VALUE CHAIN ANALYSIS FOR THE OIL SECTOR:

Potential contributions to African economies

2021

AFRICAN DEVELOPMENT BANK GROUP

African Natural Resources Centre

Important note to the reader.

This study delayed to be published electronically. The contents are based on data collected from case study countries, interviews of experts on the ground and desktop reviews during 2018/2019. Validation of the study findings was undertaken at a stakeholders workshop in the same period. Since then, some information has been partly updated during later review processes leading to the completion of the report in April 2020. The new developments in the oil industry both at country levels and globally, including those related to COVID-19 Pandemic, are not discussed to keep up with the original scope and intent of the study.

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Foreword

African countries are endowed with abundant natural resources both of renewable and non-renewable nature. Oil and gas commercial resources can be turned into a blessing and contribute to accelerating the continent's economic transformation. Adequate strategies to add value to petroleum resources can potentially drive industrialisation, job creation, regional integration and increased energy access for many oil-rich countries. However, this needs a paradigm shift away from traditional economic models based on exports of raw materials with little or no local value addition. Full exploitation of the product value chains yields more margins than from proceeds from exporting oil.

The African Natural Resources Centre (ANRC) of the African Development Bank has commissioned a series of different natural resources value chain studies for various commodities. The Natural gas value chain analysis report, already published, will be supplemented by this Oil value chain study report to give a complete picture of the Petroleum sector value chain analysis. Other value chain studies that are being finalised by ANRC include; Lithium, Cobalt, Rare Earth elements, diamonds, iron ore, gold, timber and tilapia. The centre's objective is to examine and produce knowledge to inform African countries' policies and practices with regard to value addition to their natural resources at different from upstream to downstream..

This Oil value chain report analyses the upstream, midstream and downstream value chains using selected case study countries. Data from these countries was generously provided by the governments through the African Development Bank country offices. In undertaking the analysis, ANRC sought the services of Dr Erik Jarlsby, to put together the report. It was validated by representatives of selected African countries and peer reviewed by both internal Bank staff and external stakeholders.

It is my hope that this report will reach out to many decision makers and highlight ways in which Africa can maximise benefits from its oil resources by analysing the different opportunities in the different value chains. It will be critical to analyse both challenges and opportunities depending on the individual country circumstances and where possible, consider regional or continental solutions.

Dr. Emmanuel Moreira Pinto
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List of Acronyms and Abbreviations

AfDB:	African Development Bank
ANRC:	African Natural Resources Centre
ARA:	African Refiners and Distributors Association
Bbl.:	Barrel of oil
Bod:	Barrel of oil per day
E&P:	Exploration and Production
FEED:	Front-end Engineering Design
FDP:	Field Development Plan
FID:	Final Investment Decision
GDP:	Gross Domestic Product
IAIA:	International Association of Impact Assessment
IEA:	International Energy Agency
ISO:	International Standards Organisation
LNG:	Liquefied Natural Gas
LPG:	Liquefied Petroleum Gas
MARPOL:	Abbreviation of Marine Pollution
NCDMB:	National Content Development and monitoring Board
NGLs:	Natural Gas Liquids
NOC:	National Oil Company
OECD:	Organisation for Economic Co-operation and Development
OPEC:	Organisation of Petroleum Exporting Countries
PSA:	Production Sharing Agreement
SEA:	Strategic Impact Assessment
VLCC:	Very Large Crude Carrier
WTO:	World Trade Organisation

**MARPOL: Abbreviation of Marine Pollution is the International Convention for the Prevention of Pollution from Ships*

Acknowledgements

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The Bank is grateful to the authorities responsible for the petroleum sector in Algeria, Cote d'Ivoire, Ghana, Nigeria, Senegal, Sudan, Uganda, Common Market of Eastern and Southern Africa Secretariat and all the experts whose provision of data and inputs were instrumental in preparing the report. The African Refiners and Distributors Association (ARDA) provided relevant and up-to-date data on Africa's mid and downstream sectors in addition to valuable comments on the various drafts of the report. The Bank is grateful to Dr Jarlsby for data collection, analysis and preparation of this report which was internally and externally peer reviewed before Ms Fionnuala Tennyson made extensive contributions in editing of the report.

The internal Bank staff that contributed and supported the study included those from the Regional Development front office, Economic Research Department, Infrastructure and industrialisation Department, Countries offices in Algeria, Sudan and Angola. These were in addition to the ANRC coordination team consisting of Fred Kabanda, Manager of the Extractives Division, Rose Mwebaza, former Chief Natural Resources Officer, Charles Nyirahuku, Chief Gas Officer and Arron Singhe Tchouka, Chief Oil Officer.

In completing the report, the ANRC held a validation workshop on the 28th and -29th June 2018 in Abidjan. Contributing participants included industry experts, policy makers from ministries responsible for petroleum, petroleum regulators, civil society organizations, regional institutions and representatives from national oil companies from across the continent.

The Bank is grateful for all the support given by all the people mention above and those not mentioned who contributed towards finalizing the study.

Executive Summary

Africa is endowed with significant oil resources which represents strong assets for the continent socio-economic development, that could help achieve AfDB High 5s objectives, namely Power and Light-up Africa, Feeding Africa, Industrialise Africa, Integrate Africa and Improve the quality of life for the people of Africa.

However, the oil industry is structurally complex and involves an intricate number of actors whose goals and interest are often diverging. This presents a significant challenge for policy making, as they need to weigh a wide range of factors, as they look to maximise value from their resources.

Creating value from oil production starts from the process of extracting crude oil from underground deposits and transforming it safely into the refined fuels that consumers need. It also includes the commercial production of oil-based products critical to many modern technologies, such as bitumen and polymers.

If managed well, the oil sector can produce five potential economic benefits for Africa:

(1) Revenues from oil licensing, exploration and production of petroleum, based on the premise that petroleum resources in the ground belong to the nation in which they are located;

(2) Supply of refined products;

(3) Income from the supply of goods and services to oil value chains.

(4) Value addition through oil refining and petrochemical production

(5) State participation in petroleum exploration and production operations

Revenues and other impacts from oil production

To maximise revenues, licensing, exploration and production of oil requires strong national governance and a balanced policy environment including legislation, regulations, institutions, a fair fiscal system and licensing arrangements with qualified oil firms. Good governance is required to guide operations in the national interest, including managing oil's economic value and minimising or mitigating environmental, social, and local impacts.

Supply of refined petroleum products

There is extensive and effective international trade in a range of products emerging from the oil value chains, including crude oil, refined fuels and petroleum-based products. Countries can have access to the products without producing them domestically. Refined petroleum fuels are distributed for sale throughout Africa. The merits of investing in domestic conversion capacity, such as refineries, is then mostly a matter of investment return and competitive advantage towards other refineries.

Africa's present refining capacity is significantly lower than its fuel consumption. Its refineries are inadequate in process configurations and maintenance, as evidenced by their low average capacity utilizations. The challenge of establishing effective investment and business models for new African refining capacity is unresolved. Many governments want a domestic refinery, but the history of state-owned refining in Africa is discouraging. In Europe and North America, refining has long been seen as a sector of low and volatile returns.

Supplies of refined fuels can be undertaken by commercial firms, including African-owned firms, with limited regulatory or business involvement by the state. However, many African governments have policies of subsidising or controlling the sales prices of refined fuels, which may tend to discourage private sector investment.

Income from supplying value chain operations

African enterprises and individuals can earn income by carrying out activities in different oil value chains. Opportunities for this can be found in several parts of the oil sector. In petroleum operations, the participation of host country nationals is often referred to as "local content". Value can sometimes be created by industrial conversion of oil into more valuable products. If done well, this can yield significant benefits for Africa and Africans, by developing the industrial base, and by expanding African business competencies and as well-paid jobs.

None of this is easy. The potential opportunities come with limitations and drawbacks: High entry barriers, large economic risks and not many jobs. Several African nations have designed local content policies which encourage or require firms in the oil sector to employ workers and suppliers from the host nation. Two realities have often been overlooked: Local content requirements have costs, even if these are not readily observed and measured. And there are few, insights from research on what local content policies have achieved. Nevertheless, robust research and empirical evidence point to economic benefits arising from strong linkages between the oil sector and local businesses and the importance of industrial policies towards this objective.

Value addition to oil

Oil refining and petrochemicals usually require investments of several billions of dollars for a plant of competitive size and configuration, and they inevitably entail significant risks of economic loss.

In the absence of detailed research on Africa's value addition in the oil sector, only tentative recommendations for effective local content policy can be made on the matter. This report suggests that any recommendations must be based on a proper understanding of how the industry works, and why many parts of it operate with a global scope of business.

State Participation in petroleum activities

National oil companies can provide significant benefits as an avenue for engaging host country nationals in petroleum value chains and expand competencies in the host country. There are also risks and limitations: Experience has shown national oil companies to operate less efficiently than investor-owned firms. There are issues of governance and financial management in the interface between the national oil company and the government which require careful consideration.

Findings and recommendations of the report.

This report analysed the impacts that this entire oil value chain can have on African economies, and how governments can influence those impacts. The report provides policy makers with an overview of the global oil industry with an emphasis on the value chain process; it includes a detailed analysis of common risks, challenges facing policy makers – which are contextualised with country cases. Finally, it offers broader recommendations to inform policy making and adoption of best practices for managing the oil sector.

Below are some of the recommendations aimed at enhancing the benefits for African economies from oil value chains:

National management of petroleum resources (upstream)

(i) Petroleum operations and licensing of petroleum rights should be based on an explicit policy, setting out the nation's main objectives and principles for petroleum extraction. The policy should be backed by a broad national consensus and be suitable to remain valid for a long period of time. The petroleum policy document as such should not contain legal obligations, specific plans or resource commitments, which are better covered in other public instruments. Petroleum extraction should be carried out by companies having the required capabilities for safe and effective petroleum operations.

(ii) A solid legal and regulatory framework should be in place before any licensing of petroleum rights. There will be a number of important decisions for Government to make over the course of petroleum licensing and operations, for which adequate legislation, institutional mandates and competencies must be built.

(iii) National oil companies can provide strategic advantages for African countries especially the development of national capabilities for oil sector operations. The national oil companies however require clear mandates, system of governance, monitoring, and appropriate financial arrangements.

(iv) National strategic planning for the petroleum sector needs to be far-sighted and evolving. It should address the pace of exploration and developments, systematic knowledge building on resources, key infrastructure, development of regulatory and national capabilities for value chain participation.

(v) The petroleum fiscal system should secure long term shares of high economic value for the state and avoid creating incentives for sub-optimal operational decisions. Predictability of the fiscal system and other terms affecting enterprises is an important consideration. Policies which significantly erode state revenues from petroleum extraction should be avoided.

(vi) Transparency of contracts, regulatory decisions and payments related to petroleum extraction is strongly recommended to ensure that revenues are duly collected and applied for the national benefit.

(vii) Petroleum operations should be preceded by impact assessments as tools for managing social and environmental externalities as well as public concerns and expectations.

(viii) Data acquired during petroleum exploration, development and production is extremely valuable and should be managed by the state

Mid- and downstream oil and related industries (conversion and supply sectors)

(ix) Countries should consider reducing the extent of regulation and state business involvement in oil refining and retailing. Governments should relinquish the role of determining or subsidising the prices of petroleum fuels.

(x) Trade between African nations in petroleum fuels should be facilitated and barriers to such trade avoided. Harmonisation of fuel quality standards applicable in different countries would be a step towards reducing such barriers to trade.

(xi) Construction of new refining capacity in Africa should be encouraged. New investment and business models for such refineries must be sought, without repeating earlier mistakes of ineffective state involvement.

(xii) Depending on geographical and market conditions, governments may have an important regulatory function in preventing monopolistic market powers arising from large petroleum infrastructure and refining capacity.

(xiii) Direct investment by African governments in petrochemicals should not be prioritised. Commercial investment in petrochemicals may be welcomed, but with caution regarding feedstock supply arrangements which could diminish the value of petroleum resources if subsidised. Government should focus on providing a conducive business environment for private investments in the oil sector.

(xiv) African governments can facilitate the development of effective fuels retail sectors by improving the general conditions for doing business, for which the annual Doing Business reports from the World Bank is an indicator.

Value addition from participation in value chain activities (National Content)

(xv) The international nature of important supplier industry segments, and thus the important contributions of internationally based supplier firms to African petroleum sectors should be recognized. They should be encouraged to establish substantial bases of operations in African countries, with expectations that they will significantly employ Africans and use African subcontractors.

(xvi) Collaborative approaches between International and local companies need to be encouraged.

(xvii) The state should reserve the right to impose certain requirements for national content, at least as a fall-back solution in case the expected collaborative contributions from firms are not forthcoming.

(xviii) The costs and risks to the state of imposing requirements for national content on value chain participants should be carefully assessed against expected benefits.

(xix) National content requirements must be designed to fully preserve the standards for safety and the responsibility of licensees for operational integrity.

(xx) Training for professionals, including on-the-job skills development, is an important enabling strategy for national content. Programmes for supplier development, which entails support for local firms towards becoming qualified suppliers to the petroleum sector, can also yield important benefits.

(xxi) The state can provide important enabling conditions of national content in the forms of business parks, education (not least in vocational professions), affordable financing for indigenous businesses and improving general conditions for doing business in the country.

(xxii) Certain categories of goods and services for petroleum sector activities can be recognised as lending themselves more readily than others to national content, depending on the national context.

(xxiii) Any protection or incentives for indigenous suppliers to the petroleum sector should be of limited duration, in order not to create an enduring class of underperforming firms draining public resources. National content policy will be successful if resulting in many firms being based in the nation which, after some early support, can prevail in international and domestic competition without further state support.

01
Introduction

This study concerns oil of fossil origin, which may be called mineral oil or liquid petroleum. It excludes edible and other oils of recent organic origin, except that no distinction is made against marketed petroleum products which contains a portion of biofuels in addition to mineral oil. Petroleum, strictly defined, is the same as mineral oil, but is now used as a common term for mineral oil and natural gas.

The study aims to provide:

a) An overview of the markets and value chains for oil from reservoirs to consumers, and associated supplier industries;

b) A way to assess the contributions that various parts of the oil value chain can make to African economies;

c) A way to assess the potential for African economies to develop the oil sector, including potential barriers to entry and value creation;

d) important sector policy issues and choices for African states, with their implications.

METHODOLOGY

The study combines a desktop analysis of the oil value-chain with concrete case studies to contextualise topical issues and inform policy options. A detailed analysis of key nodes in the value chain helps to identify and understand the set of related activities which lead to the production of goods and services for the petroleum industry, broad economic sectors and consumers.

Six African countries namely, Angola, Ghana, Nigeria, Sudan, Uganda and Algeria serve as case studies for the analysis to illustrate how each country individually addressed a specific oil sector challenge and where efforts were directed at the time of the study.

The data for the study was obtained from public sources and from dialogue with officials of government institutions in the case study countries. Some commercial companies operating in Africa and institutions involved in the oil value chain also provided useful data and information.

The value chain analysis was complemented by a discussion about the role of governments in enhancing the benefits of the sector for African economies and managing the impacts of the sector. It also included an analysis of the African and global market environments and the potential implications for value chains and related policies in Africa.

REPORT OVERVIEW

The second chapter is an introduction and overview of the oil sector, from oil reserves in the ground to fuels and other oil-based products as consumer goods. It describes how the sector functions, globally and in Africa with regard to value chains. There is also a section on the global oil market, which sets important premises for the sector.

Chapter 3 describes how the various parts of the oil sector can contribute to African economies in terms of economic development inputs, state revenues, employment and other effects. The potential dangers, challenges and criteria for African engagements in the sector are described. A special section reviews the concept of national content as an approach to involving Africans in the oil value chain. There are also sections on climate change and on gender and inclusion issues, the latter with references to another report published by the African Development Bank on this issue.

Chapter 4 reviews the experiences of six countries to illustrate some important oil sector challenges and policy issues. The issues treated are licensing of petroleum rights (Angola); strategic environmental assessment (Ghana). national content (Nigeria); refining and fuels pricing (Sudan); infrastructure strategy (Uganda); and sector organisation (Algeria).

Chapter 5 addresses the issues of governance and regulation for the sector, and how the state may organise its engagement. Particular attention is given to the regulatory challenges arising from the extractive aspect. The merits and drawbacks of national oil companies are listed.

Chapter 6 summarises important policy issues from the previous chapters in tabular form. It also provides a summary of key policy recommendations. and a relationship with the African Development Bank's natural gas value chain study.

The African Natural Resources Centre undertook a study for the African Development Bank on the natural gas sector in Africa in 2017, similar in scope to the present study.[1] There are important common features of the value chains for oil and for natural gas, particularly in their extraction from underground reservoirs. The two studies have been completed independently of each other and can be read separately.

1 African Development Bank (2017): Natural Gas Value Chain and its Contribution to National Economies.

02

The markets and value chains for crude oil and related industries

The exploration and production (E&P) segment of the petroleum sector is an industry on its own with dedicated value chain. The refining and retailing of fuels are each a separate industry with its own value chain. The reason for treating the E&P segment as a different value chain from refining is that these two segments have a well-functioning market between them: that of crude oil. This market makes it possible for firms to engage in petroleum E&P without necessarily engaging in refining, and vice versa. There are also markets for refined products as bulk trade, enabling the fuels retail segment to be treated as a separate value chain from refining. Transportation of crude oil and refined products can also be treated as separate value chains, especially when provided by businesses which are separate from the others.

These value chains are all linked, because the output from one is input for the other; for example, crude oil is the output of the petroleum E&P value chain and input for the refining value chain. The entire oil sector, from resource in the ground to the fuel in a car, can therefore be an integrated value chain. It has become common to speak of upstream, midstream and downstream segments of the oil sector. Upstream is the extractive segment (exploration and production); midstream is refining, trading and large-volume transportation; and downstream is distribution and sales to consumers.

Figure 1 gives a snapshot of the integrated petroleum sector with its value chains and end products. It includes some value chains not usually considered part of the oil sector, but which can be vertically linked with it, notably oil-based power generation and the chemical industries which use oil and/or gas as feedstock. Some of the latter are called petrochemical industries and are reviewed in this report.

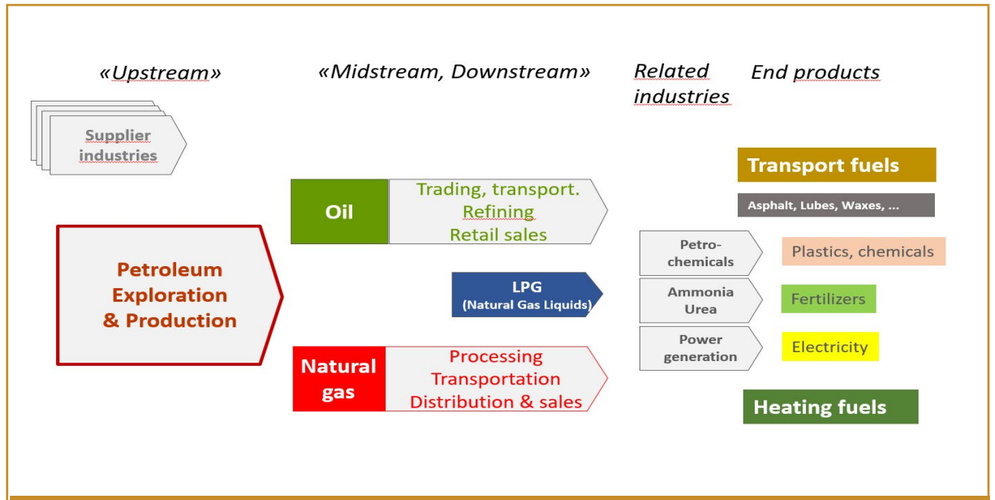

Figure 1: Petroleum value chain overview-Overview of integrated petroleum sector

The figure also shows value chains that are specific to natural gas, which are intricately linked to oil due to common origins and many similar end-uses. The value chains specific to natural gas are covered in a separate report by the African Development Bank. For further insights and information about the oil market, there are several useful publications and web sites freely available, and some more for the professional user who can pay for added information services[1].

Also shown in Figure 1 are supplier industries, which supply the goods and services obtained by the oil sector for its operations. An understanding of the role of the supplier industries is important for the issue of local content.

Globally, some 90% of all oil and the unflared gas are used as fuels, burnt for their energy content. In Figure 1, this is shown as heating fuels, transport fuels and power generation. The remaining 10% is used to make various non-fuel materials, including chemicals, fertiliser, solvents, lubricants and asphalt. There has been a tendency globally over several decades for the products from crude oil to be used increasingly for transport fuels, and less for other fuel purposes such as heating and power generation. Petroleum fuels are particularly suited to transportation uses, since their liquid form and high energy density make them convenient for storage in cars, airplanes and ships. Natural gas is mainly used for those other purposes, notably heating and power, and less as transport fuels.

1 The following free information sources are particularly useful (a) BP's annual Statistical Review of World Energy; (b) IEA's monthly Oil Market Reports; (c) ICE commodity exchange for oil futures trade (prices at the moment); (d) IEA's World Energy Outlook (for a broader and long-term perspective on energy).

2.1 THE GLOBAL OIL MARKETS

Global oil and gas production in 2019 had a value of around $3.3 trillion[2], higher than UK's GDP. Most crude oil produced is traded[3], and cargoes are often re-sold several times. The global oil market is therefore worth more than $3.3 trillion per year, although its exact size is not known. It is the world's largest market for products, and the most closely analysed because its supply and pricing movements can significantly affect global and national economies.

Figure 2 shows major global trade flows for oil in 2017[4], expressed in million tons. The Middle East, Russia and Africa are large exporting regions. Asia and Europe are large importing regions. Some regions are both large importers and exporters, such as North America, where production has increased in recent years. The largest African exporters are Nigeria, Angola and Algeria. Among the other African nations there are some smaller exporters and several importers, the latter including South Africa.

The numbers in Figure 2 include trade in crude oil and refined oil products. Most African countries do not have functioning refineries, and therefore import refined products. Globally, refineries tend to be found near centres of consumption, rather than centres of production, because it is cheaper to transport crude oil than the refined products. There is still significant international trade in refined products, partly because refineries cannot exactly match the demand for fuels in their own country. The international trade in crude oil is about twice as large as the trade in refined products by weight.

2https://www.investopedia.com/ask/answers/030915/what-percentage-global-economy-comprised-oil-gas-drilling-sector.asp#:~:text=Exploration%20and%20Production,approximately%20%243.3%20trillion%20in%202019.
3 Some oil trades are internal transfers, i.e. sales to another part of the same corporation. These usually also need to be accounted for as transactions for fiscal and other reasons.
4 BP Statistical Review of the World Energy 2018

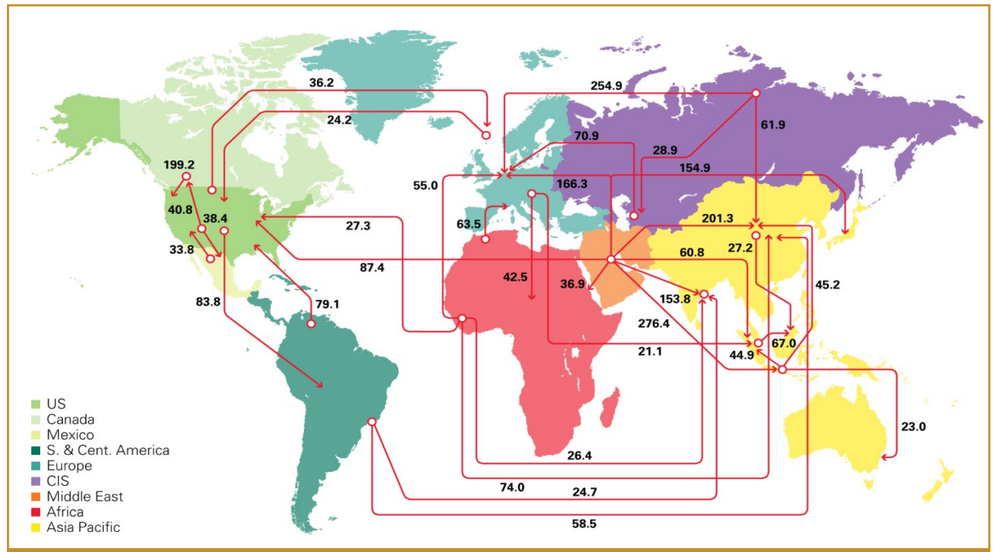

Figure 2: Major oil trade flows 2017.

