050)	• The long-term goal should be to sustain intra-Africa gas trade between Northern, Western and Southern Africa and Central and Eastern Africa. • Algeria and Angola are expected to exhaust their gas reserves in the long-term but poses LNG export facilities that could be utilised by neighbouring countries to service existing gas markets. • Mauritania, Tanzania, Libya, Mozambique and Nigeria remain best positioned to meet and sustain long-term gas demand.

Infrastructure

Short-term (current – 2030)

- Africa requires an additional 3 280 bcf in the short-term to satisfy the total demand.
- The short term's anticipated demand can be met by implementing one of the following options:[8]

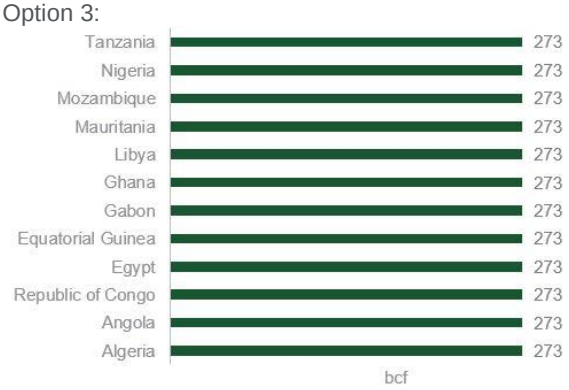
Option 1:



Option 2:

8 Option 1: Distributes the increase in natural gas production among the countries with the ability to assist, based on each country's reserve level
Option 2: Equally distributes the required increase in natural gas production between the four countries with the largest reserves
Option3: Distributes the required increase in natural gas production in an equal manner amongst all those countries that have adequate reserves

Option 3:

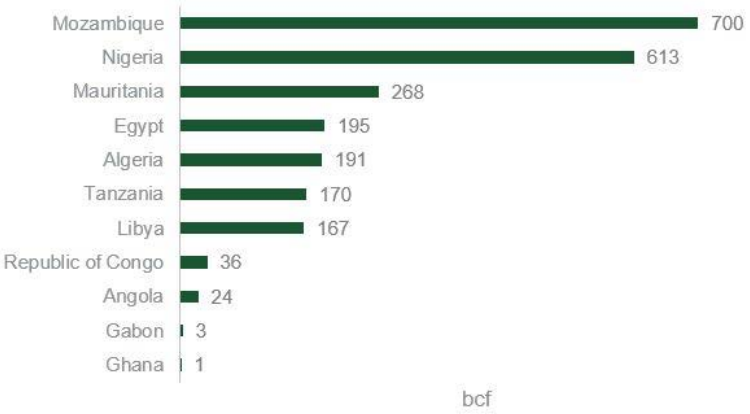


- Libya should be encouraged to build an LNG export terminal or enter into an agreement to export via Algeria's operational LNG export terminal.
- Countries with existing export infrastructure should be encouraged to increase gas production, and build new or expand existing LNG export facilities and transmission pipelines (international and domestic).

Medium-term (2031 – 2040)

- Africa requires an additional 2 370 bcf in the medium-term to satisfy the total demand.
- The medium term's anticipated demand can be met by implementing one of the following options:

Option 1:



Option 2:

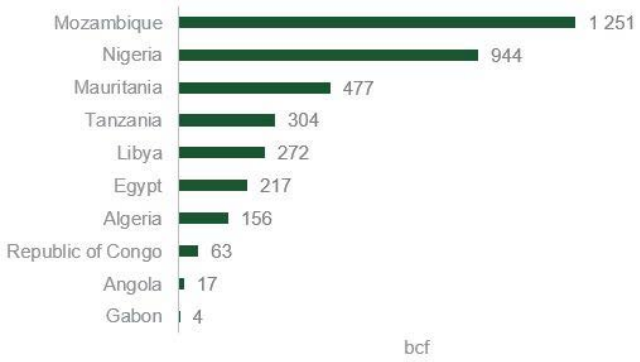
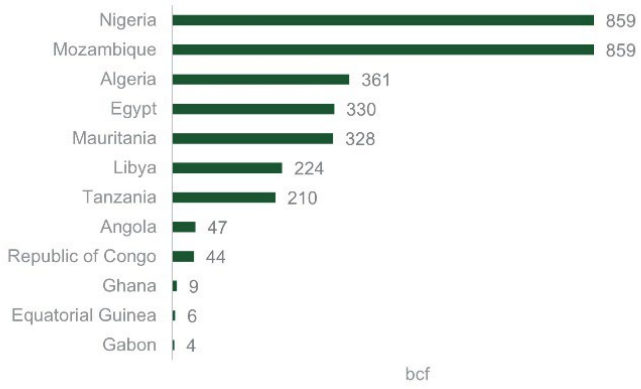
	Option 3: It is not feasible to evenly increase production amongst all 11 countries since this would deplete some reserves.
Long-term (2041 – 2050)	• Africa requires an additional 3 710 bcf in the long-term to satisfy the total demand. • The long term's anticipated demand can be met by implementing one of the following options: Option 1:  Option 2:  Option 3: It is not feasible to evenly increase production amongst all 11 countries since this would deplete some reserves.
Energy Access	
Short-term (current – 2030)	• Access to modern energy is essential for the provision of clean water, sanitation and healthcare, and for the provision of reliable and efficient lighting, heating, cooking, mechanical power, transport and telecommunication services. • Natural gas can be used as energy sources to assist certain regions and countries, with power generation, transport and cooking. • Sub-Saharan Africa should be prioritised, accounting for three-quarters of the global energy access deficit.
Medium-term (2031 – 2040)	• Sustained efforts to achieve and maintain universal energy access, prioritising Sub-Saharan Africa.
Long-term (2041 – 2050)	• Sustained efforts to achieve and maintain universal energy access, prioritising Sub-Saharan Africa.