2.1.1 Developments in Africa's supply and demand:

World production and consumption of oil has grown steadily over the last 25 years, and in 2018 was close to 100 million bod[5]. Figure 3 shows production and consumption in different regions of the world[6]. The Asia/Pacific region has had the largest consumption growth over the period, and this is also where the largest deficit in production versus consumption was found. Strong economic growth especially in China is the main driver of this consumption growth and explains why China is becoming involved in crude oil production in Africa.

Africa's level of oil production was twice its consumption in 2018. Its share of world oil production in the same year was 8.7% and of known oil reserves was 7.5% (Figure 4)[7]. Its consumption was insignificant compared to its population, at a quarter of the world average in consumption per person, and one seventeenth of that of the United States. This is even more pronounced given its total consumption of primary energy, which includes coal, natural gas and non-fossil sources of electricity (but does not here include traditional biomass).

5https://www.iea.org/oilmarketreport/omrpublic/
6 BP Statistical Review of the World Energy 2018
7 BP Statistical Review of the World Energy 2018

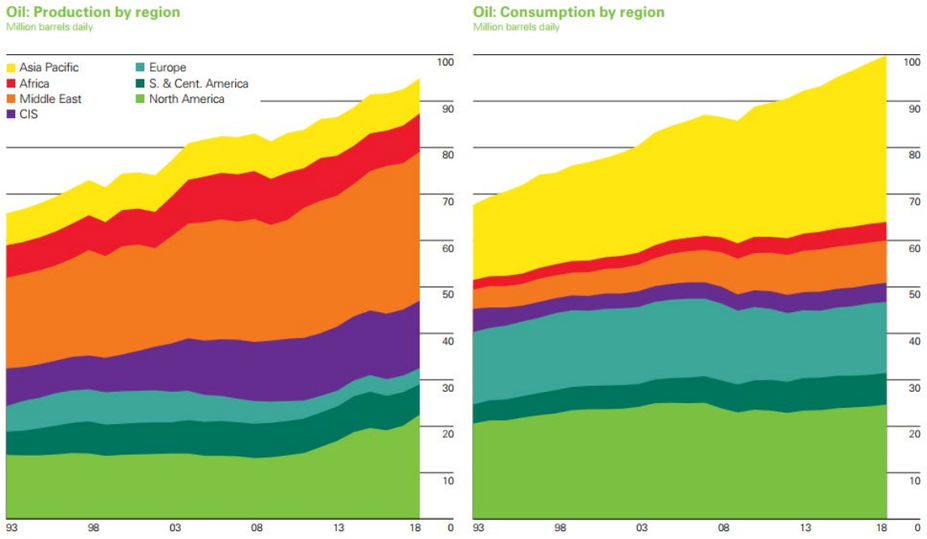

Figure 3: Oil production and consumption in world regions, 1991-2018

A low level of economic development is the main cause of Africa's low energy consumption.

Africa's oil consumption in 2018 was 48.6% middle distillates (mainly diesel and kerosene), 27.7% light distillates (mainly petrol), 8.1% heavy fuel oil and 15% others. The share of middle distillates was high but the share of petrol low by international comparisons. The reasons for this include the use of diesel as generator fuel, the use of kerosene in households and a high share of trucks in road traffic.

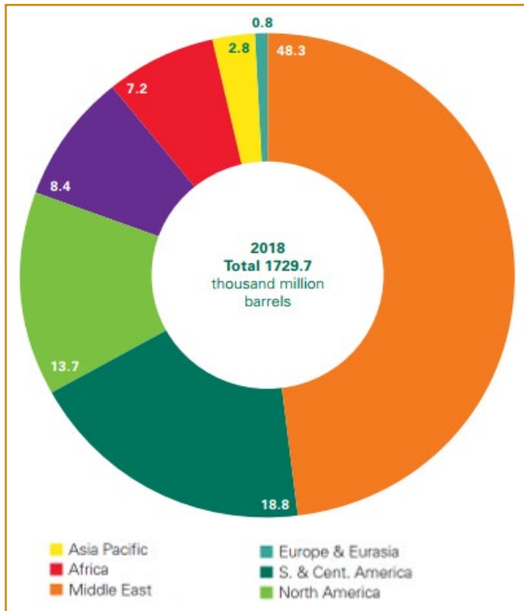

Figure 4: Distribution of oil reserves in world regions in 2018.

Africa's oil consumption grew by 2.79% per year over the period. The growth was strongest in middle distillates, whereas fuel oil consumption fell slightly. World-wide oil consumption grew at a lower average rate than Africa's, with growth rates differing strongly between China (5.1%) and the EU (-1.2%). In Japan consumption reduced by 2.3% per year over the period, indicating that oil consumption stops growing when countries have reached a high level of economic development.

Table 1 gives another perspective on oil production, refinery output and oil consumption in Africa. The 15 countries listed include the 10 African countries with the highest oil production and the 10 African countries with the highest oil consumption.

Table 1: Oil production, refinery output and consumption in African countries. Percentage changes from 2005.

1000 bod	Oil and liquids production *) 2015	*Δ-2005*	Refinery output 2014	*Δ-2005*	Refined oil consumption 2015	*Δ-2005*	Light fuels **) output 2014	*Δ-2005*	Light fuels **) consumption 2014	*Δ-2005*
Algeria	1 797	*-8 %*	432	*52 %*	428	*62 %*	324	*52 %*	314	*76 %*
Angola	1 829	*46 %*	41	*15 %*	142	*237 %*	23	*-8 %*	132	*262 %*
Congo (Braz.)	265	*12 %*	11	*48 %*	18	*140 %*	9	*80 %*	16	*138 %*
Egypt	718	*4 %*	706	*-33 %*	780	*25 %*	236	*-30 %*	515	*6 %*
Ethiopia					65	*116 %*	-		59	*102 %*
Gabon	213	*-20 %*	16	*3 %*	21	*65 %*	8	*3 %*	18	*90 %*
Ghana	102	*1606 %*	37	*-92 %*	75	*61 %*	2	*-93 %*	66	*62 %*
Kenya			34	*-58 %*	100	*51 %*	9	*-59 %*	83	*34 %*
Libya	434	*-75 %*	368	*-72 %*	259	*-6 %*	50	*-74 %*	243	*9 %*
Morocco			136	*2 %*	283	*63 %*	77	*13 %*	167	*43 %*
Nigeria	2 216	*-16 %*	191	*-63 %*	325	*11 %*	43	*-62 %*	239	*-13 %*
South Africa	123	*-39 %*	749	*-42 %*	662	*23 %*	329	*-25 %*	535	*19 %*
Sudan ***)	109	*-38 %*	88	*2 %*	113	*60 %*	72	*-5 %*	77	*27 %*
Tunisia	40	*-48 %*	39	*-11 %*	100	*14 %*	15	*-31 %*	62	*-5 %*
Other Africa	711	*-19 %*	159	*18 %*	662	*49 %*	131	*23 %*	598	*53 %*
Africa	**8 557**	***-15 %***	**3 006**	***-25 %***	**4 033**	***36 %***	**1 328**	***-21 %***	**3 125**	***29 %***

Source: Energy Information Administration, USA. www.eia.gov.
Numbers should be taken as indicative only, as other sources have different numbers.

**) Includes production of LPG and condensate in some countries.*
***) Light fuels: Gasoline, jet fuel, kerosene, gasoil (diesel) and LPG.*
****) Percentage changes shown for Sudan are for Sudan + South Sudan.*
Columns headed Δ-2005 show% change from 2005 to the value in the prior column.

i. African oil production fell by 15% from 2005 to 2015, with the steepest decline in Libya, where production was damaged by civil conflict. Nigeria's production declined, as did Angola's from 2008. Ghana increased production from deep offshore fields.
ii. Africa refines much less oil than it consumes. It is a gap that has widened since 2005, as since then refinery output fell by 25% while consumption of refined products increased by 36%. Closures of refineries in Morocco and Kenya and higher fuel consumption since 2014 have further widened the gap.

iii. The gap is particularly wide for light products, which include fuels for road vehicles, aviation and household uses. Africa produced only 43% of these most valuable fuels from its own refineries, and the ratio has been falling. Africa has an increasing surplus of low-value heavy fuel oil, the result of production quality not matching demand.
iv. Algeria and in some respects, Sudan have a good match between refinery output and consumption of light products, but they will also need more light products as consumption grows. Other African countries are large and growing net importers of light products.
v. Refinery output reduced in several countries over the period, despite rising demand, proving that many African refineries do not have the capability for effective operations.

The World Energy Outlook (IEA 2019) expected world oil demand to continue growing at a slower pace than in recent years, although Africa's energy demand is expected to grow strongly. The EIA sees a shift towards electricity as the world's preferred form of energy use, and solar energy becoming the cheapest source of electricity for many countries.

2.1.2 Oil trading

Crude oil is refined before the products are applied to final uses. Using unrefined crude oil directly as a fuel in certain applications is possible[8], but usually makes little economic sense. In the crude oil market, oil producing companies are the sellers, and refiners are the buyers.

Traders, who are neither producers nor refiners, often perform a logistical function, in that they buy crude oil from producers from their location (FOB) then sell and ship it to refiners who want it delivered to the refinery (CIF, CFR or DES).[9]

Most refineries are owned by companies that also produce crude oil. They do not necessarily have a strong preference for refining their own crude oil but will sell and buy cargoes to optimise the supply flows. Oil companies also act as traders, in that they often re-sell cargoes of crude oil that they have bought. This can optimise supply flows between their oil fields, existing purchase and sales obligations, and refineries.

Most crude oil is transported by tanker ships, such as the VLCCs (Very Large Crude Carriers), which can load around 2 million bbl. of oil. There are also many smaller and a few larger ships. Conditions at terminals (onshore tank volume, water depth, etc.) often set limitations for the size of ships suited to call there. Oil companies usually do not own tanker ships, but rent (charter) them from ship owners, including crew and operational functions. In the oil tanker market, it is common to charter ships for individual voyages or for longer term arrangements. Some international trade in crude oil takes place as delivery by pipeline rather than ships. This is common in trade from Russia to western/central Europe, and between Canada and the U.S.A., where large oil pipelines have been built for this. The crude oil market works by sales and purchase contracts which may be for individual deliveries (spot trade) or for several deliveries over a period (term trade). Term trades are rarely for more than 5 years and are often much shorter. It is not considered necessary to enter into sales contracts for crude oil before developing oil fields, as this can usually be done closer to the time of delivery. In contrast, the international natural gas market tends to work by very long contracts (20+ years) which are concluded before gas fields and infrastructure developments are undertaken.

In term sales, fixed prices throughout the contract are rare; a formula for calculating the price for each cargo is more often used. The formula is usually based on a market assessment for Brent or another reference crude oil as published by Platts or another reporting agency (see section 2.2.4 below). It also contains an agreed differential to be added or deducted from the reference price, and the price to be invoiced is then calculated from the published reference price averaged over a specified number of days around when the cargo loads. Consequently, the value of crude oil sales from a field varies from the market price of oil even if the oil is delivered under a term contract agreed in the past.

Term trades are rarely for more than 5 years and are often much shorter. It is not considered necessary to enter into sales contracts for crude oil before developing oil fields, as this can usually be done closer to the time of delivery

Sometimes, brokers are used as intermediaries in oil trade. A broker is not a buyer or seller of crude oil, but a third party who assists in making the trade happen and earns a commission for it. The large players in crude oil trade employ trading professionals who are well known to each other and communicate frequently, and therefore tend not to depend on brokers for agreeing trades. Use of brokers is more common in ship chartering.

2.1.3 Oil prices: Volatility and uncertainty

Brent is a grade of crude oil available at several terminals at the North Sea, Europe, and is widely used as a reference for oil pricing globally.

8 Caution! Burning crude oil in equipment not designed for it, is hazardous.
9 FOB, CIF, CFR and DES are Incoterms, which is a set of internationally recognised standard delivery rules in international trade. https://iccwbo.org/resources-for-business/incoterms-rules/ . In oil trade, delivery rules are usually specified in more detail in standard conditions of sale applied by oil companies and traders.

Figure 5 shows daily reported prices of Brent crude oil from 1987 to March 2018. Notable from the figure are the large and often sharp changes in the crude oil price which have occurred on several occasions. The price has varied from less than $10 per barrel briefly in 1998 to more than $140 briefly in 2008. The price was below $20 for most of the 1990s.

One economic explanation for the propensity of the crude oil price to have these large variations is inelasticity of both supply and demand on short term. This means that, unlike many other products and markets, the global demand for oil does not easily change in response to higher or lower prices. Nor does supply, which is mainly determined by development decisions made in the past. If, for instance, a significant increase in prices persists for several years, one eventually starts to see more adjustments of supply as well as demand to the higher prices, but it takes time. Price elasticity is generally important for markets to re-balance whenever some event has caused supply or demand to change. Low elasticity means that substantial changes in price are needed to create enough adjustments in supply and demand.

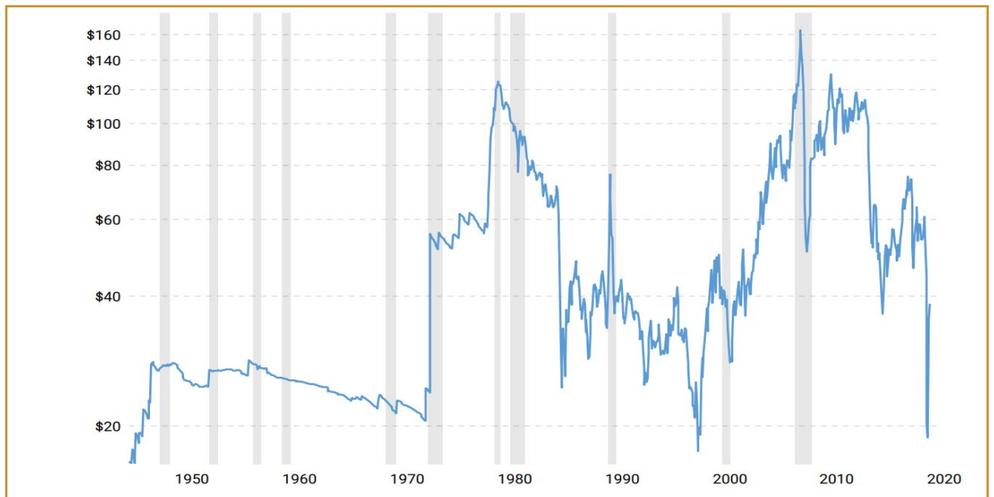

Figure 5: Daily prices of Brent crude oil (1987- 2018)

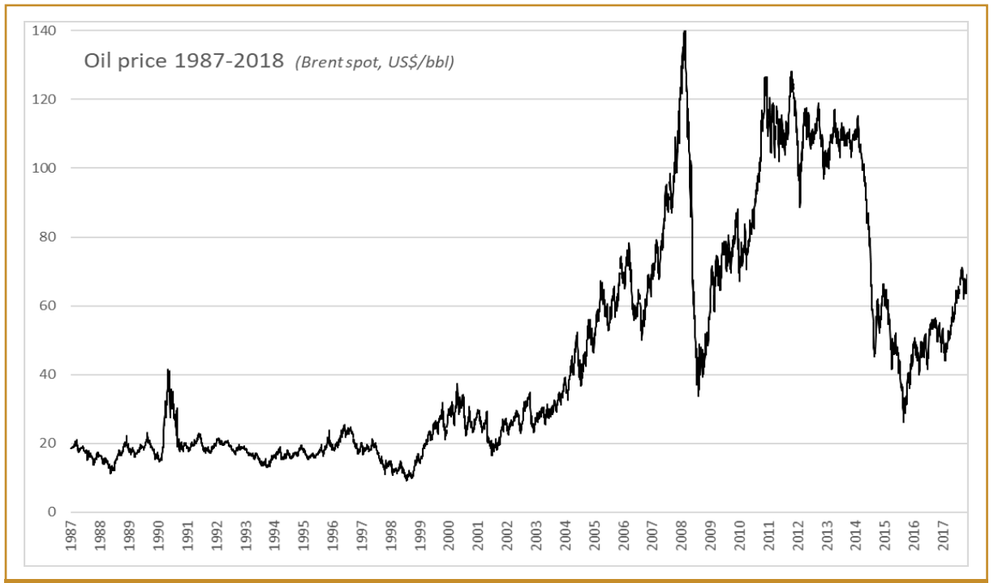

Figure 6: Oil price in international trade, 1987-2018[10]

The oil market is influenced by events causing changes to supply and demand, or at least changes to expectations. Events which caused large price changes as shown in Figure 6 include the following:

i. U.S. response to Iraq's invasion of Kuwait, 1990;
ii. Asian financial crisis, 1997/98;
iii. OPEC response to low prices and Asian financial recovery, from 1999;
iv. Strong global growth, 2000-2008;
v. Financial crisis triggered by Lehman Brothers collapse, 2008;
vi. Recovery and resumed global growth, from 2009;
vii. Oversupply after increased U.S. shale oil supply, 2014.

On several occasions, oil prices have remained somewhat stable around a level for some period, and then made a sudden shift in either direction. The problem is not only these shifts as such, but also the reality that no-one has been reliably able to predict them.

In summary, the global market for crude oil and refined products is prone to large and unpredictable shifts which cannot be reliably predicted. This reality imposes uncertainties on the economic outcomes of oil value chains, and on the costs of oil consumption for African nations. Some countries have attempted to shield their domestic petroleum sectors from such uncertainties by imposing domestic pricing

10Source: Energy Information Administration (U.S.A.). www.eia.gov

arrangements which are in part detached from world market prices, but such arrangements come with their own limitations and problems as will be discussed in later chapters.

2.2 PETROLEUM EXPLORATION, DEVELOPMENT AND PRODUCTION

The regulatory aspects and the interactions between authorities and firms in the process are treated more extensively in chapters 4 and 5.

The oil reserves and production volumes for African countries can be found at periodically updated public data sources such as BP's Statistical review of world energy (www.bp.com) and the US Government's Energy Information Administration (www.eia.gov). A distinction must be made between the total quantities of oil present in the underground (which may be referred to as resources or oil in place) and the part of this which can be extracted (recoverable reserves). By strict definition, oil in the ground only counts as reserves to the extent that plans for its extraction have been made.

2.2.1 Oil exploration

Drilling to find oil offshore is expensive and can easily cost $50 million or more per well. Onshore drilling is cheaper, but can still cost more than up to $10 million per well. The probability that an exploration well will make a valuable discovery is between 10% - 20%. Explorationists use other and cheaper techniques before drilling to increase the likelihood of drilling at the right spot. Exploration in an area, if successful, tends to go through the following sequence of operations:

i. Reconnaissance surveys. These are relatively low-cost methods that include surveying the surface geology, registering oil seeps, and sensor surveys of the earth's magnetism and gravity.
ii. Seismic surveys. These entail setting off shocks on the surface (by explosions or heavy vibrating devices) and recording the reflection of sound from under the ground.
iii. Exploration well. An exploration well drilled in an area without prior discovery is called a "wildcat" well.
iv. Appraisal work. Following a promising discovery by a wildcat well, more seismic and drilling are needed to assess the size and reservoir conditions as a basis for development planning.

2.2.2 Developing oil resources

Once a promising discovery has been made and appraised, the following components must be developed to enable production:

i. Impact assessments: Modern standards for petroleum development require environmental impact assessments as a basis for development approval and planning, and that a strategic environmental assessment is prepared at an earlier stage before initiating petroleum operations (Section 4.2).
ii. Reservoir management strategy: A plan for how to recover petroleum from the reservoir.
iii. Platform or site: For offshore fields, the in-field facilities can be placed on a fixed platform, a floating installation or on the sea bottom, or both. For onshore fields, installation sites must have the appropriate infrastructure, and follow requirements for environmental protection and a minimised footprint.
iv. Production wells: Modern wells often have long horizontal extensions through the reservoir, and may also be multilateral (several branches from a common wellbore). Wells need to be completed with downhole equipment and wellheads including safety barriers.
v. Injection wells: Modern reservoir management strategies often entail injecting water, gas and/or other substances into the reservoir to maintain pressure and aid the flow of oil to the production wells.
vi. Intra-field flow systems: Pipelines etc. for moving hydrocarbons and other substances between field installations.
vii. Process facilities: The fluid coming out of wells is rarely pure, often a mix of oil, gas, water and dirt. These must be separated before delivering the oil and gas to offtake systems.
viii. Support systems: A number of facilities and operating procedures to ensure safe and effective operations, including power supply, pumps and compressors, gas detectors, fire protection, flare, well maintenance, data processing, and others.
ix. Logistics and accommodation: Arrangements at field installations for receiving supplies, disposing of surplus materials, transporting and accommodating personnel.
x. Offtake: Pipeline or tanker loading arrangements for moving oil and gas from the field to delivery locations or processing plants.
xi. Supply bases and off-site support facilities: It is usual to locate storage, supply, operational management and administrative functions away from the field.
xii. Management system: Field operations require a coherent system of responsibilities and key procedures for ensuring safe and effective operations.

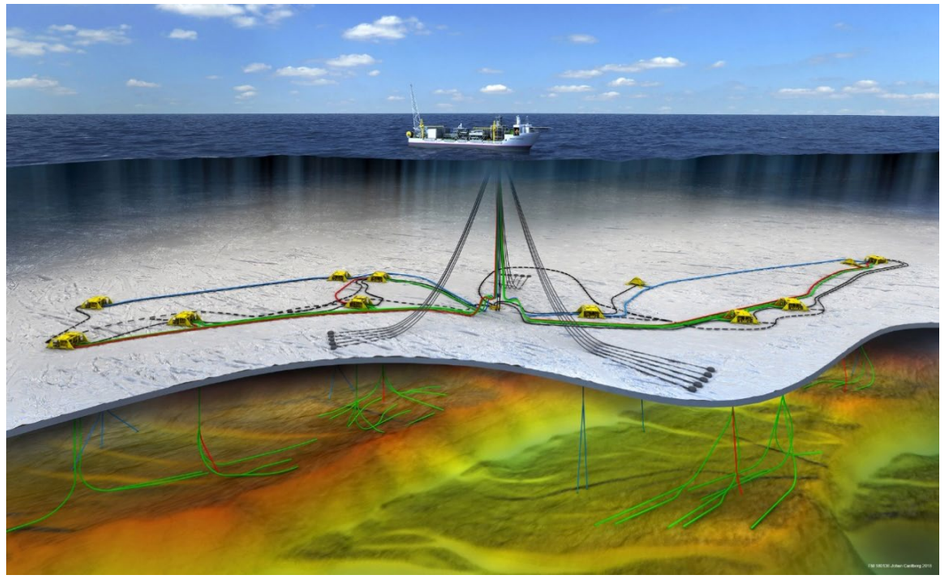

Figure 7: A modern offshore oil field development with FPSO, subsea installations and multilateral wells.

An illustration of a modern offshore oil field development is shown in Figure 7. Requirements for the above development components vary with circumstances. In demanding offshore or other conditions, they can require investments of several billion dollars. At the other end, there can be simple, single-well development projects onshore with ready access to existing installations, which may be implemented at a cost of a few million dollars.

Oil firms apply structured development processes in stages to arrive at optimal development decisions. The final go-ahead for starting a development requires a final investment decision (FID) by the firm(s) undertaking the investment, and usually also the approval of a field development plan (FDP) by authorities of the jurisdiction.