Table 6 Natural gas development roadmap: Scenario 2 (NZE)

Overview	
Short-term (current – 2030)	• The total natural gas supply opportunity for Africa on a continental and global level is expected to reach around 10 690 bcf in 2030, with nearly 22% earmarked for the global market. • In comparison with crude oil, the impact of decarbonization on the global natural gas market is less significant
Medium-term (2031 – 2040)	• The total natural gas supply opportunity for Africa on a continental and global level is expected to reach just over 12 250 bcf in 2040, with around 15% earmarked for the global market.
Long-term (2041 – 2050)	• The total natural gas supply opportunity for Africa on a continental and global level is expected to reach approximately 14 930 bcf in 2050, with merely 6% earmarked for the global market.
Investment	
Short-term (current – 2030)	• Refer to Table 5. The investment recommendations made for the BaU case, apply to the NZE case as well.
Medium-term (2031 – 2040)	• Refer to Table 5. The investment recommendations made for the BaU case, apply to the NZE case as well.
Long-term (2041 – 2050)	• Refer to Table 5. The investment recommendations made for the BaU case, apply to the NZE case as well.
Trade	
Short-term (current – 2030)	• Refer to Table 5. Trade recommendations made for the BaU case, apply to the NZE case as well.
Medium-term (2031 – 2040)	• Refer to Table 5. Trade recommendations made for the BaU case, apply to the NZE case as well.
Long-term (2041 – 2050)	• Refer to Table 5. Trade recommendations made for the BaU case, apply to the NZE case as well.
Infrastructure	
Short-term (current – 2030)	• Africa requires an additional 2 700 bcf (BaU: 3 280 bcf) in the short-term to satisfy the total demand.

- The short term's anticipated demand can be met by implementing one of the following options:

Option 1:



Option 2:

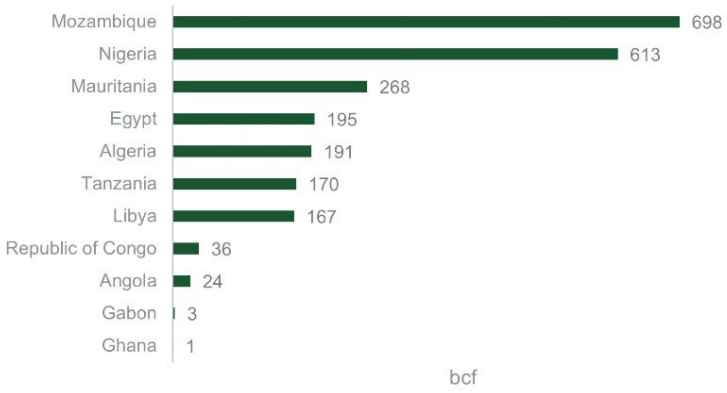
Option 3:

- Refer to Table 5. Pipeline and exporting infrastructure recommendations made for the BaU case, apply to the NZE case as well.

Medium-term (2031 – 2040)

- Africa requires an additional 1 570 bcf (BaU: 2 370 bcf) in the medium-term to satisfy the total demand.
- The medium term's anticipated demand can be met by implementing one of the following options:

Option 1:



Option 2:

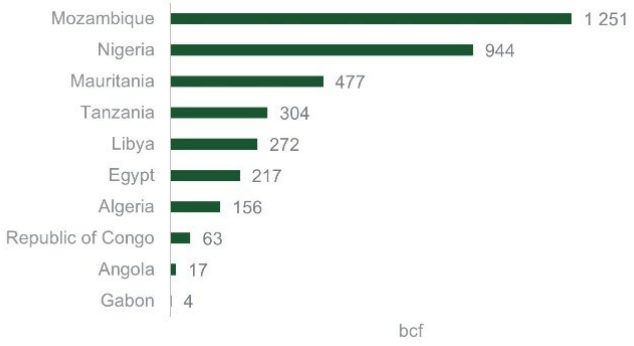
Option 3:

It is not feasible to evenly increase production amongst all 11 countries since this would deplete some reserves.

Long-term
(2041 – 2050)

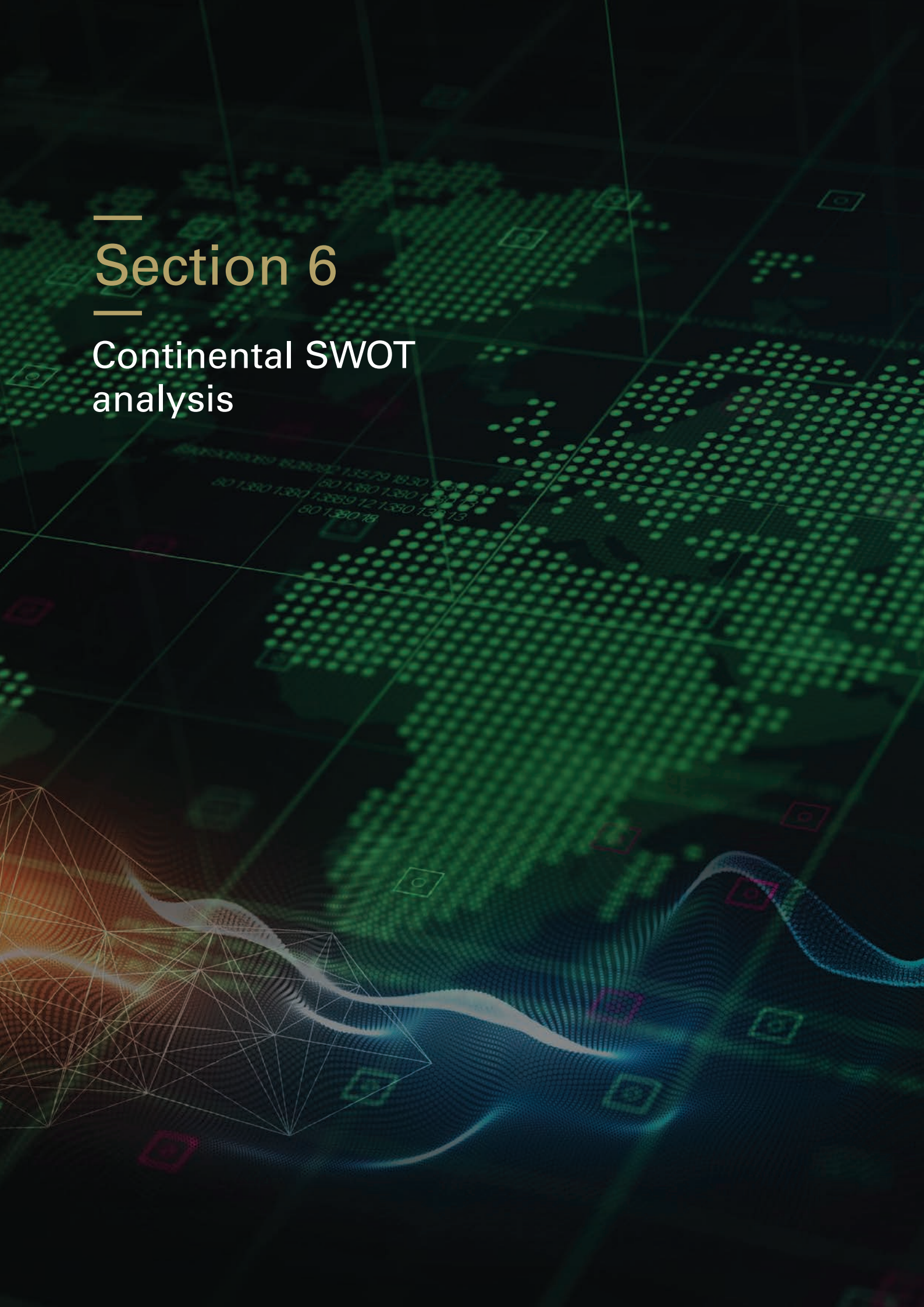
- Africa requires an additional 2 680 bcf (BaU: 3 710 bcf) in the long-term to satisfy the total demand.
- The long term's anticipated demand can be met by implementing one of the following options:

Option 1:



Option 2:

	Option 3: It is not feasible to evenly increase production amongst all 10 countries since this would deplete some reserves.
Energy Access	
Short-term (current – 2030)	• Refer to Table 5. The energy access recommendations made for the BaU case, apply to the NZE case as well.
Medium-term (2031 – 2040)	• Refer to Table 5. The energy access recommendations made for the BaU case, apply to the NZE case as well.
Long-term (2041 – 2050)	• Refer to Table 5. The energy access recommendations made for the BaU case, apply to the NZE case as well.



Section 6

Continental SWOT analysis

6. Continental SWOT Analysis

The purpose of the SWOT analysis is to:

- Identify opportunities and threats associated with oil and gas development in Africa as a result of the trends, situations, and events noted in the macro-environment
- Analyse and highlight strengths and weaknesses within the context of current and future macro-environmental conditions of the African oil and gas sector.

Presented below is a SWOT analysis for the continent, with individual SWOT and PESTLE analyses for each focus country by region, detailed in Appendix A.

6.1 Strengths

6.1.1 Trade

- Numerous existing institutional organizations, bi-lateral and multi-lateral agreements that set the stage for promoting trade.
- Large quantities of exportation for several of the African countries (including Algeria, Angola, Equatorial Guinea, Nigeria, Libya, Ghana, etc.), demonstrating export capability across the value chain.
- With sufficient natural gas reserves, existing pipeline infrastructure, and established maritime trade routes, Africa is well positioned to fill the supply gap created by the Russia-Ukraine conflict in Europe.

6.1.2 Investment

- A majority of the 55 countries on the continent have special economic zones (SEZs). As of 2019, there were 189 SEZs in operation and 57 were scheduled for completion (African Free Zones Organization, 2020). Business transactions can be facilitated through the SEZs and investments can be encouraged in the countries where these zones are located.
- Presence of International Oil Companies (TotalEnergies, Eni, BP, Shell, ExxonMobil, Chevron, etc.).

6.1.3 Infrastructure

- A considerable amount of hydrocarbon infrastructure (refineries, storage facilities, trans-national pipelines, LNG terminals, etc.) already exists in Africa, which presents a good opportunity for further development. However, in many cases, refurbishments and expansion will be necessary to facilitate further development.
- Connection to several subsea fiber systems (Hybrid African Ring Path (HARP), South Atlantic Cable System (SACS), West Africa Cable System (WACS), Eastern Africa Submarine Cable System (EASSy), Pakistan and East Africa Connecting Europe (PEACE), Africa Coast to Europe (ACE), Senegal Horn of Africa Regional Express (SHARE), etc.).

6.1.4 Energy Access

- Small number of countries in Africa providing more than 80% of their populations with access to energy are the proverbial beacons of light (Africa Business Insider, 2022): Egypt, Algeria, Morocco and Tunisia providing 100%, Gabon 91%, South Africa 85% and Ghana 84% of their population access to energy.
- Established African power pools such as the Eastern Africa Power Pool (EAPP) and the West Africa Power Pool (WAPP) demonstrate collaborative effort to interconnect electricity grids and take advantage of excess capacity within the network in order to facilitate trade of electric power between the members.

6.2 Weaknesses

6.2.1 Trade

- High vulnerability of Africa countries to global trade developments as many countries are net importers of petroleum products, food and other commodities such as nitrogen fertilizers.
- Multiple currencies and foreign exchange regulations.
- Weak intra-continental petroleum supply owing to small and underutilization of refining capacity.
- Fragmented small gas demand nodes (underdeveloped) across the different countries in Africa with a negative impact on the cost per unit.
- Underdeveloped road and rail infrastructure contributing to high cost per unit and presenting as physical barriers to intra-Africa trade.
- High level of corruption in several African countries (Transparency International, 2021).
- Lack of harmonization in regulations and standards between African countries.
- Internal conflicts between African countries inhibiting cross-border trade.

6.2.1.1 Investment

- High levels of corruption in many of the focus countries as conveyed through the positions on the corruption index scale.
- Lack of pro-active promotion of investment opportunities.
- Lack of incentives and attractive regulatory frameworks to encourage investment in many African countries.
- Poorly developed local financial markets and institutions with limited capacity able to provide capital and support investments.
- Shortage of highly skilled and experienced workforce in many African countries.