There are occasional cases of severe discrepancies between plans and implemented projects, as cost overruns, delays and other problems. The projects are in many cases large, complex, requiring solutions not previously implemented, and requiring elaborate contracts with suppliers. Depending on the fiscal system, the economic effects of such problems usually end up being borne by the state as well as the licensees.

2.2.3 Production, redevelopments and abandonment

Successful field development results in production which can effectively monetise the value of the resource. In many cases, the production phase can turn out differently than planned. There can be unforeseen problems requiring additional investments. Events can also take more favourable turns in the form of additional production opportunities. Reservoir management strategies may be revised for higher recovery rates resulting from technological advances. Existing facilities may earn additional income as tariffs for hosting nearby fields for processing and other support. Safe operations, asset integrity and optimal recovery are priorities during the production stage of a field life cycle.

Eventually, production will cease as the field nears depletion. Wells must be properly plugged and secured. Many countries have standards for the proper removal of installations and the restoration of the site to near original conditions. These must be included in the original development plan.

2.2.4 The parties involved in oil exploration and production

Throughout Africa and most jurisdictions elsewhere, oil resources in the ground are the property of the nation in which they are located. This also extends offshore based on the principles of international maritime law.[11] Governments are charged with managing the resources for the benefit of their nation and population. Petroleum operations comprise complex tasks requiring strong and specialised capabilities. Most governments engage international oil companies to find, develop and produce the reserves, because they have the capabilities and capacity to take on the financial risks required for high-quality petroleum operations.

Many countries with oil resources, including most African oil producers, have chosen to establish a national oil company (NOC) to acquire similar capabilities for petroleum operations as the international firms. Potential advantages and limitations with NOCs are discussed in chapter 5.

Except for a possible role for a NOC, petroleum operations are carried out by private sector companies. They do so by licensed agreement with the government, which owns the resources until they have been extracted. Modern licensing arrangements cover clearly delineated areas within the jurisdiction and have time limits. One form of such licensing arrangements is the production sharing agreement, which is introduced in the next sub-section.

11 The main international instrument for nations' sovereign rights in the ocean is the United Nations Convention on the Law of the Sea. http://www.un.org/depts/los/convention_agreements/texts/unclos/unclos_e.pdf

There are often more than one international oil firm participating in each license. In addition, there may be participation by the NOC. One of them is then appointed operator, who directly manages operations. The participants pay their shares of field expenditures and receive oil according to their participation shares and the license terms. It is common to have several firms participating in a license, since exploration carries major financial risks. Many firms therefore prefer smaller shares in many licenses rather than putting all their money in just a few.

Oil firms vary enormously across the world. Biggest and best-known are ExxonMobil, Shell, BP, Total and Chevron, who can undertake very large projects. At the other end of the scale there are some very small firms with limited resources and usually focusing on early exploration work. Where they receive licenses, they are likely to sell their interest to other firms in a better position to continue the exploration, drilling and development. There are also investor-owned firms of intermediate size, capable of undertaking exploration and development projects and often with a focus on certain parts of the world. Another group are national oil companies which operate outside their home countries. They may operate like the Western based firms, except that their presence in African nations is sometimes backed by high-level political accords and associated development undertakings.

International firms also apply varying degrees of transparency to their operations and finances. Those who have their shares traded on stock exchanges in Europe and North America are required to publish extensive information about their operations and finances. Some of them also publish information about all payments they have made to states in respect of their petroleum interests[12]. Such openness is not always found with national oil companies, whether they are from African nations or from other nations investing in Africa[13]. There is also generally less transparency with smaller firms in entirely private ownership. For those in privileged positions and who prefer keeping their dealings private, it may be preferable to deal with national oil companies or with small private firms with opaque backgrounds, rather than the larger, investor-owned firms.

Another group of firms involved in petroleum operations are the supplier firms, which provide goods and services required by the oil firms. They are discussed in section below.

Many people in a country are likely to be affected by petroleum operations. In a sense, the entire population is affected, since the resources belong to the entire nation in the first place. Some are more directly affected, for instance if operations are carried out close to where they live. Impact assessments (SEA and EIA as

12Examples: https://www.shell.com/sustainability/transparency/revenues-for-governments.html; https://www.tullowoil.com/sustainability/shared-prosperity
13See Natural Resource Governance Institute (2018)

discussed in section 4.2) are methods for assessing how the natural environment and people will be affected by petroleum operations before the big decisions on operations are made. The processes of developing the impact assessments are also opportunities for authorities to engage with and hear the concerns of those affected.

2.2.5 The economics of oil exploration and production

Successful petroleum operations are generally more profitable than most other business activities. This is to be expected, because petroleum operations apply a special privilege: Access to and extraction of valuable natural resources belonging to the nation. The extra profitability arising from this privilege is called resource rent by economists. One premise for fiscal systems (taxes, production sharing, etc.) for petroleum is that the resource rent should accrue to the state, because the resources belong to the nation. The oil firms should have opportunity to make profit from doing successful work, and be incentivised to do it, but the resources are not theirs. The revenues which states can obtain from valuable oil and gas reserves are usually the most important benefit which African economies can have from the upstream petroleum sector.

States are normally interested in pursuing the following economic aims for licensing petroleum rights and the associated economic arrangements between state and firms:

i. Attract capable oil firms to carry out petroleum operations;
ii. Keep the firms incentivised for value-maximising decisions and operations;
iii. Secure a large share of the resulting value for the state;
iv. Be able to manage the economic risks for the state resulting from oil prices, geology and other uncertain conditions.

Oil firms normally pursue the following aims in the same context:

i. Make decisions which are suited to maximise value for the firm, usually applying discounted cash flow methodology adjusted for uncertainties;
ii. Manage economic risks for the firm;
iii. Maintain flexibility to adjust operations to new information and changing circumstances;
iv. Freedom to move capital and other company resources in and out of the jurisdiction;
v. Avoid excessive political risks.

The fiscal system (economic arrangements between state and firms) for petroleum operations can be designed to balance these concerns of the state and firms. The needs and circumstances differ between countries, and different countries therefore have different fiscal systems. There are however some common features. A production sharing agreement (PSA) is one common form of licensing arrangement in Africa and elsewhere. Its economic provisions are based on the concept that the oil firms use part of the produced oil to recover their costs, and then the remaining "profit oil" is shared between the firms and the state. There can also be other kinds of fiscal instruments involved in such agreements, such as a signature bonus (an amount payable by the firms upon signing the agreement), royalty (a share of production going directly to the state without deduction of costs) and income tax payable by the firms on the profit they make from operations under the agreement.

There are other forms of petroleum agreements besides production sharing agreements:

Concessionary licenses are common in Europe and North America. They rely more on public law and less on contracts for specifying the terms under which oil firms operate, and public revenues from them are mainly from taxation (including special resource taxes) rather than contractual sharing of production.

Service contracts are often used in countries which have already made large discoveries but where the state requires assistance from international oil firms to produce them effectively. Service contracts come in different forms, which differ in how risks and rewards are shared between the state and the firms.

PSAs are often made for license areas where there is no prior discovery, and can reward firms significantly in cases when valuable discoveries are made.

Fiscal systems which are designed to secure for the state a high share of value from profitable developments may blunt incentives for effective operations and value-adding investments. In some cases, it can even result in the highly distortive "gold plating" syndrome, where firms can increase their profits by wasting money[14]. The need to design fiscal systems to avoid distortive effects on firms' incentives is widely recognised.

2.2.6 The challenge of gas flaring

Gas flaring, in which large amounts of gas are burned off at oil fields, is mostly recognised as a waste of a valuable resource and an avoidable burden on the environment. The largest amount of flaring takes place in Russia, followed by Iraq and Iran. In recent years there has been significant flaring even in the U.S.A., notably in conjunction with shale oil production.

The fiscal system (economic arrangements between state and firms) for petroleum operations can be designed to balance these concerns of the state and firms.

The gas which is often flared is associated gas that was dissolved in the oil and produced with the oil. Oil firms flare it because the value of the gas is small in relation to the value of the oil, so to optimise value, oil production is carried on regardless of the associated gas, for which it is difficult to find efficient uses or applications. Power generation is a possibility, but the amounts of gas produced at any given time will vary with oil production and may not match power users' requirements or the capacity of the power generating equipment.

The World Bank publishes estimates for gas flaring based on satellite observations[15]. According to these, Algeria and Nigeria are Africa's largest flarers of gas, although both countries are trying to reduce it. There are also flares in Angola, Egypt, Libya, Gabon, Congo (Brazzaville) and Cameroon.

Nigeria has long had a focus on the issue of gas flaring and on opportunities for obtaining value for its significant gas volumes. A gas master plan was approved in 2008, which attempted to co-ordinate the development of gas production, infrastructure and applications including exports. A national gas policy was passed in 2017, addressing similar issues.[16] The country still has significant shortcomings in electricity supply while gas is flared extensively.

14 The "gold plating syndrome" has been described by several authors in relation to the petroleum fiscal systems of some countries, where the fiscal provisions in some circumstances cause the oil firms' profits to increase if they needlessly increase expenditures, inflicting losses of revenue on the state.
15 www.worldbank.org/en/programs/gasflaringreduction#7
16www.petroleumindustrybill.com/wp-content/uploads/2017/06/National-Gas-Policy-Approved-By-FEC-in-June-2017.pdf

2.3 OIL REFINING

Oil refineries convert crude oil into useful petroleum products. Oil production capacity must therefore be matched by refining capacity world-wide. This section is a brief introduction to oil refining in terms of component processes, economics, industry structure and Africa's position.

2.3.1 Oil refining processes and products

Modern refineries have many different processing units, in configurations which differ between refineries. The processing units appear mostly as tall columns. Refineries also need storage tanks for crude oil, intermediate and finished products

The processing unit into which the crude oil is first fed is the crude distillation unit (CDU). It uses heat to distil the crude oil into different fractions, from light to heavy. The fractions are, for the most part, not ready to be sold as consumer products, but must undergo further processes. Those are complex and very costly. The capacity of a refinery is stated in bod of crude oil feed, but this is an inadequate indicator of what a refinery can deliver in terms of petroleum fuels.

Figure 8:A medium sized refinery in Europe

The fractions obtained from primary distillation in the CDU can be classified as follows, indicating also the main end products which can be obtained after further processing.

Range	Fractions	Main end products after processing
Light:	Gases Naphtha (light and heavy)	LPG Gasoline
Middle distillates:	Kerosene fraction	Jet fuel Kerosene
	Gasoil fraction	Diesel Light heating oil
Residue:	Atmospheric residue	Heavy fuel oil Bitumen (depending on crude oil quality)

A global challenge for refineries is that quantities of the fractions obtained from primary distillation do not match the need for end products. When distilling common grades of crude oil, the fractions obtained are 40% or more atmospheric residue. This can become heavy fuel oil and some bitumen, but the demand for heavy fuel oil is only 8% of the total demand for refined products world-wide, and 11% in Africa[17], percentages which are falling. Bitumen adds some 2% to global residue fraction demand, making it still much less than its fraction of crude oil. To obtain a smaller volume of heavy fuel oil and more high-value automotive fuels, refineries have for several decades used additional processing units called crackers. They break up the big molecules of residue to obtain smaller and lighter molecules which can be treated to become diesel and gasoline. Cokers, thermal crackers, fluid catalytic crackers and catalytic hydrocrackers are the main types of crackers. Modern crackers and their associated processes add greatly to the cost of refineries but are essential for obtaining a mix of refinery outputs that matches demand for quality fuels.

There are a number of other processing units required to meet modern quality standards for automotive fuels. For the middle distillates, catalytic hydrotreaters are used for removing sulphur and for other quality improvements. Catalytic reforming is needed to convert heavy naphtha into a high-octane gasoline component, and to obtain hydrogen needed for other processes. Isomerisation improves the octane rating of light naphtha to make it suitable for gasoline, and alkylation can be used to convert certain gases to high-octane gasoline. Blending, storage and logistics are other important functions at a refinery.

17 BP Statistical Review of World Energy 2017.The quoted percentages are for 2016.

2.3.2 Global refinery industry structure

In 2018, there were 616 refineries world-wide[18]. Refining technology has changed but little from 40 years ago. Scarcely any new refineries have been built in Western Europe or North America over the last 30-40 years. Several have closed, and the remaining ones have either been well maintained or upgraded. Upgrades undertaken have been partly to optimise and increase capacities, but also to meet stricter environmental quality standards.

World-wide refining capacity grew by 10% from 2006 to 2016, mostly in China, which increased its share of global refining capacity from 10% to 15%. India, South Korea, Russia and some Middle East countries have also increased their refining capacities. Western Europe and Japan have reduced theirs as their consumption of refined petroleum products contracted.

To be accessible for crude oil supply, refineries are located either on the ocean coast or at an inland crude oil pipeline. Coastal refineries have the flexibility of procuring crude oil from many sources. The inland ones are more closely tied to the oil fields that feed into the pipeline. It is common for refineries to be located near the consumer markets which they serve.

Most refineries are owned either by large integrated oil firms (ExxonMobil, Shell, Total etc) or by national oil companies. Several among the integrated oil firms have divested or reduced their refinery businesses. There are currently few firms specialising in refinery operations and actively pursuing new refining opportunities internationally[19].

2.3.3 Africa's refining sector

Some refineries in Algeria and South Africa operate at reasonable utilisation rates. For the rest of Africa, average refinery capacity utilisation in 2016 was 46% (World average: 83%)[20]. ow operating rates together with the ability to operate at high regularity and capacity utilisation, is an important condition for the profitability of the refineries. Low operating rates indicate a severely underperforming industry.

The Annual Refining Survey by the Oil and Gas Journal (2018) lists 44 refineries in Africa, but several of these closed, and several others are only in partial operation. African refineries are generally smaller

18 Oil & Gas Journal: Annual refining survey 2018.
19 The largest independent refiner is Valero (www.valero.com), based in the U.S.A. and having refineries also in Canada and the United Kingdom. Another firm, Petroplus, was formed in 1993 as a European focused refining specialist. It acquired several old European refineries, but struggled to make the business model work, and went into liquidation in 2012.
20 BP Statistical Review of World Energy 2017.

and have much less upgrading capacity than those elsewhere[21]. The average size (listed primary distillation capacity) of African refineries was 76 000 bod, whereas the world average was almost double, at 148 000 bod. The African capacities for upgrading heavy oil fractions by cracking was only 40% of the world average in relation to primary distillation capacities. In recent years Africa has imported more than half of its total diesel and gasoline requirements from outside the continent. But for heavy fuel oil, African refinery output was higher than African domestic consumption. Heavy fuel oil is low-value product, and its consumption is falling in Africa and elsewhere.

If a refinery is built for the purpose of refining crude oil from a particular source, the refinery can be configured to match that crude oil quality optimally. Most refineries still have the flexibility to refine crude oils of different quality, within limits, and they can blend different crude oil qualities before processing them. African crude oils tend to be light, in the range of 30 – 40 degrees API, but still yielding large fractions of residual (heavy) fuel oil from primary distillation, often around 40%. To match Africa's consumption, this fraction should ideally be less than 10%, for which advanced cracking and other upgrading capacities would be needed in African refineries.

African refineries are mostly old, but not necessarily older than refineries in Europe and North America, which achieve much higher capacity utilization.

21 The average size (listed primary distillation capacity) of African refineries was 76 000 bod, whereas the world average was 148 000 bod. The African capacities for upgrading heavy oil fractions by cracking was 40% of the world average, in relation to primary distillation capacities. Calculated from the Oil and Gas Journal annual refining survey (2018).

Some African refineries have closed in recent years, including East Africa's only refinery at Mombasa, Kenya. One of Africa's larger refineries, the SAMIR refinery in Morocco, is was in bankruptcy proceedings in 2018[22] and finally closed in 2019.

Outside South Africa, most African refining capacity is in state ownership. The biggest exception was the bankrupted Moroccan refinery referred above.

The economic performance of African refineries is in many cases opaque. Financial statements on their profitability tend not to be available. Even if they were, many African countries operate government-controlled prices for fuels and/or allocations of crude oil from state shares of production, which create distorted impressions of economic performance. South Africa's system of government-controlled petrol prices is different from other countries in Africa, but it has influenced refinery economics in favour of refinery owners, according to South African researchers[23].

When fully operational, this refinery could increase Africa's output of refined fuels by nearly a third from the 2017 level.

African states, as refinery owners, have clearly not been in a position to implement management and financing frameworks enabling efficient operations at their refineries.

2.3.4 A new, privately owned Dangote refinery in Nigeria

Construction work has started for a new refinery in Nigeria which will be entirely different from anything currently on the continent. Privately owned by the Dangote Group it is reported as costing $12 billion and will have a crude distillation capacity of 650,000 bod, making it one of the world's largest. Upgrading capacities include catalytic cracking capacity of 170,000 bod. It includes petrochemical and nitrogen fertilizer plants which are set for commissioning by 202[24].

When fully operational, this refinery could increase Africa's output of refined fuels by nearly a third from the 2017 level. It will have the capacity to cover much of the fuel demand not only of Nigeria but also of several West African neighbouring states.

22 Status as of March 2018
23 Mondliwa and Roberts (2014)
24 https://www.theafricareport.com/29913/nigerias-dangote-still-expects-refinery-to-be-running-early-2021/

2.3.5 Mini-refineries

There has been some interest in Africa in building smaller refineries. Plants with distillation capacities of around 10,000 bod or less have operated in Sudan, South Sudan and a few other countries. At least one American engineering firm offers refining units which can be manufactured and assembled on a modular basis[25]. World-wide, there are few such units operating, mainly in circumstances not suited to conventional refining but with a need to obtain some refined product from available crude oil. In China a number of small, so-called "teapot" refineries have been established, although they have come under increasing competitive and financial pressure recently[26].

Such small refineries generally have simple configurations. The Sudanese examples were described as a topping plants, engaged in the distillation of crude oil only. This normally yields little or no product meeting modern quality standards for automotive fuels. Depending on the crude oil quality, it may be possible to obtain some middle distillate which can be used for some applications, or which can be blended into higher quality material. Processing units can be added to obtain more useful products, for instance a reformer to obtain gasoline. At such a small scale, processing units will be costlier relative to capacities than conventionally sized plants. In addition to any limited fractions of products that can be used for high-value applications, the simple refineries mainly yield larger fractions which can essentially be used as fuel oil. Africa already has a surplus in this category.

The refining margin is usually expressed in dollars per barrel, which fluctuates in time due to changing prices, but since the prices of crude oil and refined products tend to move in a largely synchronised fashion, changes in the oil price do not necessarily trigger large changes in the refining margin.

2.3.6 Refining economics

Refineries generate income from the refining margin. This is the difference in value between the products they produce and the crude oil they consume. The refining margin is usually expressed in dollars per barrel, which fluctuates in time due to changing prices, but since the prices of crude oil and refined products tend to move in a largely synchronised fashion, changes in the oil price do not necessarily trigger large changes in the refining margin. The refining margin differs between refineries due to their different process configurations determining what they can produce, different crude oils used, and freight differentials for crude oil and products at the refinery. The refining margin must cover capital costs (depreciation and financing),

25 http://www2.ventech-eng.com/
26 https://www.ft.com/content/5a78b594-a365-11e7-9e4f-7f5e6a7c98a2

operating expenditures and leave some profits for the refinery owner.

BP's Statistical Review of World Energy for 2018 has a graph for refining margins calculated for refineries in selected locations. For a complex refinery in North West Europe, the average refining margin was fluctuating around $5 per barrel during 2007-2017[27]. For a refinery in the US the margin was somewhat higher, and in Singapore somewhat lower. For simpler refineries, of which Africa has many, the refining margin would be much less if located in those regions[28]. The refining margin which can be obtained by a particular refinery depends on its process configuration as well as locational factors such as crude oil supply and local product market conditions. This puts some African refiners in a position to obtain somewhat better margins than would be available at the major refining hubs in Europe, North America and Asia.

Considering that oil prices in the period referred were in the range of $50-100, a refining margin of $5 per barrel, or less, somewhat limits the potential for refineries to be large sources of added value in the overall petroleum sector. The tendency for many private-sector oil firms to reduce their interest in refining can be understood in part on this background.

Modern, complex refineries have high construction costs, as evidenced by the $12bn estimate for the Dangote Group's large project in Nigeria and the estimate of $3-4 bn for a 60,000 bod refinery in Uganda (section 4.5). Refining can be seen as a business of slim margins and high volumes. Competition in the sector has been fierce, keeping margins under pressure. Not all refiners have made attractive profits over this period. Making a refinery profitable over time tends to require the following:

i. Medium to large size (>100,000 bod common);
ii. Configuration adapted to demand, requiring complex upgrading processes;
iii. Products meeting applicable environmental and other standards;
iv. Good location for serving a product market not served well by other refineries;
v. Strong operational efficiency;
vi. Continued access to funds for good maintenance and upgrading requirements.

27 BP calculated the margins by deducting not only crude oil costs, but also other variable costs from the value of products.
28 Simple refineries are referred to as Hydroskimming (crude distillation+reformer) or Topping (just distillation)

As for operational efficiency, it is common for refiners to subscribe to benchmarking studies prepared by a consultancy[29]. They provide each refinery owner with information on where the plant is positioned against competitors on various indicators of efficiency.

Where government operates schemes of controlling or subsidising fuel prices, refining economics are likely to be affected. It also creates the challenge of distinguishing between the refinery owner's reportable profits and the real economic contribution made by the refinery to the national economy.

Quality standards for fuels have generally been tightened in most countries and over a period of several recent decades, for environmental and other reasons. Fuel quality standards are less stringent in some African countries than elsewhere, and this has caused some trade in lower-quality material being imported to Africa from outside. Fuel quality standards are not harmonized across Africa. Many African refineries would face large investment requirements to enable compliance with modern fuel quality standards applied in Europe and North America. Those having plants of small size and run-down conditions are in a weak position to undertake such investments.

An added challenge for many African refineries will come from new environmental rules for international shipping applicable from 2020, when a lowered limit on

29 https://www.solomononline.com/benchmarking/refining

sulphur emissions from ships' engines will apply under the MARPOL convention[30]. Ship owners are deploying different strategies for complying with these requirements, some of which entail switching to cleaner fuels such as distillates or liquefied natural gas (LNG), but also cleaning (scrubbing) the emissions from ships still using heavy bunker oil. The implementation of the MARPOL regulations from 2020 are expected to gradually reduce the shipping sector as an outlet for bunker fuel made from heavy fuel oil, which African refineries produce in abundance.

2.4 TRANSPORTATION OF OIL AND REFINED PRODUCTS

Crude oil in international trade is transported mainly by tanker ships on the ocean. The ships used in long distance trade are often of the VLCC size[31], carrying around 2 million bbl. in one cargo. Smaller ship sizes are also used. Pipeline is the main transport form where ocean shipping is not an option or for some other reason inconvenient. Transportation by rail is used mainly in North America. Trucks are also used, mainly to move oil from small producing fields across moderate distances to stations where it can be fed into a pipeline or a nearby refinery.

Crude oil production and refining usually involve the movement of large volumes of crude oil. This favours large bulk transport solutions such as tanker shipping and pipeline. Rail and especially trucks are suited to smaller volumes and relatively short distances. If a 60,000 bod refinery, for example, were to be supplied with crude oil by tanker trucks, it would require some 200 large truckloads per day. Crude oil movements by rail requires access to rail lines suited to such traffic, able to handle large trains on dual tracks.

For refined petroleum products, movements by truck and rail are more common, since volumes tend to be smaller and dispersed to many delivery points. River barges can be used where available. There is international trade in refined products by tanker ships, usually of smaller size than those used for crude oil. A distinction is made between "clean" and "dirty" tanker ships, where the former are used for light petroleum products such as gasoil, kerosene, gasoline and naphtha. The reason for using different ships is to avoid the light product being contaminated by heavy products from previous cargoes. Pipeline movement of refined product is used in many places usually for distances of up to a few thousand kilometres. The products pipeline in Kenya is an example[32]. It is possible to send products through such pipelines in batches, so that the pipeline is used for several different refined products without mixing them. Adequate storage tank capacities are needed at terminal points.

2.4.1 Pipeline transport

In some cases, a pipeline to transport crude oil is organised as an extension of the field development where the crude oil originates. The owners of the pipeline may then be the same as the owners of the oil inside it. In many cases however, and especially over long distances, it will be relevant to use the pipeline for oil from several fields, with different ownership.

This calls for a system of compensation by those using the pipeline for their oil to the owners of the pipeline. It is usually done by a tariff system. When a pipeline is used for crude oils of different origins, there is often an issue with crude oil quality. The oil redelivered to pipeline customers downstream, is a blend of the different oils entered upstream. Crude oil qualities have different value as indicated in section 2.2. Pipeline systems in various locations have agreed procedures for compensating for such differences in crude oil and value.

When a pipeline starts being used for crude oil from several origins, it may continue to be owned by the licensees for whose purpose the pipeline was originally built, requiring other users to pay tariffs. More often, the pipeline and associated terminals etc. is organised as a separate venture, charging tariffs from all users. Ownership of the oil transported and ownership of the pipeline may be overlapping but not identical. Some owners may effectively be paying tariffs to themselves: paying as a

30 MARPOL – International Convention for the Prevention of Pollution from Ships, in particular its Annex VI. See http://www.imo.org/en/MediaCentre/HotTopics/GHG/Documents/FAQ_2020_English.pdf
31 Very Large Crude Carrier (VLCC)
32 http://www.kpc.co.ke

pipeline user, receiving as a pipeline owner. This is the planned setup for the crude oil pipeline from Uganda to the Indian Ocean coast. Taking this a step further, some oil firms may eventually find that they no longer have an interest in owning shares in the pipeline, as long as the pipeline is there and they have assured access to it at agreed terms. They can then sell their pipeline shares. In other parts of the world, buyers of pipeline shares in such cases have often been firms specialising in pipeline transportation as a business, often financed by investment funds who manage pension funds and other long term investments.

Having adequate storage space and facilities for handling ships helps avoiding excessive shipping costs while providing added security of supply of refined fuels.

Pipelines tend to cause what economists call "natural monopolies": Where a large pipeline is built, it often makes little economic sense to build a second one. As long as there is available capacity, the pipeline operator can take in additional volumes to be moved without incurring any significant extra operating costs. Unless regulated, the owner of the pipeline then has monopoly power over the transport service needed by oil firms operating near the upstream end of the pipeline. The issue is discussed further in section 4.5 and chapter 5.

2.4.2 Oil terminals

An oil terminal is an installation with large tanks for storing crude oil and/or refined products. Africa has several export terminals for crude oil and import terminals for refined products, both of which have been built at coastal locations to facilitate international transportation by ship. There are also inland terminals for refined products serving as a distribution hub and intermediate storage for products which are brought there by pipeline, rail and/or trucks. An oil refinery normally includes the functions of an import terminal for crude oil and an export terminal for refined products. Several refineries in Africa have been closed down but continue to function as import terminals based on the available tank space and jetties.

Having adequate storage space and facilities for handling ships helps avoiding excessive shipping costs while providing added security of supply of refined fuels. In addition to storage and movement of products, oil terminals can be used for blending operations. Blending (mixing) refined product components of different process origins is sometimes important for meeting applicable product standards and for optimising the value of product components.

Control of storage volume can be an important strategic asset for a firm operating in oil trade and fuels retailing. It can also be a tool for monopolistic pricing practices for those who are in a position to influence prices by using the storage for withholding and releasing product to the market. Ownership and business model for an oil terminal is important in this regard. Some terminals are controlled entirely by one of the participants trading in the markets for refined products. Others are operated as joint ventures by several oil companies with carefully regulated rights of use, and yet other terminals may be operated by an independent service provider who charges tariffs without being a trading participant in the market.

2.4.3 Shipping and other bulk transportation

It is uncommon for oil companies to own the ships used for transporting their oil. Ships are owned by firms specialising in that business (ship owners). There are different types of contractual arrangements by which oil firms can procure ship transportation. The most relevant for shipping oil are the following:

i. Spot charter (Voyage charter): Agreement for a single voyage, or limited number of voyages.
ii. Contract of affreightment: Agreement for transport capacity to be made available for a defined period. Allowing the charterer (oil firm) to nominate voyages to be performed, for which he will pay according to an agreed schedule.
iii. Time charter: A ship, with crew and operations, is made available to the charterer for an agreed period of time. The charterer pays a (monthly) charter rate and must also pay for fuel consumption and port fees, since these depend on how the charterer decides to use the ship.

With time charters, the charterer (the oil company) is placed in a commercial position resembling that of a ship owner: He has access to a ship and is free to schedule its use, including the possibility of offering freight services to third parties[33].

The global markets for tanker shipping have many participants and are actively traded. Rate levels vary over time with supply and demand conditions, and have tended to be quite volatile. This is indicated by Figure 9, which show market rates assessed by a leading ship broker.

Shipping has become a business in which nationality is hard to pin down. Each ship has a nationality, whose flag it carries and also indicated by the name of a port of registration shown on the ship's stern. Many ships are registered under so-called flags of convenience, of jurisdictions where they will be required to pay little if any taxes, and other reasons of commercial advantage. A ship may represent many nationalities: Flying the flag of one country, having been built in a second country, with an owner from a third country, operated from an office in a fourth country,

33 The time charter party may contain restrictions on such re-chartering

captain and officers from a fifth country, other crew from a sixth country, and moving cargoes between yet other countries. Ships are often bought and sold, so can have several owners, names and flags over their life of 30-50 years.

Road transport services for oil can be provided by transport firms which own and operate trucks. Trucks may alternatively be owned by fuels distribution and retailing firms, or the latter may own the tank trailers but not the trucks hauling them.

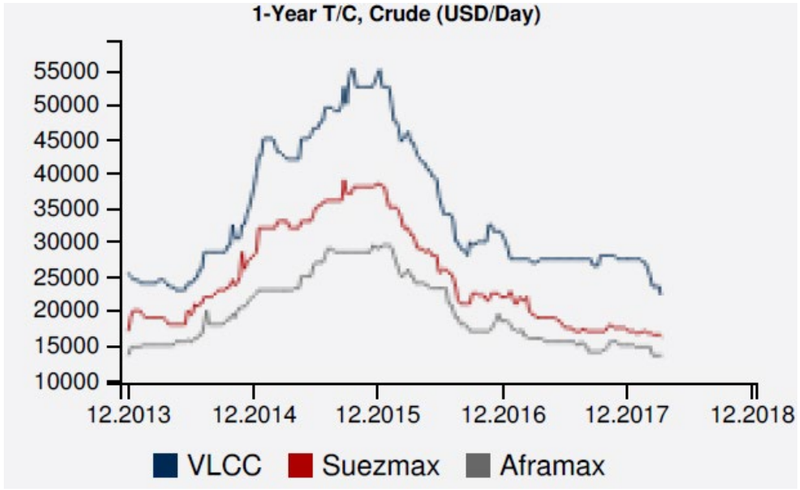

Figure 9: Market rates for tanker shipping as one-year time charters.

2.5 PETROLEUM PRODUCTS DISTRIBUTION AND RETAILING

Fuels distribution and retailing is a business found in all countries of the world. These firms operate systems of service stations where motorists can buy fuels. They also arrange for deliveries to larger customers by trucks or other means. The most common petroleum fuels are the following (their main uses in brackets):

i. Diesel (used for automotive, generators, some industrial engine or heating fuel)
ii. Petrol (automotive, small generators)
iii. Kerosene and jet fuel (domestic fuel, aviation. Kerosene and jet fuel are similar in quality.)
iv. Liquid petroleum gases - LPG (domestic and industrial fuel; automotive in some countries)
v. Heavy fuel oil (ships' bunker fuel, power generation, industrial fuel)

Other than fuels, bitumen (asphalt) lubricants and solvents are special refined petroleum products distributed to commercial buyers.

Different arrangements are found concerning the ownership and operations of service stations. These may carry the brand of a well-known oil company, but are in many cases operated by a local business person under an agreement (franchise) with the oil company. The facilities may be owned by the oil company and/or the local franchise taker. Service stations sell not only fuels, but often also equipment for motorists, fast food, magazines, groceries, car wash and other things. Some also provide repair services for cars.

The business of fuels distribution and retailing involve the following key activities critical for commercial success:

i. Acquisition of good sites for service stations;
ii. Attractive service stations with access to other products and amenities appreciated by motorists;
iii. Access to adequate supplies from refineries or import trade;
iv. Effective logistics, including terminals with storage tanks and truck transport;
v. Effective marketing and customer loyalty schemes, often involving payment cards;
vi. Strategic or national emergency stocks as may be required by legislation.

It was noted in section 2.4 that the large traditional oil companies have tended to reduce their interest in refining over recent decades. This is even more in the case of petroleum products retailing business. The activities listed in the bullet points above are a rather different from finding and extracting oil in the underground, requiring entirely different capabilities for a firm to be competitive. Shell is an example of a firm that has concluded that it will be an oil producer but not a supplier of fast food and magazines and has in recent years taken steps to exit the retailing business in Africa and elsewhere. Buyers have been firms with a focus on fuel logistics and service stations with a regional focus. Preparations are under way for rebranding its service stations.

2.6 PETROCHEMICALS

Petrochemicals is chemical conversion of petroleum to make products used for other purposes than fuels. The term is most often applied to steam cracking to make olefins (ethylene, propylene and some others) and their derivative products, of which the largest category is plastics (polyethylene, polypropylene and some others). The term petrochemicals is sometimes also applied to certain industries which are mainly based on natural gas, notably the manufacture of

The largest application of ethylene and propylene is to make plastics: Polyethylene and polypropylene (polymers). These processes (polymerisation) are the next step in the petrochemical value chain, after steam cracking.

ammonia and its derivative products (which include N-fertilisers) and methanol. These gas-based industries are outside the scope of this report, and the coverage here concerns petrochemicals in the sense of steam cracking to make olefins and their derivatives. It can also include products made from aromatics such as polystyrene. Aromatics can be extracted from petrochemical crackers and certain refinery processes.

Steam cracking is the initial major process in the petrochemical (olefins based) value chain. It involves heating a suitable hydrocarbon feedstock to around 850oC, at which it breaks down to smaller molecules of which many are olefins (ethylene, propylene, butadiene and others). These are the building blocks for the further petrochemical conversions. Olefins tend to be unstable substances, easily reacting and combining with other molecules. Some are used for making various chemicals.

The largest application of ethylene and propylene is to make plastics: Polyethylene and polypropylene (polymers). These processes (polymerisation) are the next step in the petrochemical value chain, after steam cracking. Petrochemical firms produce polyethylene (PE) and polypropylene (PP) usually as bulk products in granulate form, which are sold to other firms to turn them into useful items. PE and PP can have many different qualities suited to different end products. The qualities include softness, strength, transparency and several other parameters, sometimes enhanced by using additives with the product. The versatility of PE and PP make them convenient to be used to make many different items.

The choice of feedstock for steam cracking affects the composition of cracker products obtained. The feedstock in common use include the following, ranged from light to heavy:

- Ethane (C2H6)
- Propane (C3H8)
- Butane (C4H10), preferably N-butane
- Naphtha (C5+), preference for light and paraffinic
- Condensates (C5+), preference for light and paraffinic
- Gasoil

The terms N-butane and paraffinic above refer to the structure of molecules. Naphtha and condensates differ in origin but may be broadly similar in composition:

Naphtha comes from refineries (it is essentially unfinished gasoline), whereas condensates are stable liquids obtained from processing natural gas. Ethane is also obtained from processing natural gas: It can either be sold as part of the natural gas or extracted from the gas to be sold separately. Propane and butane are produced in refineries and in gas processing plants. Gasoil can be used in principle, but this is not very common, since gasoil has more valuable application as diesel.

Methane, which is the main component of natural gas, is not a suitable feedstock for petrochemicals involving steam cracking. There is technology which can convert methane to olefins, but it has not proved to be commercially viable.

2.6.1 Recycling of petrochemical products and environmental concerns

Spent plastic products can be recycled for re-use of the material, as can also products from metals and glass. Plastics recycling entails some challenges not found to the same extent with metals and glass, due to the variety of plastics in use and the additives used to modify their physical properties. There are many companies engaged in plastics recycling in Europe, North America and elsewhere, and there are industry associations for it whose web sites provide some guidance to recycling processes[34].

The reasons for recycling are economic and environmental. Conventional plastics do not decompose easily in nature but tend to tear up into ever smaller pieces which may be taken up by living organisms. Cracking and polymerisation processes used to make plastics require substantial amounts of energy and re-using the materials can therefore reduce the environmental burden in a global climate perspective. It also reduces the amount of litter piling up at landfills and less suitable locations. Recycling of plastics is therefore a business activity which promoted by various means by authorities around the world. Another concern emerging more recently is the accumulation of plastic litter in the oceans, including very small items. They may accumulate along the maritime food chain and end up in food consumed by humans. The long term effects of this are not yet well understood, providing a further reason for recycling rather than throwing plastics away.

2.6.2 Petrochemical industry structure

Petrochemical plants are large industrial installations. Their capacities tend to be several hundred thousand tonnes of feedstock and product per year, in some cases more than a million tonnes.

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34 http://www.plasticsrecyclers.eu; https://plasticsrecycling.org

Petrochemical plants are usually located where there might be synergy with feedstock supply or other chemical processes. Historically they were often located together with a refinery, which would then supply feedstock (mainly light naphtha) for the petrochemical crackers. This is also the case for several large refinery projects in Asia which are ongoing or have been completed in recent years. The demand for refined petroleum products has focused increasingly on automotive fuels, including petrol components which can be made from light naphtha. A refinery can set aside light naphtha for petrochemicals or use such naphtha for petrol after some further processing. There are certain other product streams in complex refineries which can be used for petrochemicals, such as light olefins which are by-products from catalytic cracking.

Alternatively, petrochemical plants can be located for good access to gas-based feedstock, especially ethane and condensate. This can be near a large gas processing plant. Petrochemical plants have a lifetime of 30 years or more, and investors will need reasonable assurance of being able to obtain feedstock in a similar time perspective.

Chemical companies which engaged in petrochemicals often co-located their plants in large chemical complex sites, where there would be various synergies between the many different processes. An example of this is Sasol's complex at Sasolburg, South Africa.

In the 1990s and later, several oil companies divested many of their petrochemical interests, giving rise instead to companies focusing specifically on petrochemicals and plastics. In recent years there has been some revival in large oil firms' interest in petrochemicals, notably to exploit opportunities for using low-cost feedstock. Several firms are planning ethane crackers in the USA to take advantage of low natural gas prices resulting also in low prices of ethane extracted from natural gas. There are also some recent and ongoing projects for large refineries in Asia, as well as the Dangote refinery under construction in Nigeria (section 2.4.4 above), which include petrochemical plants to utilize certain intermediate product streams from the refinery.

Polyethylene and polypropylene are sold in bulk by the petrochemical firms to other firms sometimes referred to as converters, which turn the bulk plastic products into other products. Converters are a large collection of smaller firms and industry plants with many different specialisations in which markets they serve. Since the polymers can be transported cost-effectively on road trucks and other means, there is usually no strong drive to co-locate the converter plants with the large petrochemical plants. It is common for polymers to be traded across borders, enabling converters to select the best supplier for their purpose from a number of international firms.

In Africa there are significant petrochemical plants in Egypt, South Africa, Algeria and Libya, though production in the two latter countries is currently inactive (April 2018). A new, sizeable petrochemical complex was inaugurated in Egypt in 2016[35]. South Africa has petrochemical plants at Sasolburg, expanded in 2014. Plans for new petrochemical plants have been launched in Algeria, including large new capacities for MTBE, alkyl benzene, polypropylene, ethane & LPG cracking and polyethylene terephthalate, and revamp of existing facilities. The new Dangote refinery project in Nigeria includes petrochemicals as well (section 2.4.4). Libya's petrochemical plants at Ras Lanuf have been shut-in since 2013, but may be restarted.

2.6.3 Petrochemical economics

The capacity of steam crackers is usually stated in terms of tonnes ethylene per year, this being traditionally their main product. Especially if using relatively heavy feedstock, such as naphtha or condensate, they also produce large volumes of valuable co-products, including propylene. Ethylene, propylene and their polymers (PE, PP) are traded bulk commodities whose prices are assessed by reporting agencies such as Platts (refer section 2.2.5). Their prices have tended to fluctuate driven supply and demand conditions, and not always in tandem with oil prices. For this and other reasons, the profitability of petrochemical operations has been variable over time, giving it the character of a cyclical industry. During 2012-2017, the large, focused petrochemical firms Borealis and LyondellBasell both reported solid earnings throughout the period.

35 http://www.plasticsnewseurope.com/article/20160929/PNE/160929768/egypts-ethydco-opens-1-69bn-pe-complex-in-alexandria .

As with refineries, petrochemical plants need to have effective configurations, favourable locations (in particular, feedstock access) and be effectively managed to achieve good profitability over time. Failing these requirements, a petrochemical industry in a country can become a significant burden on the national economy.
International firms can be expected to look for significant price advantages on feedstock when considering investments in petrochemicals. The USA, with low market prices for gas and ethane, is currently a favoured investment destination for that reason. Algeria in 2004 agreed with Total for a petrochemical complex to be built there, but according to press reports the deal eventually collapsed..

2.7 THE SUPPLY OF GOODS AND SERVICES IN THE PETROLEUM SECTOR

This section concerns the businesses which supply goods and services to the petroleum sector. They are significant for discussions of local content, which entails the engagement of people and firms from the host country in the supplier industries. The discussion in this sector focuses mainly on supplies to the upstream segment. Similar considerations apply to the refining and petrochemical segments.

2.7.1 A collection of different industries

Petroleum operations require many different types of goods and services. The oil firms tend not to produce pieces of equipment themselves, so they buy all physical goods and a wide range of services needed for operations.

Some procured services and items are specific to understanding and managing reservoir conditions and to extracting petroleum from reservoirs. They include seismic and other exploration surveys, drilling services, equipment and services for managing reservoirs through well operations. The firms serving these requirements tend to be highly specialised on the petroleum sector, technology oriented, often innovative, and having a world-wide scope of operations. They include geophysical companies for seismic surveys, drilling contractors for onshore and offshore operations, oilfield services and other petroleum engineering specialists[36].

A number of equipment items are needed for on-site petroleum operations, depending on the circumstances. They often include pumps and compressors, power supply, separators and other process equipment, sensors and control systems, IT, cranes, valves, protective equipment, pipes, cables and many others. These are often supplied by international producers specialising in each type of equipment, sometimes serving also other industries than the petroleum industry but having similar requirements. These firms also tend to market their goods world-wide.

Especially for offshore operations there is a need for large items such as platforms, subsea support structures and modules for platform or site installations. These can be made in many parts of the world, often at yards with a history of building ships. Some very large construction yards in South Korea have been successful in capturing many such contracts for world-wide deliveries in recent years. There are also requirements for smaller fabrication works and technical services which can be done locally.

Support services of several kinds are needed. They may include maintenance services, transport, accounting, facilities management, catering, medical, security, and other operational tasks which oil firms prefer to contract out.

Professional services are procured in several disciplines. One large category here is engineering services for design of installations. Geological and geophysical (G&G) services may be needed for exploration interpretation work etc. Legal and other advisory services are often procured locally to take account of host country conditions.

Figure 10:Advanced drilling equipment

36 For some examples of firms in this segment, see www.schlumberger.com, www.halliburton.com, www.weatherford.com, https://www.technipfmc.com, www.bakerhughes.com

Figure 11: Drillship operating off Tanzania.

2.7.2 The global nature of many supplier industries

To inform discussions on local content, it is useful to understand why many supplier firms for petroleum operations operate with a global business scope.

Figure 10 and Figure 11 illustrate two kinds of resources possessed by specialised supplier firms: Unique competencies (illustrated by an item of advanced drilling equipment in Figure 10) and mobile high-cost assets (drillship in Figure 11).

Drillships similar to the one in Figure 11 can have construction costs of $500 million or more. They are ideal for drilling in very deep waters, often more than 1000m. For operations in shallow waters, cheaper rigs may be suitable. Being high-value and mobile assets best suited to deep-water drilling, effective utilisation of drill ships over time requires that they move around the world, taking assignments where their special capabilities are requested.

The common issue with the examples from the above figures is that these are highly specialised capabilities deployed with a global business scope. It would be wasteful to assign such capabilities to any home country with a requirement that jobs in that country can only be performed by local staff.

There are other segments among the supplier industries where the scope of business is not global, and does not need to be. These include on-site construction, services which require local presence and are not of the most specialised kind.

Having a global scope of business means in many cases having a presence in different regions around the world. Most supplier firms have a corporate national affiliation, as the country where they have the parent company, headquarters, many top managers and often a historic origin. But many of them have significant operations also in other countries, not only to serve that particular country but also as a basis for worldwide operations in particular segments of their business. For oil producing countries in Africa and elsewhere, this means that foreign firms can set up an affiliate and have a substantial presence in their country, employ local personnel and probably also use local sub-contractors for parts of their work.

2.7.3 Economics in supplier industries

When the oil price rose in the early 2000's to a peak in 2008, oil firms eventually found that the cost of building things and having services done for petroleum operations also rose. The fall in oil prices from 2014 has triggered downward adjustments in the prices charged by the suppliers. These developments are indicated by the graph in Figure 12, which is a cost index for upstream petroleum developments globally[37]. It can be related to the oil price graph in Figure 5 to show that times of high oil prices were also times of high or rising costs. One segment where this has been observed readily, is in rates for renting drilling rigs (including drill ships similar to the one in Figure 10), since this is a market where competition is international, intense and with observable effects on rates. In other segments of the supplier industries, the impact of oil prices on the prices charged by suppliers have been more subdued and/or less observable.

The supplier industries globally employ more people than the oil firms. Precise numbers are not known and would entail a delineation problem because some firms which are suppliers to the oil industry are also suppliers to other industries. But there has clearly been a tendency, in 2014/15 and on earlier occasions when oil prices have fallen, that those oil price falls have hit supplier firms hard, triggering layoffs of personnel and financial losses.

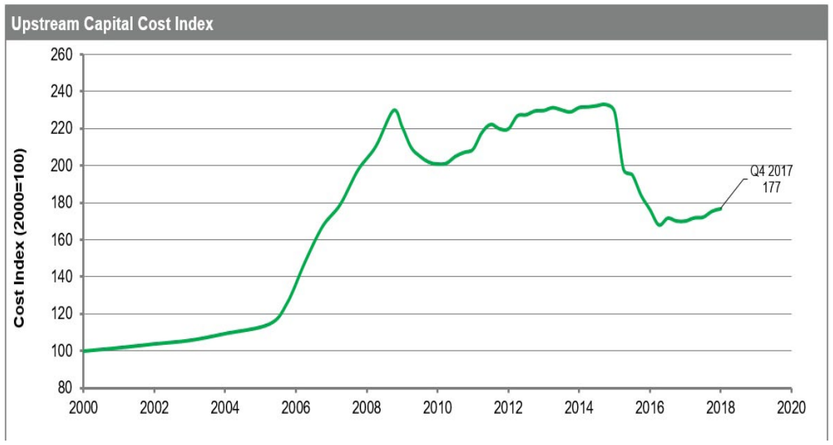


Figure 12: Upstream Capital Costs Index

37 https://ihsmarkit.com/Info/cera/ihsindexes/index.html

2.7.4 Capacity development for supplying goods and services for petroleum operations

Nationals of a petroleum producing country working for the petroleum sector require capabilities on the personal and organisational levels. Oil firms need employees often with university education in professions such as geosciences, engineering, economics, environmental sciences and law. Such personnel, with training from universities in Africa and/or elsewhere, have been recruited to oil firms in Africa. This has resulted in part from the oil firms' natural motivation to look for indigenous recruitment to reduce the high costs of moving in expatriates, but also from obligations which oil firms have undertaken to national authorities to recruit and train nationals of the host country. Since the oil companies tend to use external suppliers extensively and maintain fairly limited organisations of their own, the number of Africans who will benefit from such recruitment and training programmes is likely to remain quite limited.