6.2.2 Infrastructure

- Fragmented road and rail infrastructure contributing to expensive transport of oil and gas products.
- Vast distances between demand and supply nodes within Africa (e.g. greater oil deficit in Central and West Africa with a surplus in the North and East).
- Lack of skilled resources to efficiently maintain and operate infrastructure / mismanagement of infrastructure.
- Lack of basic utilities such as power, water and ICT infrastructure.
- Lack of public-private partnership agreements in critical infrastructure (refinery, pipelines, etc.), leading to inefficient and ineffective operation and management of key infrastructure.

6.2.3 Energy Access

- Energy Access is a continental challenge, from the recent African Energy Outlook compiled by the IEA, positive trend towards energy access has been reversed in the period between 2019 and 2021 with now less people having access to energy than in 2019.
- Rural to urban area ratios indicate the pre-dominance of rural areas in the population footprint of African countries and the vast distances between rural and urban areas create barriers to energy access.
- Insufficient and outdated grid infrastructure (limited network distribution).

6.3 Opportunities

6.3.1 Trade

- The energy deficit in Sub-Saharan Africa (LPG, paraffin, diesel, heavy fuel oil, gasoline, natural gas) presents an opportunity for intra-continental trade, particularly from North Africa.
- Sustainable development agreement allows for trade to provide gas (clean access to energy) (SDG7).
- As a result of a strong population and economic growth in Africa, hydrocarbon demand is on the rise.
- Utilisation of SEZs to promote investments and facilitate business transactions.
- The European oil and gas market is under stress and looking to diversify supply of oil and gas.

6.3.2 Investment

- A number of new investment opportunities have arisen in Africa as a result of continuous exploration efforts (e.g. Namibia).
- A growing population and economic growth in Africa contribute to the attractiveness of the market for foreign investors.
- SEZs to promote investments and facilitate business transactions are already established in many African countries.

6.3.3 Infrastructure

- Utilization of existing infrastructure (refineries, LNG plants, pipelines, storage facilities, etc.) that is currently underutilized.
- There is additional potential for countries in all regions, specifically Algeria, Egypt, Libya, Sudan, South Sudan, Angola, South Africa, Nigeria, Senegal, Republic of Congo, and Gabon.

6.3.4 Energy Access

- Education in terms of energy alternatives / access (e.g. clean cooking).
- Increasing exploration in oil and gas provide an opportunity for Africa to obtain access to local feedstock to produce energy.
- Gas-to-power, utilizing African gas and combining with CCUS technology.
- Petrol and diesel generators providing off-grid connections in the rural areas.
- Electricity trading via Power Pools.

6.4 Threats

6.4.1 Trade

- Decline in the global demand for oil and petroleum products, and therefore trade of petroleum products owing to commitments made by many countries around the world regarding the goal of reaching net-zero emissions by 2050.
- Import of petroleum products and export of crude oil therefore under threat, Africa needs to act with own production and self-efficiency to hedge against future shortage (global market is breaking away).
- Any conflict is a threat for trade.
- Trade impediment by Lobbyist groups.

6.4.2 Investment

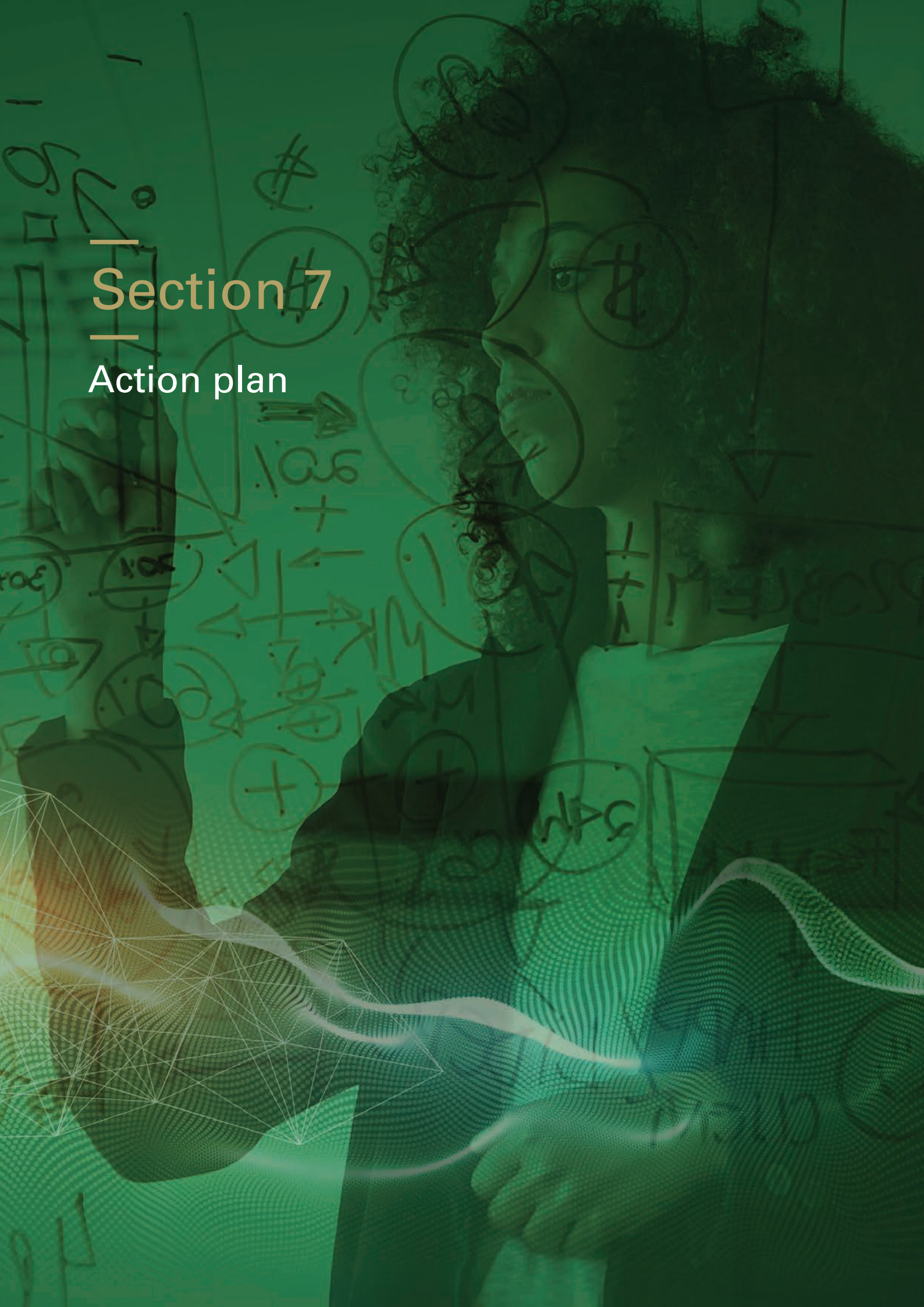
- Ongoing political unrest and terrorist activities as well as protest in many of the focus countries.
- Environmental lobbyists preventing investments in hydrocarbons (e.g. Shell exploration in South Africa).
- Lack of contractual and fiscal stability (e.g. Namibian government renegotiation of contractual and fiscal terms after exploration success, driven by government's attempts to capture more of the benefit of oil/gas developments).
- Banks and financial institutions retracking on investing in hydrocarbons despite the recent EU decision to include gas as part of green energy.
- Multi-national public oil companies now more focused on returns to shareholders (dividends and share buy-backs) than re-investment into new exploration and field developments.
- Large public oil companies pressured by shareholders and finance providers to pursue renewable energy strategies rather than invest in new oil and gas projects.