Larger employment opportunities can arise among firms supplying goods and services for petroleum operations. The key condition for this is that such firms establish significant business operations in Africa, irrespective of whether their ownership is indigenous of the host country, other African or non-African. In such businesses, the largest personnel requirements are often for vocationally and technically trained professionals, not necessarily at university level. This is a segment of education which appears to be underdeveloped in many parts of Africa. For someone to be employed in a supplier business to petroleum operations, there will typically be a need for certified training in a relevant trade (electrician, mechanics, IT, construction trades, logistics, accounting, hospitality, etc.), supplied by specific job related training.

The oil industry needs to maintain strong quality systems for all aspects of petroleum operations. This puts requirements for quality systems also on firms supplying the oil firms even for seemingly simple tasks such as driving, security, catering and basic maintenance. Supplier firms need to be properly incorporated and compliant with applicable regulations, as oil firms will normally shun the informal sector. Supplier firms also need to provide documentation of adequate quality systems covering their operations, for instance as ISO 9000 certification.

03

Industry analysis: Potential impacts and competitive forces

This chapter provides an analysis of the potential of the oil industry segments for making valuable contributions to African economies in terms of state revenues, value creation, jobs and other effects. The potential dangers, including environmental, are also analysed. It is intended to provide guidance for African policy makers on whether there are reasons for governments to make particular engagements in developing the various parts of the petroleum sector, beyond general economic policies which may benefit any sector of the economy. The chapter also provides a basis for highlighting sector policy issues which are discussed further in the remaining chapters.

The analysis is summarised in Table 2, of which the bottom row concludes on the strategic development impacts. A high strategic development impact indicates that there may be reasons for government to engage actively in the sector, either to promote its development and/or to regulate it in ways not generally required for other sectors of the economy. A significant strategic development impact suggests the same in some but not all cases, or to a more limited extent.

The analytical framework is presented in section 3.1. Sections 3.2 – 3.7 comment on and supplement Table 2. Three final sections address issues which concern the entire petroleum sector value chain in Africa: National content (3.8), renewable energy and climate change (3.9), and gender and inclusion issues (3.10).

3.1 ANALYTICAL FRAMEWORK

An essential question facing African policy makers in respect of the petroleum sector is: Should policy makers pay particular attention to the petroleum sector?

The reasons for the question are the following: First, African governments aim for overall economic development generally, and not limited to particular sectors. Second, private sector business development is the main driver for broad economic development, with government as an enabler and provider of the social and regulatory conditions in which economic development can thrive.

Those conditions for thriving private sector economic development include conditions analysed in the World Bank's Doing Business reports (World Bank 2018). With very few exceptions, African country scores are poor, indicating that African governments have not successfully managed to provide favourable conditions for entrepreneurial contributions to economic development. This is a serious impediment to broad economic development. It indicates that even if the petroleum sector can make positive contributions to Africa's development, this alone is not sufficient reason for African government to devote special resources to the sector. Other sectors can make positive contributions to development, and they also require governments' financial resources and engagements so as to provide the basic conditions in which they can thrive.

For this reason, the analysis in this chapter aims to highlight conditions which would warrant any particular attention by governments to the petroleum sector, in the form of engagements which may require economic resources and/or regulatory undertakings. In the absence of such conditions, the implication is that the petroleum sector, or segments within it, may develop if private sector businesses find it attractive to do so without any particular privileges or promotions from the government.

Table 2 summarises the analysis. There is one column for each segment of the petroleum sector as reviewed in chapter 2 (sections 2.3 – 2.8) with the following additions: The transportation segment is divided into three; pipeline, shipping and road/rail, due to their very different structures. The supplier industries are exemplified in two columns; A and B, which represent two types of supplier industries as further explained in section 3.7.

The criteria

The criteria are represented by the rows in Table 2. Following are explanations of what they represent.

The first three criteria have a common heading: Competitive forces. They are summarised from Michael Porter's five forces model for industry analysis.[1] African firms are likely to have better prospects for successful entry and persistence in

1 Porter (1985). There are really six forces, as Porter later added the influence of other stakeholders to his model.

the segments where competitive forces are mostly low, than where they are high.

Entry barriers in the petroleum sector are primarily due to two conditions: Specialised capabilities not easily acquired or imitated, and high capital requirements. Entry barriers have two effects: They make it more difficult for newcomers to enter an industry, and they provide some protection for those who have already entered against competition, thus making the industry less competitive.

Intensity of competition summarises the other components of Porter's model[2] which are relevant for each segment. The emphasis is on conditions which can cause margins and profitability to come under severe pressure, making less efficient industry participants unprofitable in the long term.

Cyclicality is the tendency of prices and profitability in the industry to vary strongly over time. The term cyclicality is commonly used for this, but it gives a somewhat misleading impression that prices going down is a guarantee that they will come back up later. There is no such guarantee.

The next section of Table 2 summarises the positive impacts that the petroleum sector can have on African economies, in terms of the following four criteria.

Development inputs are products made in the segment which can be directly used and will be important contributors to economic activities and development.

Employment is an indicator of whether the segment can generate high or low employment of nationals relative to the investments required to develop the segment. All segments of the petroleum sector can generate some employment, but segments get a low score on this criterion if employment there is likely to be significantly less than would have been created by making comparable investments in other sectors of the economy.

State revenues is the potential for the sector to generate revenues for the state, either as broad-based taxes or from specific involvements by the state.

Indirect economic benefits are positive externalities, i.e. economic effects which may be felt by citizens who are not specifically involved with the sector as employees, suppliers or customers.

The next five rows in table 2 represent potentially negative impacts on the economy and society from the segment.

2 The original five forces of Porter's model are: Rivalry between competitors, threat of new entrants, threat of substitute products, suppliers' bargaining position, and customers' bargaining position.

Physical hazards is the possibility of harm from operations on people or the environment.

Direct societal impacts & risks arise if operations disturb people's livelihoods, for instance by requiring resettlements or upsetting established ways of life.

Macro-economic risk is the possibility that growth in the petroleum sector may weaken other sectors of the economy. The phenomenon referred to as Dutch disease is a manifestation of this: A strong petroleum sector may erode other sectors by strengthening the currency and driving up costs of labour beyond what other sectors can sustain, thereby hurting their competitiveness against foreign suppliers.

Risk of state financial losses may occur primarily if the state has elected to make financial commitments towards developing the sector, for instance, by participating as an owner in a refinery. This criterion can be disregarded in cases where the industry establishes in the country without any particular economic commitment from the state.

Risk of monopoly power is the danger that certain players may gain undue influence over prices and other terms affecting others. Even where the risk is highlighted in Table 2, it is usually possible for authorities to mitigate the risk by carefully designed regulatory measures.

Strategic development impact: This parameter represents a conclusion drawn from the above criteria and other analysis in this report. Where the strategic development impact is High, there are tentatively reasons for the state to engage specifically with the segment as regulator and, in some circumstances, with economic commitments.

Table 2: Competitive forces and potential impact of petroleum value chains on national development in Africa

►Segments ► / ▼Criteria▼	Exploration & production	Refining	Pipelines	Ship transport	Road/rail transport	Retail	Petro-chemical	Supplier **) industries A	Supplier **) industries B
Competitive forces:									
Entry barriers	Moderate	High	High	Low	Low	Low	High	High	Moderate
Intensity of competition	Moderate	Moderate/High	Low	High	Low	Low	High	Moderate	Moderate
Cyclicality	High	High	Low	High	Significant	Significant	High	High	High
Potential positive impacts:									
Development inputs	Low (Gas:High)	Significant	Significant	Low	Significant	Significant	Significant	High	High
Employment	Low	Low	Low	Low	Low	Significant	Low	Low	Significant
State revenues	High	Low	Low	Low	Low	Significant	Low	Low	Low
Indirect economic benefits	Significant	Low	Low	Low	Low	Low	Low	Significant	Significant
Potential negative impacts:									
Physical hazards	Significant	Significant	Low	Significant	Significant	Significant	Significant	Significant	Significant
Direct societal impacts & risks	Significant	Low	Low	Low	Significant	Low	Low	Low	Low
Macro economic risk	High	Low	Low	Low	Low	Low	Low	Low	Low
Risk of state financial losses *)	Significant	High	Significant	High	Low	Significant	High	Significant	Low
Risk of monopoly powers	Significant	High	High	Low	Low	Significant	Low	Significant	Significant
Strategic development impact	**High**	**Significant**	**Significant**	**Low**	**Low**	**Low**	**Low**	**Significant**	**Significant**

*) *Assuming state investments in the sector.*
**) *Supplier industries with a strongly globalized orientation (A) and a less globalized orientation (B) as further explained in section 3.7.*

3.2 THE PETROLEUM EXPLORATION AND PRODUCTION (E&P) INDUSTRY

As explained in section 2.3, petroleum production provides much larger revenues for the state than is normally the case with other businesses.

There are countries where oil production has clearly had a transformative effect on society. The monarchies bordering on the Middle East Gulf are the most obvious examples. Their incomes from oil have been very large in relation to their populations, and they have become very different societies because of oil. But this is not the same for most oil producing countries. Oil is produced in about 100 countries, and nearly two-thirds of these produce less crude oil than they consume as refined products. Half of oil producing countries make less than 50,000 bod, whereas Saudi Arabia makes 10 million bod. For many countries, oil production can make a useful, but not transformative, contribution to economic development and state revenues.

Where oil production becomes a very large part of the national economy, it is not inevitably beneficial. Two terms are often used about how oil can damage a country: "Dutch disease" and resource curse. The first is about distorted macro-economics: Oil production causes the national currency to appreciate and drives up salaries and other costs of production not only in the petroleum sector, but also in other sectors of the economy. This causes industries in that country to be less competitive against other countries, causing erosion of the non-oil sectors exposed to foreign competition.

The resource curse concerns a distortion of the political system and the ways people seek to make a good living, resulting in a country dominated by rent-seeking, which is to obtain personal advantage by privilege and position rather than by creating value. There are some examples of how large resource wealth has failed to bring prosperity to the nation and the population as a whole.

These considerations led to the scores of "High" on state revenues (positive) and macro-economic risk (negative) under oil exploration and production. There is also a "high" score on cyclicality from the reality that oil price changes can have large impacts on state revenues. The way most petroleum fiscal systems work, a fall in oil price by a certain proportion normally reduces state revenues from oil by a larger proportion compared to what it would have been at a flat price. The reverse happens when the oil price rises.

Fiscal management is about ensuring that the state receives fair and correct shares of petroleum value, while revenue management is about applying the revenues for the national benefit. Some oil-rich nations have established a sovereign wealth fund for accumulating surpluses of revenue from the petroleum activity, for the purposes of ensuring benefits for future generations, avoiding macro-economic damage and providing a disciplined approach to spending petroleum revenues.[3]

3.2.1 Other criteria for oil exploration and production

Entry barriers and intensity of competition were both classified as moderate. The requirements for a nation to enter oil production are

a. there is oil in the ground,
b. oil firms have found the prospects of discovering oil there sufficiently attractive, and
c. the government has established an adequate licensing framework for engaging the firms.

There is a certain competition between nations to attract capable oil firms, but there are usually also many oil firms looking for opportunities.

Development inputs were classified as Low, because crude oil in itself is not a very useful product for consumers. The products obtained from it are however useful, so the classification under refining is more favourable. It is noted that natural gas can have larger positive impact on economic development, because it can be used in less processed form for power generation and other useful energy applications. Oil exploration and production often requires very large investments while creating a rather limited amount of jobs in the host country. There can be more

3 An introduction to Norway's sovereign wealth fund can be found on its web site; https://www.nbim.no/en/

jobs in relation to some of the supplier industries, as noted in a later section. Oil E&P can create indirect benefits in areas such as education and training, research, infrastructure and increased international and professional exposure for parts of the country's work force.

In addition to the issues of "Dutch disease" and "resource curse", petroleum operations can cause harm to people and environmental damage. These can occur as a result of accidents, but also from enduring operations at less than high standards. Communities can be affected negatively. These are issues which modern resource management seeks to control with impact assessments (SEA and EIA).

Many governments of oil producing nations have ambitions for economic participation in the sector beyond collecting their shares of revenues. This often leads to the establishment of a national oil company, which will participate in operations alongside with the international firms. Depending on how this participation is structured, it may entail a significant risk of economic losses if projects go awry.

Fiscal management is about ensuring that the state receives fair and correct shares of petroleum value, while revenue management is about applying the revenues for the national benefit.

If licensing policy consistently favours one or a small number of oil firms, the firm(s) may develop a position in the country which places the government at risk of undue dependence. It is normally possible to avoid this with an appropriate licensing strategy.

3.2.2 High strategic development impact

The score for strategic development impact of petroleum exploration and production is clearly High. Depending on how much is found and how it is managed, petroleum operations and revenues can have large impacts on economic development in a country. It calls for active national engagement in the sector, certainly on the regulatory front as reviewed in chapter 5. The state needs to ensure that resource wealth is transformed to lasting benefits for the nation, and to avoid potential negative impacts from this part of the value chain.

3.3 THE REFINING INDUSTRY

Entry barriers are high in the refining industry due to the high capital costs, which can be $5-10 billion, or more, for a plant of contemporary standards in terms of size and configuration. It is also a low-margin, competitive industry exposed to

strongly variable profitability. Competitive pressures can be less for a refinery installed at a favourable location for serving a nearby market which other refineries cannot serve well. If such a refinery's capacities are too large for the local market, it will be forced to sell some of their products further away and in competition from other refineries.

Much of Africa's consumption of refined fuels is supplied from refineries outside the continent, notably the Middle East Gulf and Europe.

Another entry barrier in refining is the challenge of establishing a viable business and investment model. Policy makers in a number of African countries have expressed interest establishing refining capacities in their countries. The history of government-owned refining in Africa is discouraging. Refineries are complex plants in a highly competitive market, and any new refinery would need to be planned, owned and operated by a firm with solid experience from refining elsewhere. There have been press reports of several plans for new refineries in Africa in recent years, but generally not backed by experienced refinery owners, and such plans have usually failed to materialise. The perceived political risks to private sector investors would be a hurdle, as refineries are long-lasting, immobile assets, making products whose prices are politicized in many African countries. The political risk is likely to be perceived as large due to the tendency of governments in much of Africa to interfere with the price setting of refined fuels.

Good supply of refined fuels is undoubtedly important to Africa's economic development. Much of Africa's consumption of refined fuels is supplied from refineries outside the continent, notably the Middle East Gulf and Europe. Trade can usually work effectively if not restricted, but these supply routes can be exposed to risks. With increasing consumption, the economic logic for building refinery capacity in Africa strengthens, and even more so where there are nearby sources of crude which might be used as feedstock.

There can be opportunities in refining from the reality that Africa has a significant deficit in refined fuels supply. The large new Dangote refinery in Nigeria will reduce the deficit for a while, but growing demand is likely to re-open it. East Africa at present has no operating refinery between Sudan and South Africa, except for the small one deep inland in Zambia. The global refining industry may be approaching a point at which industry regeneration will be needed after many years of too little investment and aging infrastructure.

New refining capacity on the continent will face challenges. Simple, cheap solutions are unlikely to fit the continent's needs, which are mainly automotive fuels (Diesel, gasoline and jet fuel for airplanes). Simple refinery configurations produce less automotive fuels but plenty of fuel oil, of which the continent already has a surplus. Global demand for fuel oil is on a continuing downward trend and is likely to be further constrained by new rules for international shipping requiring less pollution from their funnels. There could be a significant market in Africa for heavy fuel oil used for power generation. Some continuing and additional demand for this can be expected but is unlikely to be on a very large scale. Hydro and natural gas would normally be used in preference to heavy fuel oil for power generation, and solar power costs have decreased strongly making it a significant competitor to conventional grid power.

The 54 African countries consumed 4.1 million bod of oil in 2019. If we remove the three biggest consumers of Algeria, Egypt and South Africa, the rest consumed 2.33million bod which is an average of 45, 686 bod per country. The world's average refinery size in 2018 was 148,000 bod. This would mean that if each African country put up a refinery for its consumption, they would be three times smaller than the world average. Refineries which are small will lose out due to their unfavourable economies of scale, especially when there is also a need for African refineries to have advanced upgrading capacities to produce mainly automotive fuels. The idea that each country needs a refinery is not viable; Africa will need fewer refineries than it has countries for the foreseeable future.

3.3.1 Benefits and risks from refining

Refineries provide automotive and other fuels which African countries need. Such fuels can alternatively be provided by trade. The difference between being supplied from a nearby refinery or by trade from abroad is mainly a question of economics, but may also have affected the security of supply, particularly for inland countries with complicated supply logistics for imported fuels. This is also applicable to specialty refined products such as bitumen (asphalt for roads etc.), which is made in some but not all refineries.[4]

4 Not all crude oils are suitable for making bitumen.

Under realistic economic conditions, even well-run and efficient refineries are likely to inflict financial losses on their owners from time to time due to the cyclicality of pricing and profitability in the industry. The less well-run ones are likely to inflict losses on a lasting basis, and the losses can be large. Politically motivated price distortions risk concealing the real impact of a refinery on a nation's economy. If funds available for maintenance and upgrading of a refinery are not consistently made available due to year-to-year budgetary considerations of owners, the integrity and efficiency of the refinery will soon be eroded.

A refinery can have a significant and positive impact on economic development in a country, in some circumstances, by securing a supply of fuels which otherwise would be subject to difficult and vulnerable supply logistics

Refineries are dangerous places if not operated to the highest standards. Large volumes of highly inflammable materials are present, with a potential to cause explosions as well as pollution. Efficiently run refineries employ relatively few people during operations in relation to the large investments in building them. Around 500 employees may be considered an indicative number for a well-run plant of medium to high complexity, most of whom will be engineers and qualified technicians. Some additional employment can come from procured services.

A refinery can give rise to monopolistic market positions if it becomes the sole realistic source of fuel supply in a country. It is normally possible to mitigate this risk by adequate regulations.

3.3.2 Significant, not high, strategic development impact

A refinery can have a significant and positive impact on economic development in a country, in some circumstances, by securing a supply of fuels which otherwise would be subject to difficult and vulnerable supply logistics. If a refinery venture is considered and this issue is part of the justification, the existing supply arrangements based on trade may be easier, cheaper and safer than a refinery is going to be.

Policy makers who believe they should fully control the prices of fuels in the country may be tempted to see a refinery as a way of avoiding exposure to international market prices. But there are serious long-term limitations and problems with such an approach, related to smuggling, mismatch of refinery output and demand, and the supply of crude oil needed for refining.

3.4 TRANSPORTATION

In table 2, the transport segment is shown as individual columns for pipelines, ship transport and road/rail transport. They are reviewed here in the same sequence.

3.4.1 Pipeline transport: strategic development impact

The need for oil pipelines is determined by the locations of supply and demand for oil. Most commonly, oil fields need to be connected to refineries or shipping terminals. High costs of laying pipelines make for high entry barriers. The example of Uganda, reviewed in section 4.5, shows that it took much longer time to establish a viable export pipeline than to find the oil fields and plan for their development. Eventually, the volumes and locations dictated that the pipeline should be built, and hurdles were cleared. These hurdles included the need for an inter-governmental agreement between the countries to be crossed by the pipeline.

Pipelines can have a positive development impact by establishing a long-term, cost-efficient transport mode for oil. They can be built to last for more than 50 years. Their commercial and regulatory arrangements need to be carefully considered to increase the likelihood that they can continue to serve useful purposes under shifting conditions of production and license interests.

3.4.2 Ship transport

Shipping is a service provided by a large variety of shipping firms, operating in competitive markets. Tanker ships have substantial construction costs, but entry barriers in the business are still low due to the relative ease of obtaining finance for such mobile assets and a lively market in used ships. It is generally not necessary for a country to own ships to cover its transport requirements. Tanker ships can be operated by crews of around 20 sailors on board,[5] so building a tanker fleet would hardly be an effective policy for creating employment.

Investment in shipping can generally be seen as a commercial venture with significant potentials or profits and losses, and with little strategic development significance.

5 The total crew requirements for a ship can be twice as large because sailors have schedules of sailing and time off.

3.4.3 Transport by truck and rail

Trucks and rail are used for refined products being distributed between refineries or import terminals and points of delivery to end users. In some cases, they are also used for crude oil.

Truck transport is usually provided by transport firms. It is a business which easily lends itself to national content, as business can be started with relative ease by enterprising people, provided that capital for buying trucks can be available at reasonable financing costs. The most important contribution to be made by the government in this area is to build adequate roads. Also, government could remove unnecessary hurdles to establishing and operating businesses in the country. The cost of finance for business ventures is important here as for many other sectors of the economy. Adequate regulations for handling hazardous goods in road traffic are needed.

3.5 FUELS RETAILING

Internationally, fuels retailing has evolved over several decades from being an integral part of the oil industry to becoming more of a separate merchant business. In countries where government does not control fuel prices at the pump, there are usually service stations under a variety of brands, some belonging to integrated oil companies and some being merchants specialising in this business. In countries where there is government control and/or subsidies of fuel prices, the possibilities for who can do retailing business may be more constrained, usually with a larger involvement of a state owned entity.

The business needs to be subject to ordinary economic regulation in terms of building permits, handling of hazardous goods, competition, environmental protection

For most countries, the market for refined fuels will be reasonably well served in the absence of any government intervention. This suggests that there is little need for strategic intervention by government in the segment, except for any interventions resulting from government policy for controlling fuels prices. The business needs to be subject to ordinary economic regulation in terms of building permits, handling of hazardous goods, competition, environmental protection, etc.

3.6 THE PETROCHEMICAL INDUSTRY

Building on section 2.7, the relevance of petrochemical (olefins based) industry for African economies can be summarised in terms of opportunities and barriers for entry and potential economic impacts.

Opportunities (+) and barriers (-) to entry:

i. Large requirements for capital, which will be exposed to significant financial risk (-);
ii. Large economies of scale and of integration, favouring large industrial complexes (-);
iii. Small markets (converter industries using bulk petrochemicals as their feedstock) in most of the continent (-);
iv. Unproven capabilities for advanced industrial operations in much of the continent (-);
v. Globally oriented industry structure (-), yet international firms might be interested in establishing African operations in some circumstances;
vi. For petrochemicals based on feedstock from refineries (naphtha cracking; extraction of olefins and aromatics):
   - ***Inadequate size of most African refineries (-);***
   - ***Large demand for automotive fuels, favouring upgrading of light naphtha to petrol component (-);***
vii. For petrochemicals based on natural gas liquids from gas processing (Ethane cracking etc.):
   - ***Some African gas production may yield sufficient ethane, supplemented by other NGLs, to form basis for cracker (+).***

Potential impact of petrochemical industry on African economies:

i. Drain of limited financial resources (investment capital requirement) (-);
ii. Little employment (-);
iii. Reduced value of petroleum production if subsidised feedstock is granted (-);
iv. May enhance value of some petroleum fractions which otherwise have limited markets (+);
v. Variability of margins (annual value contribution) due to international competitive pressures (-);
vi. Significant potential for economic loss if plant is not consistently built and operated on level with most effective international competitors (-);
vii. May give some stimulation to establishing converter industries (+).