6.4.3 Infrastructure

- Damage to infrastructure and terrorist actions pose a constant threat to infrastructure.
- Several markets in Africa lack economies of scale because of their fragmentation.

6.4.4 Energy Access

- Strong dependency on imported products makes Africa very vulnerable towards any disruption in the supply chain (including import tariffs and foreign exchange fluctuations).
- Sabotage and theft damaging the grid infrastructure.
- Cost of electricity (difficult to make energy access sustainable).



Section 7

Action plan

7. Action Plan

As a first step towards a strategic plan, an action plan for the expansion of national and sub- regional oil and gas markets in Africa is proposed, offering stakeholder actions and milestone dates to achieve the desired future state, which includes maximizing local value addition of the entire oil and gas value chain, building the continent's refining capacity and ensuring security of supply of oil and natural gas.

To ensure a successful (and cost-effective) energy transition, it is essential that natural gas infrastructure codes and standards allow for future integration of clean energy options, such as hydrogen.

7.1 Stakeholder Actions

Many stakeholders are invested both commercially and emotionally in the oil and gas sector. To assign actions, key stakeholders have been identified and group as follows:

1. Public sector
2. Private sector
3. Civil society and communities
4. International and regional institutions.

Each key stakeholder is provided with a summary of broad actions that may be considered for each of the four pillars, in Table 7.

7.2 Milestones

To help ensure that collective efforts are designed and implemented consistent with the desired final state of the African oil and gas sector, milestones, to serve as a practical guide, is summarised in Table 8.

7.3 Studies Needed

In this study, a concise, clear summary of current oil and gas resources and market conditions is provided, along with emphasis on the opportunities that can be tapped, in order to serve as a guide for strategic, political, and institutional decisions that will assist in planning, maximizing and coordinating investments in the African oil and gas industry.

Developing the African oil and gas market will require further studies, which can be undertaken by any of the stakeholders identified in this report, although the initiative may be best suited to International and Regional Institutions working in collaboration with the Public and Private Sectors.

The following is a non-exhaustive list of potential studies to be undertaken in the short-term. The first step should be to undertake regional studies, followed by a continental overview.

7.3.1 Studies Pertaining to Investment

It is important to quantify the amount of investment that will be required for the oil and gas industry over the time period considered. Furthermore, it is recommended that research is conducted in order to collate information related to regional banks and investors, and that an action plan be developed in order to facilitate the formation of partnerships between various parties (banks and investors) in order to finance African oil and gas projects.

Conceptual studies should be conducted on the potential for decarbonizing African oil and gas production/activities.

In order to minimize unintended consequences from policy initiatives, regulations and legislation, including unnecessary costs associated with implementation and unanticipated outcomes, it would be worthwhile to conduct socio-economic impact assessments based on the roadmap presented in this study.

7.3.2 Studies Pertaining to Infrastructure

To gain a comprehensive understanding of the petroleum production industry, and new refining requirements, it would be beneficial to conduct regional assessments of Africa's refining systems (capacity, asset useful life, feedstock requirement, and petroleum production output).

The African oil and gas human resource pool needs to be identified and developed by conducting regional resource assessments, encompassing both available skills and training institutions.

The energy outlook scenarios presented in this study provide a continental perspective. To concentrate future investments, it is necessary to analyse regional demand nodes and determine strategic locations for required infrastructure (including storage and logistic services (road, rail, maritime and pipeline)). Based on the analysis, national and regional master plans for oil and gas infrastructure should be developed, and provisions should be made for their timely revision.

Table 7 Key stakeholder actions

	Investment	Trade	Infrastructure	Energy Access (incl. Energy Security)
Public Sector	• Development of a regional financial framework to coordinate fund raising. • Development of a framework for joint procurement of feedstock, products or infrastructure on a regional level to benefit from economies of scale. • Development of regional energy integration roadmaps. • Development of de-risking instruments to attract private investors. • Development of attractive regulations and fiscal terms. • Work closely with the private sector to establish energy bank/s focused on funding African energy projects and in particular oil and gas projects. • Promotion of upstream and downstream investment opportunities.	• Development and harmonisation of continental oil, gas and associated product specifications (including emission standards). • Development of a regional oil and gas pricing policies for cross-border trading, including currency of trade and tariffs, to achieve cost-reflective but competitive prices.	• Development of cross-border infrastructure agreements (general terms and conditions; including third-party access) and construction standards. • Develop pragmatic (not onerous) regulations to promote local procurement of goods, services & labour. • Development of PPP framework to attract investment and participation from the private sector in bulk infrastructure.	• Development of a portfolio of least-cost energy options to fulfil lighting, power, heating and cooking needs. • Development of subsidy programmes to increase energy access to the poor. • To cushion the impact of the Covid-19 pandemic, the effect of the Russian-Ukraine conflict on global supply chains, extension of current exploration licences to support oil and gas operators • Establishment of strategic reserves / stockpiles for petroleum and natural gas.
Private Sector	• Development of a portfolio of least-cost energy options to fulfil lighting, power, heating and cooking needs.	• Prioritisation of intra-Africa trade, based on recognition of growing domestic market	• Formation of private-public partnerships (PPP).	• Creation of a local market to provide access to affordable appliances to enable energy access

	Investment	Trade	Infrastructure	Energy Access (incl. Energy Security)
	• Development of subsidy programmes to increase energy access to the poor. • To cushion the impact of the Covid-19 pandemic, the effect of the Russian-Ukraine conflict on global supply chains, extension of current exploration licences to support oil and gas operators • Establishment of strategic reserves / stockpiles for petroleum and natural gas.			
Civil Society & Communities	• Constructive engagements (via NGO's and community forums) with public and private investors to ensure fair benefits to communities from investment.	• Spearhead public awareness promotional campaigns, advocating gas and refined product applications for new market development.	• Leverage infrastructure developments to benefit communities. • Participate in provision of goods, services and labour	• Spearhead public awareness promotional and educational campaigns to safely utilise affordable energy access alternatives.
International and Regional Institutions	• Promotion of public and private investor opportunities through pro-active information sharing and advertisement of upcoming projects. • Provision of investment support (e.g. low interest loans) from e.g. World Bank and IMF. • Co-investment e.g. IFC.	• Development of a regional data base for data (production, consumption, supply, demand, prospects) coordination. • Assignment and mandate of an overarching institution to collect, process and store continental data. • Development of transport corridors to create a regional network of trade	• Development of regional infrastructure database (transmission, distribution, storage, refining, processing, export/import terminal capacity), to improve capacity utilisation. • Assignment and mandate of an overarching institution to collect,	• Coordination of the development of energy services to integrate with productive uses in order to create the income base necessary to pay for the investment in energy.

	Investment	Trade	Infrastructure	Energy Access (incl. Energy Security)
	• Provision of investment protection e.g. MIGA. • Establishment of an African energy investment bank as for example the African Export-Import Bank (Afreximbank) to pool and enable investments in the African hydrocarbon sector. • Quantification of investments required in the oil and gas sector.	routes (traditional and virtual) serving as a gateway to markets. • Participation and support towards the AfCFTA to harmonise trade within Africa. • Regional collaboration and harmonization of industry standards and codes.	process and store continental data. • Coordination of cross-border infrastructure (pipelines, storage facilities, export/import facilities) to ensure least-cost developments. • Development of institutional and individual skills, as well as resources, to ensure successful project implementation and operations using local labour.	

Table 8 Key milestones per outlook period

	Short-term (2022 – 2030)	Medium-term (2031 – 2040)	Long-term (2041 – 2050)
Investment	• At least one promotional campaign to pro-actively advertise upcoming investments from the following countries: For Oil Exploration projects: Mauritania, Senegal, South Africa, Mozambique, Egypt, Ghana, Equatorial Guinea, Angola Oil Production increase projects: Mauritania, Senegal, Uganda Gas Exploration projects: All countries in southern and eastern Africa, Ghana (urgent) Gas production: Mozambique, Nigeria, Tanzania. • Revised regulations and fiscal terms for producing countries and draft regulations for non-producing (intended producers). • Energy integration roadmaps in place for all regions, followed by individual countries. • Establishment of one additional energy investment bank.	• At least one promotional campaign to pro-actively advertise upcoming investments from the following countries: For Oil Exploration projects: Gabon, Republic of Congo, Algeria, all countries in southern Africa (urgent) Oil Production increase projects: Libya Gas Exploration projects: Algeria, Angola Gas production: continental Africa - all countries. • Revised regulations and fiscal terms for producing countries and draft regulations for non-producing (intended producers). • Revision of energy integration roadmaps to align with continental and global trends and developments. • Establishment of one additional energy investment bank.	• At least one promotional campaign to pro-actively advertise upcoming investments from the following countries: For Oil Exploration projects: Central and Northern Africa • Revised regulations and fiscal terms for producing countries and draft regulations for non-producing (intended producers). • Revision of energy integration roadmaps to align with continental and global trends and developments.
Trade	• Regional agreement signed between countries for continuous continental data sharing. • A new overarching African Energy Institution (in alignment with the role and responsibility of the EIA) established or	• Access to database (trade, consumption, etc.). • Review of product specifications and industry standards and codes.	• Review of product specifications and industry standards and codes.

	Short-term (2022 – 2030)	Medium-term (2031 – 2040)	Long-term (2041 – 2050)
	strengthening of mandate of existing institution as for example the African Energy Chamber. • Continental product specifications (standards) and industry standards and codes established. • Continental gas pricing policies established. • Defined potential regional transport corridors by regional institutions. • AfCFTA ratified by all 55 countries.		
Infrastructure	• Operationalize a regional infrastructure database. • Secured investment funding of at least one small-to-medium scale oil and gas infrastructure project - refer to roadmap. • Operationalize new refining capacity - refer to roadmap. • Enactment of regulations to promote local procurement of good, services and labour on country level. • Established PPP framework (individual country level). • Establishment of one *Centre of Excellence* with regards to oil and gas technology to harness skills and know-how (e.g. LNG Centre of Excellence).	• All countries have adopted minimum infrastructure construction standards and sector related programmes. • Secured investment funding of at least one small-to-medium scale oil and gas infrastructure project - refer to roadmap. • Establishment of one *Centre of Excellence* with regards to oil and gas technology to harness skills and know-how (e.g. LNG Centre of Excellence).	• Secured investment funding of at least one small-to-medium scale oil and gas infrastructure project - refer to roadmap.

	Short-term (2022 – 2030)	Medium-term (2031 – 2040)	Long-term (2041 – 2050)
Energy Access (incl. Energy Security)	• Regional energy access improvement roadmap. • At least one subsidy programme launched per country with low energy access. • At least one public awareness promotional and educational campaign launched per country. • Agreements to extend exploration licences from relevant countries. • Established strategic stockpiles and reserves for both oil and gas for all individual countries.	• Between 30% and 50% energy access improvement, based on 2019 baseline data per country. • Affordable appliance supply available on regional level.	• Between 50% and 100% energy access improvement, based on 2019 baseline data.