Petrochemical industry is given a Low score for strategic development impact in Table 2, indicating that there are hardly any compelling reasons for African

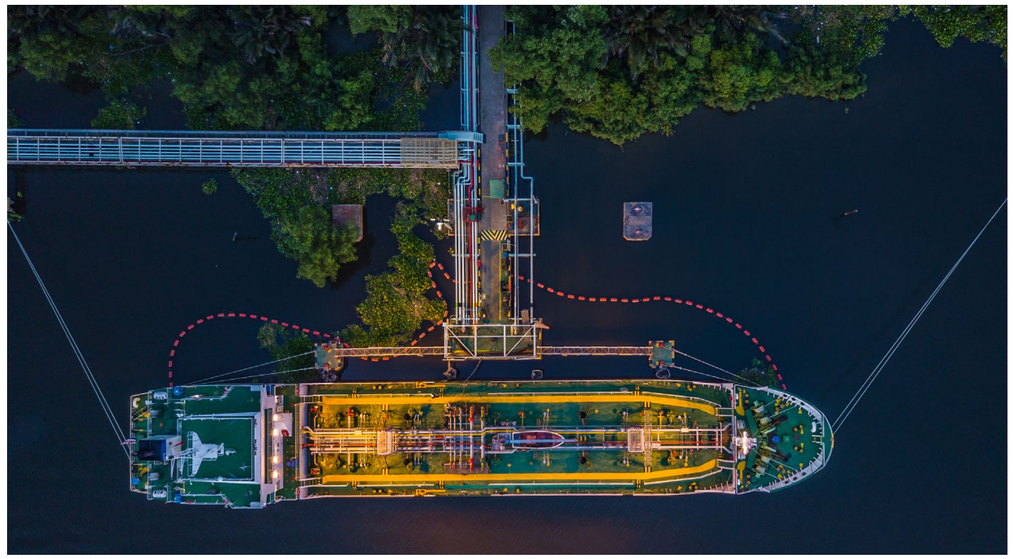
governments to devote resources to establishing a petrochemical industry. It is an industry requiring high investments, with a high potential for inflicting financial losses and a limited scope for supporting broad based economic development.
The most likely commercial case for building petrochemical industry in Africa is if a location has large gas resources with a high content of ethane. The ethane might be separated from the gas and used for ethylene cracking. Internationally, the industry is dominated by large players such as LyondellBasell, Dow Chemicals, Borealis Polymers and others. It may be financially risky for an African state to set up an entity of its own to compete against these firms. International firms might be tempted to establish petrochemical industry in Africa on the condition that they will be guaranteed access to low-cost feedstock. If that means that the African state must provide feedstock to them at a lower price than could have been obtained elsewhere, it can amount to large foregone revenues.

The above considerations concern mainly the petrochemical industry segments of cracking and polymerisation. Downstream of these are the converter industries, which turn bulk plastic material into useful objects. These are often smaller businesses with a large variety of product specialisations. Converter industries are found in many countries including Africa. World-wide they employ many more people than the petrochemical firms. Since bulk plastic product from the petrochemical firms can be transported at reasonably low cost, the location of converter industries is not mainly determined by the location of the petrochemical plants. The emergence of converter industries in a country is more likely affected by the proximity of customers and by general conditions for doing business there. Some converter industries can use recycled plastic materials. If there are many converter businesses in an area, it may strengthen the case for building a petrochemical plant there. These are commercial considerations that will be made by companies in these businesses.

The mainly gas based industries of ammonia/fertiliser and methanol production are not covered here.

3.7 THE INDUSTRIES FOR SUPPLYING GOODS AND SERVICES

The issue of the supplier industries is mainly relevant for countries having large reserves of oil and gas. To a lesser extent it applies also in relation to refineries. It relates to the issue of national content, which is discussed in the following section. The supplier industries are a collection of very different value chains, whose common feature is that they supply goods and services needed for petroleum operations (Section 2.8). Two columns for supplier industries are included in Table 2. The "A" case is conceived as a supplier industry in which firms have strong reasons to develop a global scope of business. It can be thought of as a



deep-water drilling contractor using advanced rigs or an oilfield service company applying sophisticated proprietary technology. The "B" case is conceived as a supplier industry in which firms can operate well on a national or regional scope, not necessarily a global scope. It can be thought of as a firm for light fabrication and mechanical servicing or a road transport contractor used for moving oilfield supplies.

The supplier "A" segment has high entry barriers for either or both of two reasons: Proprietary and highly specialised technologies, and high capital investments. The segment is strongly affected in terms of business volume and profitability by the ups and downs of the oil price, therefore a high score on cyclicality. The firms have some competitive benefits from their specialised assets but are exposed to competitors having slightly differentiated assets which can be applied to similar applications. The firms' services and products are highly relevant for effective petroleum operations.

African oil producers will benefit from the presence of highly specialised firms, as expectations for developing locally-owned firms with comparable skills in the medium term would be unrealistic. A realistic goal would be to encourage regional supplier firms to establish a significant presence in their countries, and have some operations carried out there. If successful, such an operation can lead to spin-off businesses locally, and may be relevant for also serving operations in other countries if communications are good.

Supplier firms in the "B" segment should normally develop in countries having significant petroleum operations, if general conditions for starting businesses there

are good (on which Africa has large room for improvement). They are more likely to be in indigenous ownership. It is rarely appropriate for them to be owned by government, but rather by individual entrepreneurs and firms adept at pursuing business opportunities. This can be a source of significant employment and income for national residents. The government can facilitate local business participation in the petroleum sector by introducing relevant national content policies and by improving the country status for doing business. There needs to be awareness and capability with any business supplying to petroleum operations to meet requirements for quality standards and consistency which are more stringent than indigenous businesses may have been accustomed to.

3.8 NATIONAL CONTENT (LOCAL CONTENT)

The participation of personnel and firms from the host nation in petroleum value chain activities is often referred to as local content or national content.[6] Many, if not all, African countries having significant oil reserves have taken measures designed to promote national content. While the aim of promoting national content in oil rich African nations is laudable, the concept also has limitations and risks. This section reviews national content policy as a concept for engaging Africans in petroleum value chains. The section puts an emphasis on risks and limitations of national content policies – not as an argument against national content policy, but rather a call for caution in designing successful policy. The issue is further illustrated by the case of Nigeria in section 4.3. Some tentative recommendations for national content policy are given in chapter 6.

3.8.1 The rationale for national content policies

National content generally refers to the participation of the host nation's work force and firms in value chain activities. Jobs are then created, and citizens draw income from their work – income which otherwise would have flowed to recipients abroad. It is an additional source of economic benefit for the nation beyond the fiscal revenues from resource extraction. One definition of it is as follows: Local content is income received by locals in return for their contribution to petroleum operations.[7] Similar definitions are promoted in much of the literature, emphasising value creation by nationals of the host nation. National content policies have mainly promoted two different avenues for engaging locals in petroleum operations: By awarding license rights to indigenous oil and gas firms, including sometimes a national oil company; and by stimulating the local workforce and firms in the country to do work for the sector as employees and as suppliers of goods and services.

There are countries in the world where the petroleum sector has evolved as an insular phenomenon dominated by foreigners and with little contact with the rest of the national economy. In other countries, such as the USA, the petroleum sector is an integral part of the economy and employs significant numbers of personnel in certain regions. Nigeria, as shown in section 4.3, is a mature oil producer which for many years had little involvement by locals in the industry, but which more recently pursued an active national content policy to increase this involvement. Norway pursued active national content policies in the first two decades of its petroleum activities, with acclaimed success,[8] but has since scaled back state engagement in this area as many of its firms have become capable to thrive in the face of international competition.

Potential benefits of increased national content are widely acknowledged, as evidenced by a rich literature including scholarly works, reports by international organisations and consultancy resources.

Potential benefits of increased national content are widely acknowledged, as evidenced by a rich literature including scholarly works, reports by international organisations and consultancy resources. The African Development Bank (2016) has proposed a step-by-step guide for a country's policy formulation and implementation of local content. The World Bank and the African Centre for Economic Transformation have published studies which describe national content policies implemented in several countries.[9] Guidance documents for oil and gas companies to promote national content in their operations have been issued by the International Finance Corporation (2011) and by IPIECA (2011), the latter being a petroleum industry association.

3.8.2 Some reservations

Missing in the international literature are systematic assessments of the performance of national content policies, in terms of their achieved benefits as well as costs. There are individual stories of apparent successes with national content from several countries. There are also references to percentage levels of national content achieved, but no common definition or well-defined methodology for calculating them. There is ample scope for well-intended but flawed national content requirements to yield counterproductive outcomes.

6 National content and local content are used synonymously here. Local content is the more common term, but is sometimes understood to mean the involvement of people from a specific locality rather than the whole host nation. The issues of local content are generally best addressed on the national level.
7 Farouk Al-Kasim, lecture materials.

8 Johnson (2014)
9 Tordo et al (2013), ACET (2017)

Different from much other literature in the area, Kolstad and Kinyondo (2015) question the merit of national content policies. They make two pertinent points. First, that national content requirements are costly to the nations imposing them, and those costs are often disregarded or underestimated. Requiring oil firms to do what they would not have done by their own choice, is a form of burden which reduces the potential for collecting fiscal revenues. The revenues thus foregone could in many cases have been spent more effectively on other measures to promote economic development.

Second, Kolstad and Kinyondo argue that national content requirements tend to strengthen the negative phenomena associated with the "resource curse": Dutch disease, patronage and rent-seeking. The latter occurs when certain individuals use connections to political power to increase their wealth without much value creation. National content requirements can contribute to this especially if they include requirements for contracts to be awarded to firms in national ownership or to foreign firms in joint-ventures with firms owned by nationals.

Even if one does not fully accept their negative view of national content requirements, Kolstad and Kinyondo's arguments give cause for reflection on how national content policies can be useful or counterproductive. The point that national content policies can create new opportunities for rent-seeking enrichment of local elites is also made strongly by Ovadia (2016), a researcher who in other respects makes a robust case in favour of national content as a driver of economic development.

National content requirements are pursued by various countries not only in the oil and gas sector, but in many sectors where foreign direct investments are common. The OECD has taken a largely negative view of it, describing national content requirements as a protectionist type of policy with detrimental effects on the imposing country's own economy (Stone et al. 2015). Avoiding the term "national content", the OECD has instead issued a paper titled "Collaborative Strategies for In-Country Value Creation" for extractive projects as a development policy tool (OECD 2016). It promotes collaboration between governments and firms to identify opportunities for local value creation which can benefit both sides, but without recommending any "hard" policies of imposing obligations on firms.

Sections 2.8 and 3.7 reviewed the supplier industries in the petroleum sector, where most employment opportunities in the sector are located. The supplier industries have many segments, of which the economically most substantial must deploy their assets and their competencies on a global scale to attain the highest standards of operations and to be competitive. This reality sets important conditions for what can be meaningful national content policy. Pursuit of self-sufficiency in supplies for the sector is unrealistic and carries a high risk of depriving the host nation of the inputs needed for a safe and profitable petroleum sector.

The potential costs and drawbacks of national content requirements can be identified on two levels: As reductions of overall project economic value, and as negative impacts on state finances. Following are brief summaries of those potential impacts

Potential reductions of overall project value:

i. Reduced value of petroleum, including loss of present value due to delays, e.g. implementation delays caused by contractors with less than world standard capabilities, and time-consuming procurement review procedures;
ii. Increased project costs, e.g. national content compliance procedures, excessive prices charged by privileged domstic suppliers, cost overruns by contractors with less than world standard capabilities, extra costs and occupational health, environment and operational risks associated with quality assurance, and bloated workforce to fulfil required indigenous quotas.

Potential negative impacts on state finances:

i. Fiscal losses from reductions of overall project value as described above;
ii. Fiscal losses from incentives granted for national content endeavours by firms;
iii. Fiscal losses from weakened fiscal terms because oil firms regard stringent national content requirements as a burden making them less prepared to accept fiscal terms favouring the state;
iv. State's costs in implementing national content requirements, including administrative costs.

National content policies can and should of course also create benefits for the state: More employment and income for its own work force, yielding more tax revenues and a general stimulus to economic development. A successful national content policy is one where those benefits exceed the negative impacts for the state. Such success cannot be assumed unless benefits as well as costs have been carefully assessed as a guidance for policy selection.

There is an increasing recognition that location of value-chain activities matters more than their ownership.[10] Emphasis on the latter risks stimulating national content in semblance only, except for some well-connected local names taking a percentage. Moreover, firms which are not from the host country can provide good opportunities for local employees and local sub-suppliers to derive income from work in the sector, as indicated by the example of the Samsung yard in Nigeria (section 4.3). The yard in Nigeria is part of the Samsung group from South Korea. Nigerian authorities might have insisted that yards in Nigeria supplying the petroleum sector should be Nigerian owned – with the likely effect that the entire construction process would have taken place in Korea.

Meaningful and reliable monitoring and evaluation tools for measuring achievements in national content are largely lacking internationally.

Metrics matter. When countries pursue policies for national content, there is reasonably a desire to report achievements which can be compared to targets. Focus on inappropriate parameters can influence monitoring and decisions counterproductively. There are practical challenges in framing this in a useful manner. [11] Meaningful and reliable monitoring and evaluation tools for measuring achievements in national content are largely lacking internationally. The definition referred above of local content as income received by locals in return for their contribution to petroleum operations, suggests that it should be a quantifiable parameter, as a component of Gross National Income in national accounting. Even where this is recognised as the proper measure of national content, monitoring and reporting on the firm level usually must apply approximations for the various drivers of national content which firms can influence. The measures of national content which sometimes are made public, are not necessarily comparable nor representative.

3.8.3 National content and international trade rules

The multilateral agreements which are established by the World Trade Organization

10 ACET (2017) and others argue this point.
11 Warner (2010) and Ovadia (2013) review the challlenges, ambiguities and some proposed methods for measuring national content.

(WTO) are intended to stimulate international trade by reducing or eliminating barriers to trade. Such barriers to trade have traditionally been tariffs levied at products crossing borders, which serve two main economic purposes: Revenue for the state, and protection of domestic producers from foreign competition. While the role of outright tariffs has been reduced globally, states can impose several other forms of impediments to trade to give advantage to domestic suppliers in the domestic market. Local content rules are clearly in this category when seeking to promote domestic suppliers at the expense of foreign ones. The question is therefore raised: Do WTO rules or other international trade regulations significantly constrain the legality of local content requirements?

The answer to the question is not known with certainty, because there have scarcely been any cases in which requirements for local content in the petroleum sector have been challenged under WTO's or other relevant conflict resolution mechanisms.

The existing literature on the matter from the legal discipline usually addresses local content requirements in general, not limited to the petroleum sector. Some have argued that very few local content measures can be considered compatible with WTO law, and that a widespread failure by affected governments to bring cases for conflict resolution has caused a situation in which illegal practices are widespread internationally.[12] Others have argued less restrictive positions, entailing that WTO rules forbid certain practices such as quantitative import restrictions but leave space for several other forms of local content requirements, particularly for developing countries.[13]

Besides WTO rules, restrictions on local content requirements can come from at least two other sources: Bilateral investment treaties (BIT) and regional trade

12 Hestermeyer and Nielsen (2014)
13 Johnson (2014); Ramdoo (2016).

agreements. Bilateral investment treaties are made between two or more countries and can afford companies from a contracting state the opportunity to challenge practices in another contracting state. BITs are in many cases more restrictive against local content requirements than WTO rules – a reality that some negotiators on behalf of states may have been insufficiently aware of. Regional trade agreements usually comprise several countries in a region, usually going further than the WTO rules in reducing barriers to trade. It was when Norway in 1994 entered into a comprehensive economic agreement with the European Union that the country was obliged to discontinue certain practices giving preference to its own companies in the petroleum sector.[14]

Countries contemplating national content requirements are advised to seek legal guidance to maintain consistency with international trade rules.

3.8.4 National content as an obstacle to regional economic integration?

National content policies in extractive industries are intended to promote the host nation's work force as suppliers and participants in the petroleum sector. Notwithstanding the Nigerian NCDMB executive secretary's assurance that "Nigerian content is not about chasing foreigners away",[15] national content policies inevitably have an aspect of preventing foreign firms and personnel from doing work which could have been done by nationals. The foreigners whose roles are to be constrained may have been thought of as Chinese, Korean, French, American and other firms from countries having advanced industrial capabilities. Unfortunately, local content requirements impose constraints also on suppliers from African neighbours, which may have the effect of eroding opportunities for developing strong African based suppliers with a regional business scope.

The following illustration shows why this is a problem. Along Africa's Western coast from Angola to Senegal there are at least 12 nations which are or will probably be petroleum producers. Pipelines are needed in all of them. Pipeline systems are an example of a product category for which it might be possible to develop one regionally, or a few but definitely less than 12 internationally competitive companies for that region. These are bulky items with significant transport costs relative to the product value. The supply chain for making pipe could possibly integrate backwards linkages to iron ores present in West Africa. The pipe producers' chances of becoming effective and internationally competitive would increase if

14 Norway turned down European Union membership in a referendum in 1993, but had established the European Economic Area as a comprehensive economic agreement with the EU. By that time, the preferential treatments previously afforded to Norwegian firms in the petroleum sector had aided many of these in becoming sufficiently competitive to prevail in international markets without further privileges.
15https://www.dailytrust.com.ng/news/feature/-nigerian-content-not-about-chasing-away-foreigners/193765.html

they could take a regional approach, rather than just a national approach, to their scope of business.

The underlying reality of this issue is that most petroleum supplier segments operate internationally, for good reasons.

When the Nigerian Content Act states a requirement that pipeline systems must be of 100% Nigerian content by tonnage, and if other African petroleum producing nations would impose similar requirements, then this prevents the formation of companies based in Africa and serving the African market as a region. Producers of pipeline systems would need to operate across African borders, at least, to develop their capabilities and their value chains to internationally competitive levels. Having one producer in each country to serve that specific market is not a feasible approach to developing fully competitive firms. The likely result is that waivers for imports will continue to be granted, because domestic capacities are inadequate, and many fewer pipeline systems will be produced in Africa than could be achieved by another policy. Nigeria, being the region's largest country by population and in terms of petroleum production, may be less affected by this policy dysfunction than its smaller neighbours, and there is indeed some pipeline production capacity in Nigeria. But when Africa loses overall, so will Nigeria.

The underlying reality of this issue is that most petroleum supplier segments operate internationally, for good reasons. The needs for effectiveness and integrity of operations place high demands on the quality and availability of inputs (see section 3.7 above). The supplier firms' capabilities can be deployed much more effectively across many countries than if confined to any one country. Insisting that supplies for each country's petroleum sector must be produced in that country induces waste and loss of international competitiveness. These could be significantly reduced by at least allowing for regional trade integration: Promoting West African (or indeed African) supplies for West Africa's petroleum sector, more than confining policies to national promotion.[16] A regional orientation needs not lose sight of the reality that Africa contains many of the least developed economies on the planet, and may for some time require a protected economic environment for its nascent petroleum supplier segments to develop.

"Integrate Africa" is one of the High 5s of the African Development Bank's strategic orientation. The national content legislations currently applicable in some African petroleum-producing countries do little to integrate the continent; rather the opposite. The effectiveness and integration of African engagements in the sector could be improved if the nations could agree on a regional rather than national

16 A similar argument is made by ACET (2017).

approach to content promotion – in short: moving from national content to African content.

3.8.5 Potential for effective national content policy

The previous sub-chapters have identified some substantial reservations applicable to the pursuit of national content policies for the petroleum sector. The lack of rigorous research and assessments of what existing national content policies in developing countries have achieved makes it impossible to present any clear prescription for how national content policy will be successful in African contexts. However, $194 billion is expected to be spent on 93 upcoming African oil and gas field projects during 2018-2025 according to one industry analyst, and in addition there are ongoing expenditures for producing fields.[17] It is reasonable to hope that large parts of this spending on African projects should become income for Africans, and that African governments can and should take measures to increase Africans' shares in them. Existing literature and documented experience point tentatively towards some "do's" and "don'ts" - strategies which seem promising and others which risk generating costs and counterproductive effects. Building on the case of Nigeria described in section 4.3, some recommendations for national content policy will be presented in chapter 6.

3.9. PETROLEUM, RENEWABLE ENERGY AND CLIMATE CHANGE

With the exception of the U.S.A. under its current leadership, the nations of the world have acknowledged the problem of man-made global climate change and the common responsibility for addressing it. The Paris Agreement of 2016 is the global community's most significant common endeavour to address the problem.[18] Oil is a large contributor to man-made climate change, along with other fossil fuels (coal and natural gas) as well as some non-energy activities. Efforts to contain climate change need to be equitable to developing nations, in Africa and elsewhere. The argument is that denying these nations the opportunity to use fossil fuels for their development would be unfair, when the developed nations are carbon-intensive

Oil is a large contributor to man-made climate change, along with other fossil fuels (coal and natural gas) as well as some non-energy activities.

17 News article: Almost $194 billion will be spent on upcoming oil, gas projects in Africa to 2025, says GlobalData. March 28th, 2018. www.WorldOil.com
18 https://unfccc.int/process/the-paris-agreement/the-paris-agreement

economies and major contributors to the climate problem. While the Paris Agreement and other international agreements do not require African nations to stop using oil, it is understood that African nations, like others, should seek to reduce emissions where this can done efficiently and without constraining development.

Renewable energy has advanced over several decades in terms of technology, efficiency, convenience, and costs. In Africa, renewable energy includes biomass as used in traditional ways of life, and modern renewables such as hydropower, photoelectric and other solar energy, wind power, biofuels for vehicles and geothermal (the latter stretches the term "renewable" a bit). The following comments relate to modern forms of renewable energy as mentioned above.

Increased use and production of renewable energy in Africa have several advantages. Prominent among these are reduced emissions (with global and sometimes also local benefits), and improved trade balances in respect of petroleum and electricity through substitution. Renewables often offer more local employment opportunities than other forms of energy.

Petroleum and renewables are substitutes for some applications. Following are some examples:

i. Electricity generation for the grid. In some cases the relevant alternatives are (1) from generators running on refined petroleum fuels, or (2) from renewables, which can be hydro, solar, wind and geothermal.

ii. Off-grid electricity. Solar, wind and small hydropower can supply local communities, reducing their need to be connected to main grids whose power is often produced from petroleum. Household solar panels end the need for kerosene, and their falling costs allow African households to consider going off-grid.

iii. Biofuels for cars. Biodiesel, bioethanol and some others can be mixed in with petroleum fuels in limited portions to be acceptable for most cars. Some car engines can be built or modified to run entirely on biofuels.

iv. Solar non-electricity applications: Solar-powered water heaters and cooking devices can reduce petroleum consumption.

Availability of petroleum fuels at widely affordable prices is a deterrent to the development of renewables, and even more so if petroleum prices are kept artificially low by government intervention often in the form of consumers' subsidies. Higher priced petroleum stimulates more use of renewables.

There are also some complimentary uses of renewables and petroleum fuels. In grid electricity, and even more in off-grid electricity, intermittence of renewable supply is a challenge. The sun doesn't shine when most people want power for the TV and to light their homes. If hydropower is produced from a river having seasonal flows and without a very large water reservoir, supply is likely to be variable over the year in ways which do not suit customers' requirements. There can be several ways of bridging these gaps, depending on local power system characteristics. Some of these ways involve using petroleum fuels to run back-up generators.
Most recent projections of world energy supply, including the IEA's World Energy Outlook (2017), project strong increases in the role of renewables, but still a big role for petroleum in the decades to come. This is also a reasonable expectation for Africa. The advance of renewables in Africa may be curtailed by government policies of supplying petroleum fuel at prices below market conditions.

3.10 GENDER AND INCLUSION ISSUES IN THE PETROLEUM SECTOR

The African Development Bank (2017) produced a report on women's economic empowerment in oil and gas industries in Africa[19], which points out how women tend to be disadvantaged by the oil industry in terms of employment opportunities,

[19] The African Development Bank (2017) report on women's economic empowerment in oil and gas industries in Africa.

and as persons outside the industry but affected by it.