7.4 Attracting Investment

Africa has enormous undeveloped capacity in its resources, specifically oil and gas. The development needs related to this are significantly greater than many of the individual governments' capacity – financial, institutional, organizational and otherwise – to realise. This is particularly true in the upstream part of the oil and gas value chain, where investments are large, front-loaded and exposed to significant investment risk, in fact, it is not advisable, even for developed countries, to commit public funds solely to these projects. There is therefore a need to (a) attract investment from private international investment in the development of Africa's potential, and (b) manage this process carefully to reward not only the private investors, but also benefit domestic needs and priorities. This requires policies that make private international investment attractive while striking a fair balance between private returns and social returns.

Unfortunately, Africa has historically not been able to manage this well, leading to a perception that its resource wealth is exploited to the benefit of foreign investors while its local population and regions remain poor and underdeveloped. In reality, foreign private investment in African infrastructure projects has been low and declining over the last number of years, with public entities and state owned enterprises executing 95% of projects (Eyraud, Pattillo, & Selassie, 2021). Figure 45 shows the downward trend observed for Sub-Saharan Africa. Sub-Saharan Africa has seen a decline in private sector investment in infrastructure projects from over USD 8 billion in 2012 to around USD 5 billion in 2021 (The World Bank, 2022).

To turn this around and achieve success, the following issues bear consideration:

- Attractive investment environment and landscape for private foreign investment. This can be achieved by having:
  - Stable, transparent and competitive fiscal, statutory and regulatory policies
  - Open and transparent foreign exchange regulations, allowing investment without burdensome duties, tariffs and other similar restrictions, and allowing the free repatriation of profits
  - Protection and guarantees against nationalization and expropriation of foreign investment (ownership). This also includes security of tenure and protection of intellectual property rights.
- Safety and physical security for investor facilities and personnel.
- Development of public institutional capacity to:
  - Enable Public-Private participation in projects
  - Avoid unnecessary and burdensome public interference
  - Prevent any form of corruption.
- Development of capable financial institutions and associated infrastructure, to allow easy and safe private investment and participation, and access to credit facilities.
- Creation of capable and effective investment promotion agencies to promote investment opportunities, assist private investors and to provide effective co-ordination between government departments internally and with investors.
- Establishment and maintenance of effective and reliable infrastructure such as transport, provision of energy, provision of modern information technology, etc. This also includes the development of a diverse and educated labour force.
- Co-operation with multi-lateral institutions and development agencies such as the World Bank, African Development Bank, Multi-lateral Investment Guarantee Agency and others. These institutions and agencies provide access to foreign private finance and provide security and risk mitigation to potential private investors.
- Establishment of special Economic Development Zones (EDZ) to facilitate ease of duty-free import/export and tax-attractive investments.
- Inter-regional co-operation and participation in regional development promotions.

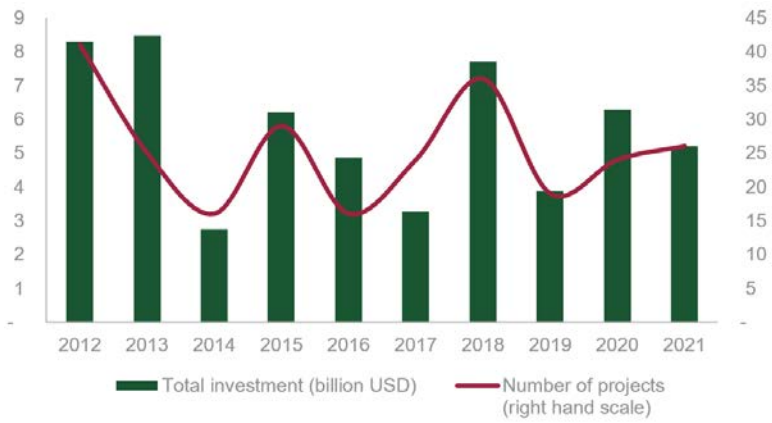


Figure 45 Private sector participation in Sub-Saharan Africa's infrastructure projects

- Establishment of technical stan-dards in harmony with international standards.

The items listed above are not exhaustive, and may not all apply to every country. Host governments should also make use of the vast body of international expertise available from the likes of the World Bank, IMF and others to guide and assist them in pursuing and managing international foreign investment.

According to a recent study by the OECD, only 8% of the total assets of the 36 pension funds in the survey sample were allocated to developing countries during 2017-18 (OECD, 2021). The total investment in Africa accounted for only 0,64% of the total. In addition, the study found that local corruption levels and political instability influenced investment decisions. Consequently, African projects face both a large opportunity and a significant challenge in order to attract institutional investment. As an additional challenge for oil and gas projects, many institutions have investment mandates that exclude or severely limit exposure to fossil fuels as well as an increased focus on governance risks (the "G" in "ESG" criteria).

The Global Impact Investing Network indicates that the time required to launch a fund and attract investors is approximately 24 months, as depicted in Figure 46 (Global Impact Investing Network, 2022).

It should be noted, however, that the time required to launch a fund differs from the time required to attract institutional investment directly in a project. The latter can vary greatly, depending on the complexity of the project, technical and economic risks associated with the project, political risks associated with the jurisdiction of the project, credibility of the sponsors, suppliers and off-takers of the project, alignment of the project with the investment mandate of the institutions, etc.

It may be beneficial for institutions to participate in infrastructure funds initiated and managed by development banks as a means of limiting exposure to project risks. For instance, Afreximbank has four types of investors, with four different types of shares: A shares are held by African governments or institutions; B shares are held by African institutions and African private investors; C shares are held by non-African institutions and economic organizations, as well as non-African private investors; and D shares are listed on the Mauritius Stock Exchange. The African Petroleum Producers Organization (APPO) and Afreximbank recently signed a memorandum of understanding establishing an African Energy Transition Bank that is of particular interest in this regard (Afreximbank, 2022).

7.5 Emissions Mitigation Measures

Africa's contribution to global carbon emissions is less than 4%. Nevertheless, by decarbonizing oil and gas production, African countries can reduce their emissions and extend their license to operate as part of the global decarbonization initiative. There are currently a number of technologies available to decarbonize the extraction and production of hydrocarbons, and many of these technologies are economically viable.

Optimizing operations by minimizing heat and power demands and optimizing feedstocks would be an initial step towards achieving greater energy efficiency. Additionally, sustainable design measures such as monetizing associated gas from flaring, minimizing fugitive emissions, and deploying zero-carbon energy sources such as solar power for electricity at the well pad have become increasingly available and are providing economic benefits (McKinsey & Company, 2022).

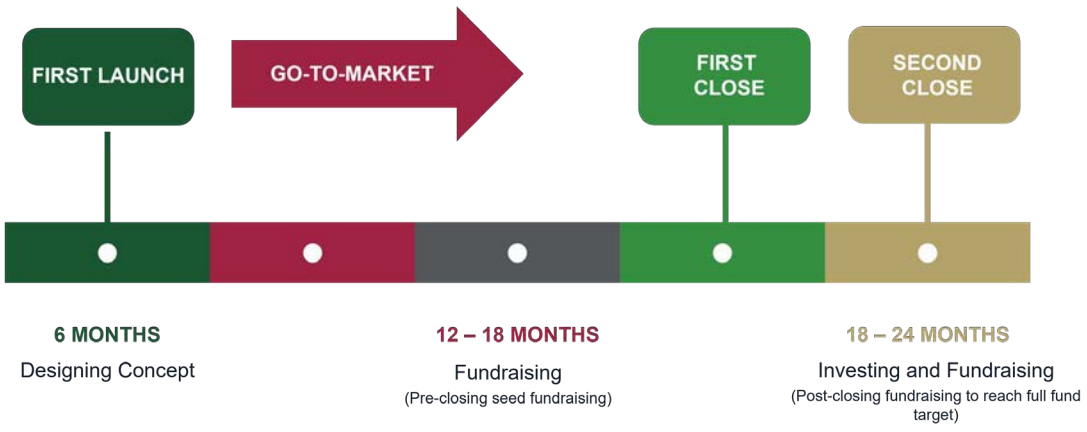


Figure 46 Fundraising and marketing timeline

A further downstream step would be to capture CO2 released from large point sources such as oil refineries and use it for other applications or permanently store it in deep geological formations (such as depleted oil and gas reservoirs or saline aquifers), with Africa's capacity for CO2 storage estimated to be around 445 gigatonnes in these formations (SNAM, IGU, & Rystad Energy, 2022).

Apart from initiatives that seek to directly decarbonize operations, oil and gas sector players may consider, as a last resort, offsetting their emissions or generating carbon credits through the implementation of nature-based solutions that preserve and improve natural ecosystems that are responsible for sequestering atmospheric carbon (McKinsey & Company, 2022). Forest conservation, reforestation, and improved land practices are examples of such initiatives.

7.6 Security of Trans-border Infrastructure

Oil and gas projects are exposed to a variety of technical, economic, environmental, social and governance risks. Trans-border projects, such as oil and gas pipelines are exposed to an additional set of risks associated with the host governments, communities, jurisdictions, and contractual relationships on both sides of the border. The risks can manifest in the form of disruption to flow of product, loss of product (leaks, theft), loss of facilities (pipeline), or damage to the environment and/or local communities.

In addition, a cross border pipeline can give rise to conflicts leading to any of the risks just mentioned. Such conflicts may stem from (a) the involvement of several parties in more than one jurisdiction with differing interests and desires (b) the (actual or perceived) inequitable sharing of rent, or (c) unclear or inadequate contractual arrangements dealing with more than one legal and fiscal regime.

To avoid cross-border specific risks, it is important that the contractual frameworks governing the pipeline and relationships between the project parties and governments, are clear and fair, and contain adequate flexibility and provisions to deal with changing circumstances and disputes that may arise over the life of the investment. This framework should be based on commercial principles creating an equitable balance of interests. There should also be effective and credible mechanisms to deter and deal with transgressions. The detail will depend on the specifics of any particular case and goes beyond the scope of this report.

7.7 Risks Associated with Subsidy Programmes

Around the world, subsidies are frequently used to support certain sectors of the economy or certain economic activities. A recent example is the "Inflation Reduction Act" in the United States, which addresses a number of issues beyond inflation, including the extension of subsidies to clean energy projects and investments. Subsidies are often aimed at noble and understandable objectives – universal access to essential services, lower consumer prices, increased supply, protection of an industry from foreign competition – and they can be successful in the short term, however the unintended consequences of these subsidies are often overlooked or unaddressed.

An indirect consequence of a subsidy, other than supporting the industry/activity being subsidised, is to distort normal economic activity, behaviour, and resource allocation decisions, often negatively. Programs designed to provide subsidies are not sustainable over the long term, and some of their negative consequences include:

- The development of uneconomic production projects may lead to excessive consumption (due to cheap prices) and shortages in the long run
- Tax increases to fund subsidies
- The creation of inefficient industries that are not self-sustaining
- A difficulty in determining the success and returns of investments, resulting in a distortion of capital allocation and investment decisions
- Subsidies can sometimes lead to corrupt practices and behaviour
- In extreme cases, may lead to a culture of dependency.

The use of a subsidy to achieve a particular goal may be justified in the short term despite the negatives mentioned above, provided the purpose and objectives of the subsidy are clear, the implications are understood, and a strategy for exiting the subsidy has been agreed upon once the objectives have been achieved.

A direct payment to consumers (either in cash or in coupons) is a common alternative to a subsidy, but still has some of the same negative consequences.

(a) Establishing a level playing field with appropriate support (energy, access to finance, communications, and other infrastructure) is probably the best alternative; and (b) encouraging and supporting the development of capacity building programmes to enable local businesses and employees to compete on an equal basis.

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Appendices

Please download a digital copy of this report and associated appendices by scanning the QR code below.

- Appendix A: Situational Analysis (Country Level)
- Appendix B: Crude Oil and Natural Gas Flow Infographic (Country Level)
- Appendix C: Reserve Outlook

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