There are good reasons to focus on women's empowerment in an industry traditionally dominated by men: as a matter of social justice, and because the best person for the job is often a woman. The heaviest physical tasks are now automated or supported by mechanical equipment in modern operations, removing the reason to disqualify anyone on the basis of gender from any tasks.

Reports addressing gender issues in Africa have tended to focus on women in their traditional roles, which may entail disadvantage in terms of property, employment, qualifications, household work and physical abuse. There are good reasons of social justice to address these issues, for which the Bank provides useful advice in relation to petroleum operations. The industry should, and in many cases does, also provide opportunities for women to assume professional roles, based on academic or vocational qualifications, in oil companies; public service in relation to the sector; and in supplier companies. The petroleum sector should not lose the professionalism and skills of African women. Being an industry of international working environments, it is in a better position than many others to offer careers where capabilities count for much and accustomed gender roles count for little.

04
Issues and country cases

This chapter has six sections addressing six important issues for petroleum sector governance, illustrated with the examples of six African nations. Each section starts with an overview of the country's petroleum sector and ends with an inventory of policy issues related to the case described.

4.1 PETROLEUM LICENSING IN ANGOLA

With 1.534 million bod of oil production in 2018[1], Angola is Africa's second largest producer (after Nigeria). Oil was first discovered in 1955, when the country was under Portuguese rule. Early production was onshore, but production is now mostly offshore, much of it in water depths of more than 1200 m. Deepwater production is made from floating production systems, where oil is processed offshore and loaded directly from the offshore installations onto crude oil tankers for exports. Production costs in Angola are therefore high in comparison with many other countries, where oil can be produced in easier environments. Angola's gas production is much less than its oil production. Large amounts of associated gas at oil fields have been flared. An LNG (liquefied natural gas) plant for exports started production in 2013, but was shut down for much of 2014-16 due to technical problems.

Petroleum operations in Angola are for the most part carried out by large international firms in partnerships with Sonangol, the national oil company.

Petroleum is a predominant contributor to Angola's economy, providing 95% of export revenues and two-thirds of Government revenues in 2019[2].

1 BP Statistical Review of Work Energy 2019.
2 https://www.economist.com/middle-east-and-africa/2019/10/03/angolan-oil-production-is-in-decline

Figure 13: An FPSO[3] operating outside Angola, operated by Total.

4.1.1 Angola's framework for petroleum licensing

Angola 's key institutions for the petroleum sector are the Ministry of Petroleum (MINPET)[4] and the national oil company, Sonangol[5]. MINPET's responsibilities mainly concern the formulation of higher-level policy for the petroleum sector. It also has responsibilities for biofuels.

Sonangol is the national concessionaire for petroleum exploitation in Angola, and fully owned by the state. A government decree in 1976 established the company and vested in it the sole right and responsibility for petroleum production in the country. Other companies can engage in the sector by agreement with Sonangol. The licensing processes are carried out by Sonangol, with involvement also by the ministries of petroleum and of finance[6].

The main legal basis for petroleum operations in Angola is the Petroleum

3 FPSO: Floating Production, Storage and Offtake. The produced oil can be loaded directly onto tanker ships for export
4 www.minpet.gov.ao
5 Sonangol's full name is Sociedade Nacional de Combustíveis de Angola. www.sonangol.co.ao
6 A similar position was held by Sonatrach in Algeria before 2005 as explained in the next section, and until more recently by TPDC in Tanzania. Those two countries have established national regulatory agencies to carry out regulatory functions previously done by the national oil company.

Activities Law, No. 10/04, of 12 November, 2004. There are other laws and decrees covering aspects of petroleum operations, including the law on taxation of petroleum activities, No. 13/04, of 24 December, 2004[7].

The most common form of petroleum agreement used to set terms for individual licenses[8], is production sharing agreement (PSA). This form of contract is also used by many other African countries, with some variations. Some licenses are governed by certain other contract forms. Model PSAs have been published, i.e. as template agreements without specifics for each license and without signatures. Some texts of signed agreements can be found in the public domain, for instance as filings with the Securities and Exchange Commission of the U.S.A.

Some relevant information is made available on Sonangol's web site, including Terms of Reference where Sonangol specifies its requirements for the licensing

Sonangol has carried out several licensing rounds. These are procedures where Sonangol issues an invitation to companies to submit bids for their participations in individual licenses. There are procedures for pre-qualifying companies as operators and as non-operating partners, intended to verify that they have the required capabilities to take on the obligations as operators or partners. The licensing rounds are usually preceded by presentations held by Sonangol in cities like Luanda, London and Houston, referred to as "road shows", in order to attract industry interests for the licensing rounds. Some relevant information is made available on Sonangol's web site, including Terms of Reference where Sonangol specifies its requirements for the licensing[9]. Additional geological information can be procured. Sonangol states on its web site that award of licenses follows criteria which include discretionary elements, i.e. not just a matter of selecting the highest bid. This is justified by circumstances such as the very high technical capabilities and requirements for operating in the very deep waters outside Angola.

Angola is a member of OPEC, the organisation of petroleum exporting countries. As such, it participates in OPEC's system for setting production quotas, intended to curtail oil supply and support oil prices in the global market. In December 2019, Angola planned to raise its oil production from 1.39 million bod (bpd) to 1.44 million bpd in 2020, still below the 1.48 million bpd target agreed with the OPEC (Organization of the Petroleum Exporting Countries[10]. Sonangol sets production limitations for individual licenses to attain a degree of compliance with the national quota agreed with OPEC. OPEC has limited means of enforcing compliance, and Angola's production has at times exceeded its OPEC quota.

7 English translations of these and certain other laws are found on Sonangol's web site, www.sonangol.co.ao/English/AreasOfActivity/Concessionary/Pages/Licensing-Rounds.aspx
8 Licenses are also referred to as concessions in Sonangol documents.
9 www.sonangol.co.ao/English/AreasOfActivity/Concessionary/Pages/Licensing-Rounds.aspx
10https://www.reuters.com/article/us-oil-opec-angola/angola-petroleum-minister-says-he-supports-maintaining-opec-oil-cuts-idUSKBN1Y91J1

4.1.2 Licensing and developments in recent years

Angola's proved oil reserves decreased from 9.5 bn bbl. in 2008 to 8.4 bn bbl. in 2018. With the production shrinking from 1.8 mln bod to 1.53 mln bod over the same period.[11] Operations there were at the forefront of deep-water technology, and led by the major Western based oil firms ExxonMobil, Total, Chevron and BP. Increasing oil prices after year 2000 were clearly also helpful in Angola's deep-water, high-cost environment. Chinese interests have also entered Angola's petroleum sector.

Since 2012, progress has stalled on several fronts. There have been several attempts at holding licensing rounds, but with little success in attracting the required interest from the most capable oil firms. As of March 2018 there are no firm plans for further licensing rounds. Production has been flat or slightly declining since 2008. Some new production is brought on stream, while some older fields have entered decline. There has been a series of very expensive and unsuccessful exploration wells, and a scarcity of final investment decisions. Several international oil firms have reduced their exploration portfolios.

Angola still had proved reserves corresponding to 15 years of production at end-2017, but decline will set in before long unless the sector is revitalised. With 96% of export revenues coming from the petroleum sector, Angola is currently very dependent on it.

Several causes for the stalled progress can be indicated, some but not all of which are beyond the control of Angola's government:

Geology: When many wells come up dry, interest in the basin is affected.

Terms: Angola's requirements and expectations for licensing terms, as reflected in the Terms of Reference issued with the licensing rounds, may be ambitious and suited to different market conditions than those prevailing in recent years.

Governance: The way in which Angola manages its petroleum sector, is in several respects not in conformity with practices adopted elsewhere, for instance with respect to Sonangol's large role. Western based oil firms have increasingly subscribed to standards of transparency and social responsibility for which practices in Angola are lagging.

11 According to BP's statistical review of world energy. https://www.bp.com/content/dam/bp/business-sites/en/global/corporate/pdfs/energy-economics/statistical-review/bp-stats-review-2019-full-report.pdf

4.1.3 Challenges in transparency and accountability

Angola ranked 146th out of 200 countries on Transparency International's Corruption Perceptions Index for 2019[12]. Unlike a number of other petroleum producing nations (e.g. Nigeria, Mozambique, Ghana), Angola has not (as of early 2018) joined the Extractive Industries Transparency Initiative (EITI) to be assessed against its standard for managing resource contracts and revenues[13]. There has been an abundance over many years of reports from international organisations, NGOs and writers about misappropriations and lack of transparency in the management of Angola's petroleum wealth. The issue clearly touches licensing processes for petroleum, as some of the negative focus has been on cases where companies of concealed ownership and questionable qualifications have gained access to valuable assets[14].

The Angolan authorities have taken some demonstrably positive measures to improve transparency and accountability in the petroleum sector[15]. The country scored poorly in the 2018 Corruption Perceptions Index, and other similar reports. However, these ongoing measures by the Government indicate a recognition of the need for continued progress in this area.

4.1.4 Issues for petroleum policy

Following is a selection of policy issues which Angola faces or has faced with respect to its licensing of petroleum exploitation.

- Pace of licensing and production. Angola has recently produced oil at a rate which would deplete its reserves over 15 years as of end-2018. Reserve estimates are bound to change over time, often positively, but in recent years Angola has depleted reserves without fully replacing them with new ones. Angola then faces a question of how long it can expect to remain a major oil producer. Oil companies have a normal preference for producing reserves fast, which usually increases their net present value. Countries may stand to benefit more from producing for longer at a more modest pace. Angola can extend its life as a major producer by letting production fall back to a lower rate (which may be a natural result of field decline) and/or by stimulating more exploration, if there are grounds to assume large undiscovered resources. Prioritisation of improved oil recovery is also an option.

12https://knoema.com/CPI2014/corruption-perceptions-index-by-transparency-international-2019?regionId=AO
13 www.eiti.org
14 For two examples, see www.ft.com/content/f0e69381-08e4-3084-a16c-41d2cd600989 and www.uscc.gov/sites/default/files/Research/The_88_Queensway_Group.pdf
15 IMF Country Report No. 12/103, www.imf.org/en/Countries/AGO; www.transparency.org/news/press-release/ti_welcomes_revenue_disclosures_by_angolan_government

- Economic diversification. A large petroleum sector such as Angola's comes with a high risk of undermining other sectors of the economy, a phenomenon often referred to as the "Dutch disease".[16] Angola has a population of 31 million (2019), and the petroleum sector can employ only a very small portion of the workforce. Macro-economic and strategic measures can be taken to stimulate other sectors of the economy while the petroleum sector remains strong. Angola promotes "Angolan content", i.e. involvement of nationals as employees and suppliers to petroleum operations, but this goal risks being made more difficult and less useful if the outlook for Angola as a large producer is relatively short term (previous bullet point).

- Sector organisation. Sonangol has a dominant position in Angola's national management of its petroleum resources. Algeria and other countries have moved from a similar configuration towards a separation of regulatory functions from the national oil company, as is discussed in section 4.6.

- Licensing terms. If Angola chooses to pursue more active exploration, it may be necessary to revisit the fiscal and other terms of licensing. It is possible to make fiscal terms more responsive to changes in oil price outlook and individual field economics, for instance by removing strongly regressive components such as large signature bonuses.

16 The term «Dutch disease» was first introduced by The Economist newspaper, referring to how natural gas production in the 1960s and 1970s strengthened the Dutch currency at the time and salary levels in the Netherlands, with the effect of making other sectors less competitive. The Dutch economy has since recovered well from the affliction. Other countries have not.

- Transparency and accountability. A decisive drive to improve Angola's standing and performance in this regard must come from the nation's top leadership.

4.2. STRATEGIC ENVIRONMENTAL ASSESSMENT (SEA): VOLTA BASIN IN GHANA

Petroleum operations often require physical installations and activities on a significant scale: Seismic surveys, drilling of wells, pipeline connections, process and support facilities, movements of oil, gas, equipment and supplies, and in many cases the presence of personnel from outside the locations where operations take place. In addition to operations that can be planned, there are risks of unplanned events such as spills and explosions. With or without unforeseen calamities, the value chain activities inevitably affect the environment where they take place, including nature and humans (natural and social environment).

It has become established international practice to carry out impact assessments before significant petroleum operations start in an area. It is also done for many other kinds of public and commercial project involving large physical operations. Impact assessments entail the study of natural and social conditions in the area, identification of activities, assessments of impacts and risks related to future petroleum operations, consultations with local and other stakeholders, and establishing a basis for mitigation and monitoring plans. The purposes of impact assessments are to enable key decisions on petroleum operations to be informed of their likely impacts and risks for the environment, and to enable affected stakeholders to express their concerns on an informed basis.

For petroleum operations, it is common to issue two kinds of impact assessments at different stages:

- Strategic Impact Assessment (SEA), ideally before significant petroleum operations are initiated in an area. Commissioned by a government authority.

- Environmental Impact Assessment (SEA) (or Environmental and Social Impact Assessment, ESIA), issued as part of the decision basis for specific petroleum development projects. Commissioned by the licensees undertaking the operations, and approved by a government authority.

There is no single authoritative standard for how SEAs should be carried out, but guidelines and good practice descriptions have been issued by several international organisations including the World Bank (2011), UNEP (2009) and OECD (2006). Methodologies for carrying out SEA tend to be based broadly on one or more of these guidelines and adapted to circumstances. There is also an international association for practitioners in the field, IAIA, which holds conferences and issues topical publications[17].

Requirements for EIA are legislated in many countries. International organisations and donors often make impact assessments a requirement for their involvements. Several African countries have received support from the World Bank or European countries (often the Netherlands or Norway) for carrying out strategic impact assessments. Donor support for SEA is particularly relevant to ensure methodology at international standards. The SEA is a basis for the strategic governmental decisions, and the process therefore needs to be funded and steered by the government. Industry firms are involved as ordinary stakeholders.

A published example of an SEA covers the Albertine Graben in Uganda, which is where the Ugandan oil discoveries have been made.[18]

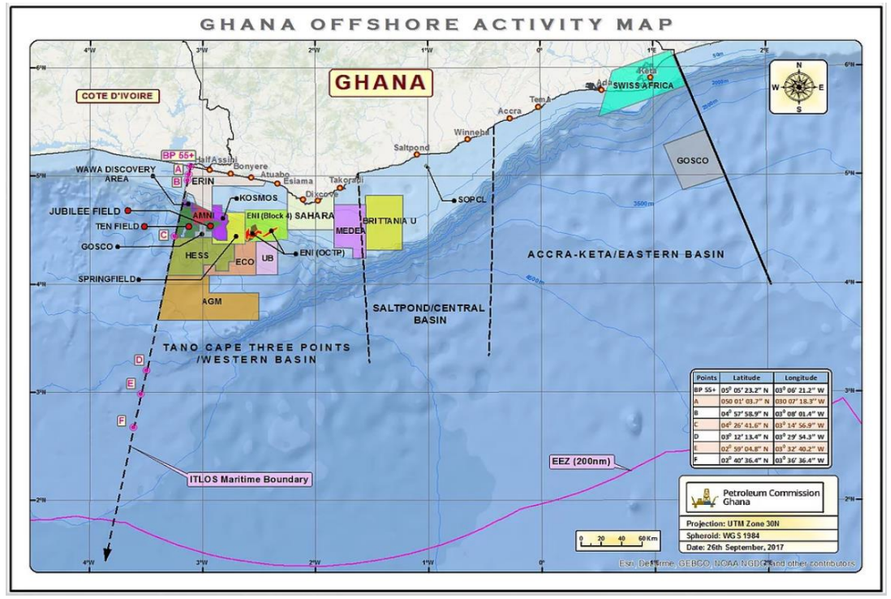


Figure 14: Ghana's offshore petroleum sector[19]

4.2.1 Ghana's petroleum sector

Minor amounts of crude oil were produced in Ghana in the late 19th century, followed by several decades of occasional exploration efforts by international firms. A small oil field in shallow waters near the town of Saltpond started

17 International Association for Impact Assessment, www.iaia.org
18 http://chein.nema.go.ug/wp/?page_id=445
19 Map from Ghana Petroleum Register https://www.ghanapetroleumregister.com

production in 1978, later followed by another small producing field at Tano. Ghana has an oil refinery at Tema, originally from 1963 and expanded later. It is owned by the Government and is of modest size and complexity by global comparison[20].

A much larger oil discovery was made in 2007 of the Jubilee field in 1100 m of water depth. It started production from a FPSO (floating production, storage and offtake unit), operated by Tullow Oil plc and with mainly international petroleum companies as licensees but also a 13.64% share for GNPC. The Jubilee field is located in two blocks covered by petroleum agreements between the Government, GNPC and the international firms. There have been several other discoveries in nearby offshore areas, of which the TEN and Sankofa fields as well as the Jubilee field were producing at the end of 2017. Ghana's oil production was 126,000 bod according to one source[21]. At the start of 2018, proved crude oil reserves stood at 660 million bbl., with subsequent new discoveries set to increase the estimate[22].

Ghana established a national framework for petroleum operations in 1980s including the Petroleum Exploration and Production Law, the Petroleum Income Tax Law and the national oil company GNPC[23]. The Petroleum Commission was established in 2011 as the authority assigned to regulating and managing petroleum resources, under the supervisions of the Ministry of Petroleum. A new Petroleum (Exploration and Production) Act (No. 919) was enacted in 2016. It contains a requirement that a petroleum agreement shall only be entered into after an open, transparent and public tender process. This was not a requirement under the previous law from 1984, and petroleum agreements before 2016 were made without licensing rounds. However, the active Petroleum Agreements and other legal instruments in respect of licenses have been disclosed on a public register from 2017[24], and some were also disclosed earlier on company web sites. The Act from 2016 contains a requirement for a strategic impact assessment to be undertaken before the opening of a new area for petroleum operations, and requirements for environmental impact assessment prior to petroleum operations (Article 82). Requirements for impact assessments are further set out in the Environmental Protection Agency Act (No. 490 of 1994) and the Environmental Assessment Regulations (LI 1652, 1999).

20 45,000 bod crude distillation capacity. The refinery also has a catalytic reformer and residue cracker. Technical deficiencies are reported to have prevented the refinery from operating at full capacity during extended periods of time.
21 Oxford Institute for Energy Studies (2018); Ghana's Oil Industry: Steady growth in a challenging environment.
22https://oxfordbusinessgroup.com/overview/period-growth-oil-and-gas-infrastructure-continues-develop-companies-explore-onshore-and-offshore
23 Ghana National Petroleum Corporation, www.gnpcghana.com
24 https://www.ghanapetroleumregister.com

4.2.2 Strategic Environmental Assessments for Ghana's petroleum sector

Two Strategic Environmental Assessments (SEA) have been initiated for Ghana's oil and gas sector. The first SEA focused on the offshore areas, in which the major discoveries have been made, also covering impacts on the coastal regions potentially affected by the offshore operations (Figure 14). The SEA was initiated in 2009 and completed in 2013. It has not been published by Ghana's authorities. A presentation of the process of developing this SEA is available[25].

The second SEA focuses mainly on the onshore Volta basin within Ghana. The Volta Basin is defined by the river Volta and tributaries in Ghana and other countries in the greater region (Figure 15). The SEA covers 28 specified districts within the Northern, Brong Ahafo, Ashanti, Eastern, Volta and Greater Accra regions of Ghana. They include a large part of the Volta river basin within Ghana. There are no areas licensed for petroleum operations in the Volta Basin areas covered by the SEA (as of early 2018). The area is considered as underexplored but prospective for petroleum resources based on observed oil seeps and some early reconnaissance work.

Also covered by the second SEA is an area outside the Volta basin, comprising four districts along Ghana's coastline near the Eastern border, of the Keta Basin. The reason for including this area is that the Government in 2014 awarded an agreement for a newly defined block there to a group led by a firm incorporated in Switzerland and a privately held Ghanaian company.

25 http://api.commissiemer.nl/docs/cms/CD%20SEA%20Ghana%20def.pdf

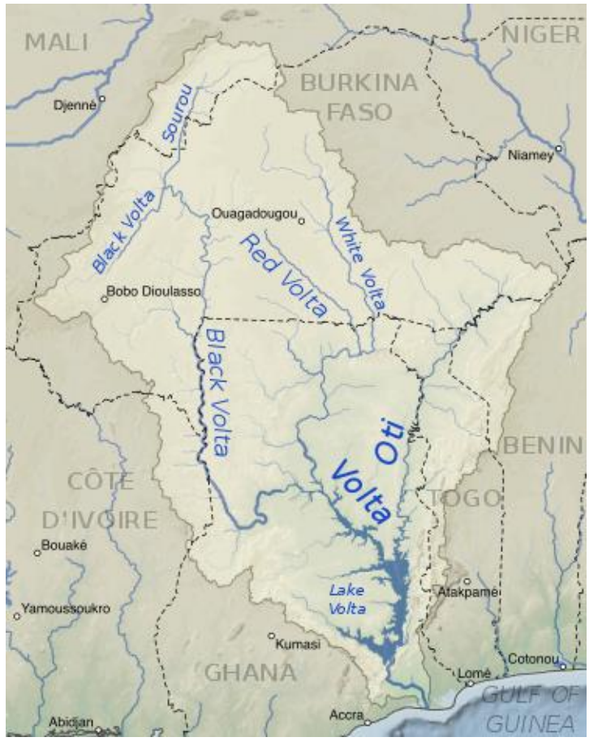


Figure 15:Volta river basin.

Work on the Volta Basin SEA was initiated in 2015 and is ongoing as of early 2018. It was launched by the Minister for Environment, Science, Technology and Innovation[26]. Ghana's Environmental Protection Agency (EPA) is responsible for its preparation[27]. The work is directed by an inter-ministerial steering committee and a 16-member SEA Core Team with members from EPA and other relevant government agencies. The work is co-ordinated by a Norwegian and a Ghanaian consultant, who also co-ordinated the first SEA[28]. Financial support for the SEA work is provided by the Norwegian Oil for Development Programme involving the Norwegian Environment Directorate.

4.2.3 The SEA process

The SEA is essentially a public process, requiring interactions between those preparing it and a wide range of stakeholders. With an SEA, the process of developing it is perhaps as important as the resulting document. It is an opportunity for authorities to engage with stakeholders and become aware of their concerns, for expectations of petroleum activities to be modified, and for the interactions between petroleum operations, society and natural environment to be better understood. Oil companies are involved in the SEA process as stakeholders. They will eventually be required to follow up on the SEA process by preparing environmental impact assessments in respect of their operations.

One aim of the SEA process is to identify issues and concerns associated with future petroleum operations, and to integrate adequate responses to them with the country's planning and regulatory framework. The main stages of the SEA process as carried out for the oil and gas sector in Ghana are as follows (6 stages).

i. **Screening:** Defining the need for SEA and initial stakeholder consultations.

ii. **Scoping:** Delineating and organising the SEA. Identification of issues through review of available documentation, stakeholder consultations, expert assessments and scenarios. The scenarios are designed as several tentative ways in which petroleum operations in the area may evolve as a result of exploration outcomes and subsequent development decisions.

iii. **Assessment:** Key issues from the scoping stage are analysed. Issues and tentative responses are reconciled with the existing national planning framework and regulatory responsibilities. Meetings in affected communities were held to present results from the assessments and get further reactions from affected communities.

iv. **Capacity building:** Developing the capability of Ghanaian authorities and key stakeholders for addressing environmental aspects of petroleum operations is an integral part of the SEA processes in Ghana. This is achieved mainly as a direct consequence of involving Ghanaian personnel in the work, but also study tours etc. for key personnel.

v. **Implementation and Monitoring:** An implementation and monitoring plan is developed, covering the key issues of the SEA and recommendations for mitigation, monitoring and responsibilities.

vi. **Reporting:** The SEA process and findings are documented in a comprehensive report. The SEA reports for Ghana have not been published at the time of writing. (A corresponding report for Uganda's Albertine Graben is available[29].)

4.2.4 Issues from the SEA process

In the monitoring plan for the first Ghanaian SEA, issues were grouped into the categories of natural resources, socio-cultural, economic and institutional. More than 70 issues in total were identified. Of these, the following 24 were identified as key issues:

26http://www.ghana.gov.gh/index.php/media-center/115-mesti/2520-report-on-the-launched-of-strategic-environmental-assessment-on-the-voltaian-basin-february-29-2016
27 http://www.epa.gov.gh
28 The consultants are Bjorn Kristoffersen and Evans Darko-Mensah. Mr Kristoffersen kindly provided information on the process for this report. https://eurekaenergy.webnode.com/bjorn-kristoffersen/

29 http://chein.nema.go.ug/wp/?page_id=445

Natural Resources

- Invasive species associated with the disposal of ballast water and its effects on marine environment
- Accidental spillages and incidents at all stages
- Waste management at all stages
- Climate change

Socio-cultural

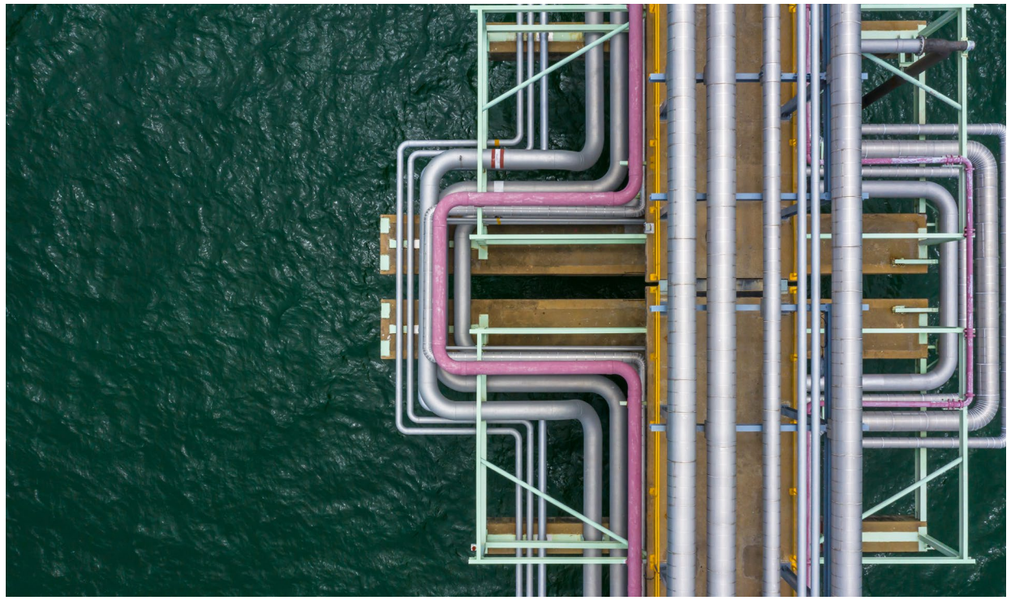
- Increase in social vices
- Public and occupational Health and Safety
- In-migration and related social and health implications
- Unrealistic or exaggerated expectations in the local population
- Oil spills and their effects on the livelihoods of the coastal communities, especially women, children and the vulnerable

Economic

- Job creation and increase in employment leading to improvement in the living standards of the people particularly the youth
- Avoidance of over-dependence on oil and gas (Dutch Disease) by investing in agriculture and allied sectors
- Sustainable Alternative Livelihood schemes for persons affected by the oil and gas development
- Proper management of petroleum revenues and gas resources
- Price distortions arising from income dispositions in oil producing areas
- Drain of skilled workforce from other sectors into the oil and gas sector

Institutional

- Institutional mandate and arrangement for offshore petroleum safety and emergency training
- Need for a dedicated port to support oil operations
- Institutionalization of a forum for continuous stakeholder engagement/ consultations and conflict resolution & management
- Capacity building, skills training and technology transfer for local businesses to participate in the oil industry
- Institutional capacity building for monitoring and regulation
- Need to ensure transparency and fairness in the operations of the oil and gas industry
- Management of expectations including issues relating to naming of fields and wells, etc
- Land use Planning and Control
- Health and other Emergency Response Facilities



The Implementation and Monitoring Plan makes recommendations for mitigation, implementation and monitoring, focusing on indicators, budgets and responsible institutions. Where appropriate, these recommendations are linked to Ghana's existing planning and regulatory framework. The recommendations from the SEA were finally coordinated with the actions of the Ghana Shared Growth and Development Agenda (GSGDA) and were thus implemented effectively into the relevant budgeting structures in Ghana.

The issue of employment and jobs was brought up in several stakeholder consultations. Residents understandably have expectations and hopes that petroleum operations will bring new opportunities especially for young people to regions where such opportunities have been scarce. This is not an issue caused by petroleum operations, but often becomes a large concern where petroleum is found and produced. Given that the petroleum industry tends not to be a large employer, realistic expectations can be a challenge, as identified in the list above. Nevertheless, local content as a component of petroleum policy is clearly called for, as will be reviewed in the next section with references to Nigeria.

Fishermen along the coast expressed concerns that catches were reduced and livelihoods threatened as a result of petroleum operations and for other reasons, including competition from larger commercial vessels. Some of the key issues listed above are related to fisheries and were selected by analytical assessment of how fisheries may be affected by petroleum operations.

4.2.5 Issues for petroleum policy

The use of impact assessments and the associated processes of stakeholder consultations reflect a fundamental view of the relationship between government and its subjects: Government is there to serve the people, and therefore makes decisions of large consequence only after consulting with those affected and considering their interests. It also reflects a duty to protect the natural environment. These views are not endorsed by all governments and rulers, and certainly have not been in the past. In Ghana they now are, as evidenced by her Government's commitment to the SEA process. The alternative approach, still pursued in some African nations, is imposition by sovereign determination, accompanied by as much force as it takes.

The first Ghanaian SEA, finalized in 2013, would have been better positioned to serve its purpose had the Government decided to publish it.

The first policy issue facing governments in respect of impact assessments is therefore whether to legislate them as mandatory. Ghana and many other countries have done so. Ghana's legislation on the matter became more clear-cut with the new petroleum (Exploration and Production) act of 2016. It requires SEA to be made before opening areas for petroleum operations. This was not Ghana's earlier practice, as evidenced by the reality that the first SEA was initiated well after the licensing and discovery of the Jubilee field, and could be finalized only three years after production start. The principle of developing the SEA before initiating petroleum operations has been adhered to for the onshore Volta basin, but not for the block awarded in 2014 to two little-known players in the coastal Keta basin.

There is a further issue of transparency. SEA is a process suited to full transparency, without which it is likely to be less useful. The first Ghanaian SEA, finalized in 2013, would have been better positioned to serve its purpose had the Government decided to publish it.

A SEA highlights a number of issues which are of concern to stakeholders in respect of future petroleum operations. Protecting traditional livelihoods from pollution and other dangers, new employment opportunities, inwards migration and the pace at which operations will proceed are often among these issues. Addressing them entail choices for petroleum policy.

4.3 LOCAL CONTENT POLICY IN NIGERIA

Local content or National content is income earned by nationals of the host nation for value-creating work in the petroleum value chain. In Nigeria, it is referred to as Nigerian content.

4.3.1 Nigeria petroleum sector overview

Nigeria is Africa's largest oil producer, with 2,051,000 bod in 2018. This was 19% less than in the peak year of 2010. In addition to decline for other reasons, some production in recent years has been lost due to insurgency and sabotage in the Niger Delta. Nigeria is also a significant exporter of natural gas as LNG. With remaining oil reserves at 50 times annual production at the end of 2018, and more than 100 times for gas, Nigeria is positioned to be a major petroleum producer for many years still[30].

Nigeria is Africa's most populous country, with 200 million people (2019). Most of the population depend on traditional biomass for daily energy needs, and lack access to grid electricity.

Most production in Nigeria takes place offshore or in the Niger Delta. Large oil firms based in Europe and the U.S. operate much of the production under production sharing agreements (PSA) and joint venture agreements with the Nigerian National Petroleum Corporation (NNPC). There is also some participation by firms in Nigerian non-state ownership. The Ministry of Petroleum Resources oversees the sector through a regulatory agency, the Department of Petroleum Resources (DPR).

Nigeria is Africa's most populous country, with 200 million people (2019). Most of the population depend on traditional biomass for daily energy needs, and lack access to grid electricity. Petroleum has a large position in the country's export earnings and government revenues. Even though the sector is less than 10% of the country's GDP, it contributes about 65% of Government revenue and 88% of Nigeria's foreign exchange earning[31].

4.3.2 An Act to enhance Nigerian content

Oil production in Nigeria started in the 1950's, shortly before independence from Britain. For much of that time, petroleum operations have been conducted with little involvement by Nigerians. After some earlier and less effective policy initiatives, an

30 Production and reserves data from BP statistical review of world energy, www.bp.com/en/global/corporate/energy-economics/statistical-review-of-world-energy.html
31 https://assets.kpmg/content/dam/kpmg/ng/pdf/tax/Nigerian-Oil-and-Gas-Update.pdf

act with substantial measures to promote Nigerian content was passed in 2010[32]. Its measures include the following:

- For licensing of petroleum rights, first consideration to be given to Nigerian independent operators;
- Establishment of the Nigerian Content Development and Monitoring Board NCDMB) with important regulatory functions[33];
- License operators to submit Nigerian Content Plan demonstrating compliance with the Nigerian content requirements, and must obtain a certificate from NCDMB to that effect;
- First consideration to services provided from within Nigeria and to goods manufactured in Nigeria;
- Nigerians to be given first consideration for training and employment;
- Nigerian content levels to be calculated for projects and to satisfy percentage levels set in the Act for different types of project[34];
- Minister may authorize continued importation of items for which there is inadequate capacities in Nigeria, limited to 3 years after commencement of the Act;
- Bidding processes for procurements to give full and fair opportunity to Nigerian suppliers;
- For procurements, Nigerian indigenous companies not to be disqualified for reason of not being the lowest price bidder as long as the difference is within 10%;
- For procurements exceeding UD$ 1 million: Quarterly reporting to NCDMB in advance (planned procurements) and after the quarter (awarded procurements). Bidding procedure to be approved by NCDMB before the procedure, and details of selected supplier to be reviewed by NCDMB before contract award;
- Requirements to maintain local office in areas where operator has significant activity, and to employ local personnel;
- Operator to submit plan for Nigerians to enter all positions held by expatriates within four years, except that 5% of management positions may continue to be held by expatriates;
- Plans to be submitted by operators every 6 months for research and development to be carried out in Nigeria, and corresponding activities reported quarterly;
- Technology transfers by operators to Nigerian individuals and firms subject to annual plans and reports;
- Requirements for license operators to invest in facilities for production or services which would otherwise be imported to Nigeria;
- Requirements for procuring insurance, legal services and financial services from Nigerian providers;
- The NCDMB to establish a Joint Qualification System as an industry databank of available capabilities in Nigeria[35];
- The NCDMB to set up a Nigerian Content Consultative Forum as a platform for information sharing and collaboration with regard to projects, capabilities and policy proposals[36];
- A Nigerian Content Development Fund to be managed by the NCDMB, funded by a deduction of 1% of the value of contracts awarded by license operators;
- "Nigerian Company" is defined as a company formed and registered in Nigeria with not less than 51 % equity shares by Nigerians.

The schedule to the act prescribes minimum Nigerian content levels for several hundred different categories of work and supplies. For instance, FEED and detailed engineering on a deep offshore floating structure shall be 80% Nigerian content by man-hours, and geophysical interpretation services have to be 90% Nigerian content, with the measured unit stated as "Spend". The Act provided that the Minister could grant deviations from these requirements for the first three years after the Act became effective.

4.3.3 Does it work?

To summarise the answer to the question in the heading: It is not known for sure. Regulatory actions based on the Act appear to have some effects of enhancing national content, but not yet systematically assessed, and there are significant deviations between legislation and implemented practice.

There is incidental evidence that some Nigerian businesses are becoming significant suppliers to petroleum operations, and emerging Nigerian oil firms taking license shares not only in Nigeria but also in other African countries. It would be a reasonable assumption to ascribe such positive developments at least in part to the implementation of the Act since 2010.

As of April 2018, no systematic evaluation had yet been published of what Nigeria has achieved in this area, and also no assessment of what the Nigerian content requirements may have cost Nigeria in the form of fiscal losses resulting from cost increases and other impacts on petroleum operations. Some numbers purported to indicate the level of Nigerian content are referred in the public domain from time to time, but as their definition as well as their empirical basis remain unclear they will not be repeated here. The NCDMB pursues a 10-year strategy aiming at in-country value retention of 70% of oil and gas industry expenditures.

32 The Nigerian Oil and Gas Industry Content Development Act, of April 22nd, 2010.
33 http://www.ncdmb.gov.ng
34 The Act has 10 pages listing types of project
35 https://nogicjqs.gov.ng
36 http://www.ncdmb.gov.ng/nccf/

NCDMB does not publish annual reports of its work and achievements[37]. The Executive Secretary of NCDMB, having assumed the position in late 2016, has announced that a baseline study of capabilities relevant for petroleum sector supplies in Nigeria will be undertaken[38]. Information was received from NCDMB for the present study that work on the baseline study had commenced but not yet been finalized[39].

The NCDMB has chosen a strategy emphasizing collaboration with major industry players. There has been dialogue with international oil firms and international major suppliers identifying possibilities for Nigerian content in major development projects and developing relevant capabilities. International contractors have established capacities in Nigeria fulfilling certain parts of large construction contracts. An example is Samsung Heavy Industries, of South Korea, which delivered a large floating installation to Total which was fabricated partly in Korea, partly at a Samsung yard in Nigeria[40]. Such combined deliveries are facilitated by a balanced and pragmatic attitude expressed by NCDMB towards the presence of foreign firms in the country[41]. NCDMB has, at least before 2018, taken a cautious approach with respect to legal action against non-compliance with the Nigerian Content Act, recognizing that full compliance has not been possible while proceeding with development and production of Nigerian oil (further commented below). A more assertive approach, involving legal actions, was signalled in 2018[42].

The NCDMB has pursued a strategy of promoting establishment in Nigeria of manufacturing facilities for equipment used in the petroleum industry. The strategy is labelled the Equipment Component Manufacturing Initiative (ECMI). It includes the intended establishment of industrial parks which are suited to hosting such manufacturing facilities. Construction of the first such park, at Odukpani in Cross River State, commenced in early 2018. Several new manufacturing facilities for petroleum supplies have opened in 2016/17, including a steel pipe mill and a pipe coating plant.

The Nigerian Content Development Fund, into which operators are required to pay 1% of the values of awarded contracts, has accumulated a large balance, as there have been few disbursements from it[43].

37 Information was received from NCDMB for this study that annual reports have been prepared but not published.
38 Interviews with Mr Simbi Wabote executive secretary of NCDMB,, reported in several Nigerian media, April 2017.
39 Information received March 2018.
40 https://www.ncdmb.gov.ng/2018/02/egina-recorded-over-50-nigerian-content/, https://www.vanguard-ngr.com/2018/01/total-egina-fpso-arrives-nigeria/
41 https://www.dailytrust.com.ng/news/feature/-nigerian-content-not-about-chasing-away-foreign-ers/193765.html
42 https://www.ncdmb.gov.ng/2018/03/ncdmb-sue-offenders-local-content-act/
43 Press interview with Mr Wabote, executive secretary of NCDMB. Published February 16th, 2017.

The fund has been restructured in 2017/18 and supplemented by a Nigerian Content Intervention Fund with an aim of increasing access to fund financing for relevant business developments.

The Act set a limit of three years during which the Minister could authorize continued imports of items for which the capacities in Nigeria were still inadequate for meeting the requirements of the Act. Ovadia (2016) noted that after the initial three years, the routine of issuing waivers for imports became entrenched and largely discretionary, due to the reality that the stipulated targets for Nigerian content simply cannot be met in some cases. He also noted that measurements of local content were not well defined, even though they are essential to the application of the percentage limits stipulated in the Act. Information received from the NCDMB for this study as well as a press release on the NCDMB web site indicate that waivers (import permits) are now in effect granted by the NCDMB (not the Minister)[44]. The NCDMB pursues a policy of granting such waivers conditionally on the recipient undertaking specified and agreed work to promote Nigerian content. The NCDMB executive secretary stated in the press release that the requirements of the Act could not be fully complied with without stopping oil production in Nigeria until such time as the requisite capacities could be developed.

Success of a Nigerian Content policy requires that many businesses are established in Nigeria to provide goods and services needed for petroleum operations. This depends not only on the implementation of the Nigerian Content act of 2010, but also on the general conditions for doing business in Nigeria. These are not of the desirable standards. With a score of 52.03 (where 100 is maximum),

http://punchng.com/local-content-ncdmb-targets-midstream-downstream-sectors/
44 https://www.ncdmb.gov.ng/2018/02/egina-recorded-over-50-nigerian-content/

The lack of a basic industrial capacity such as a steel mill in a country of Nigeria's large size is notable, and must be due in part to the general difficulty of doing business in the country.

Nigeria ranked as 145th out of 190 countries on the World Bank's ease of doing business ranking for 2018, far behind other Africa nations such as Morocco (69th) and Kenya (80th). Issues where Nigeria's scores were particularly dismal, include dealing with construction permits (147th), getting electricity (172th), registering property (179th), paying taxes (171th) and trading across borders (183th). The NCDMB executive secretary has lamented the lack of a steel mill in Nigeria as an impediment to achieving national content[45]. The lack of a basic industrial capacity such as a steel mill in a country of Nigeria's large size is notable, and must be due in part to the general difficulty of doing business in the country. It is within the Nigerian government's remit to improve on these aspects, all of which are important for businesses aspiring to be effective suppliers to the petroleum sector.

4.3.4 Issues for petroleum policy

Few would dispute that Nigeria and other African petroleum producing nations should aim for their nationals to obtain substantial income as suppliers to petroleum operations. There are important policy choices to be made in how this can be achieved, and how this relates to other equally important national interests. Several among these issues are discussed further in chapter 6.

- **National or global positioning.** A fundamental issue is whether a petroleum producing country should seek to position its firms and workforce as dominating the national petroleum supplier sector, or as strong participants in industry segments which are essentially global. Nigeria has chosen the former approach, with its insistence on Nigerian dominance in supplying Nigerian petroleum operations. Other nations, particularly among the advanced economies, do not insist on indigenous dominance of the home market, but on developing a substantial local presence of industries with strong global positions as suppliers to petroleum operations.

- **Focus on ownership or location of activities.** The Nigerian Content Act gives preferences to firms which are at least 51% Nigerian owned. The Nigerian Content Development and Monitoring Board has taken a pragmatic approach, seeking to encourage foreign firms to establish a presence in Nigeria. International supplier firms to the petroleum industry often establish active operations in several, but not all, countries in which they have sales. They are in many cases reluctant to surrender ownership and control over their investments. This results in a trade-off: A country can insist on majority indigenous ownership of petroleum related operations taking place in the country, at the risk of having fewer such operations in the country than if it had been tolerant of fully foreign-owned operations.

- **National or regional scope of business?** Low levels of trade between African nations is sometimes referred to as an impediment to the continent's economic development. The emphasis on Nigerian firms and individuals as beneficiaries of the Nigerian Content Act from 2010 may have been intended to prevent domination by European, American and Chinese firms, but as formulated, it also limits the scope for firms from other African countries as contributors to Nigeria's petroleum sector. Nigeria must then expect the reverse to also apply, with the effect of limiting the scope for Nigerian firms to do business elsewhere in Africa. There is geographical proximity as well as operational similarities of petroleum operations along Africa's western coast from Angola to Senegal, and possibly beyond. This could be suitable for the development of effective African enterprises with a regional scope of operations. This is restricted by legislation such as the Nigerian Content Act from 2010, which may have the effect of weakening African content in Africa's petroleum sector.

- **Collaborative approach versus rigid impositions**. The Nigerian Content Act of 2010 contains many specific requirements for oil firms to fulfil. As the authority responsible for its implementation, the Nigerian Content Development and Monitoring Board has acknowledged that a number of these requirements are simply not realistically attainable in the originally targeted timeframe, or that their strict implementation would impose unacceptable costs on Nigeria. The Board has then taken a pragmatic approach of issuing waivers, i.e. permits for exemptions, preferably conditional upon the benefiting party undertaking agreed commitments to promote Nigerian content[46]. This practice can result in a more collaborative and constructive approach to national content involving the affected firms. It can be criticised for being discretionary (Ovadia 2016), but can potentially be effective if applied wisely. This raises the question of whether the legislation might better have been designed with a more collaborative strategy and fewer rigid requirements, to improve the coherence between legislation and regulatory practice. It would have implications not only for national content policy but also for the general credibility and respect for national legislation.

45 As above

46 The question of NCDMB's legal basis for this practice is left aside here.

- **Balance of enabling versus imposing measures for national content**. Many measures in Nigeria's 2010 act are impositions on the oil firms, obliging them to do things they might not have done by choice. National content policies usually contain some measures of this nature. Other measures are more oriented towards enabling nationals to become effective and sought-after contributors to the sector. This would include education, including high-quality vocational training, to provide a labour force qualified for work in the sector, and the establishment of industrial parks with adequate infrastructure. These could be effective locations for petroleum related businesses. It would also include enhancements of the general business conditions in the country as indicated by the World Bank's regular Doing Business reports. The Nigerian Content Act (2010) has some measures which are mainly of this enabling nature, notably the joint qualification system and the consultative forum.

- **A dedicated tax for national content?** The 1% charge on contracts which operators in Nigeria must pay into the Nigerian Content Development Fund, is in effect a tax. If this tax is acceptable to the operators, then it would arguably also have been acceptable for them to pay similar amounts as increases to regular fiscal instruments. In this perspective, the 1% charge deducts from the regular fiscal income which Nigeria could otherwise have had to the treasury[47].

4.4 OIL REFINING AND FUELS PRICING IN SUDAN

The country's largest refinery, near Khartoum, began operations in year 2000, and was later expanded to a capacity of 100,000 bod.

Oil production on a large scale started in Sudan in 1999. The main discoveries are in areas which straddle the border between Sudan and South Sudan. This is deep inland. A pipeline of more than 1500 km was built to Port Sudan for export shipments from 1999. A second pipeline to Port Sudan was completed in 2005, dedicated to fields whose oil is of lower value due to contaminants. The pipelines pass by Khartoum, Sudan's capital and largest city. The country's largest refinery, near Khartoum, began operations in year 2000, and was later expanded to a capacity of 100,000 bod.

South Sudan separated from Sudan[48] to become an independent nation in 2011, following a peace agreement and a referendum in the South. By that time, Sudan's combined oil production had already peaked, at 483,000 bod in 2007[49]. The larger parts of reserves and production are located in the South. The separation resulted in oil production in the remaining Sudan being less than 30% of the combined production before the separation. Sudan's oil production in 2016 was 104,000 bod, 13% lower than two years earlier. South Sudan depends on the pipelines through Sudan to Port Sudan for exporting its oil. South Sudan's oil production has been variable and generally lower than before independence, due in parts to armed conflicts and to South Sudan's production being shut in for a period in a dispute with Sudan over pipeline transit fees for the oil.

Figure 16: Map of Sudan and South Sudan; key oil infrastructure.

Some refineries shown in the map are inactive or not (yet) built.
Source: Energy Information Administration, USA. www.eia.gov

4.4.1 Refining capacities and fuel consumption

The Khartoum refinery is among Africa's most modern and advanced refineries. In global comparison it can be characterized as being of medium size and medium complexity. In addition to 100,000 bod of crude oil distillation capacity, it has several upgrading units enabling it to produce automotive fuels of modern qualities. The refinery is configured to use two different qualities of crude oil which are produced in Sudan and South Sudan. The upgrading units include a catalytic reformer, residue catalytic cracker, delayed coker (a form of thermal cracker) and hydrotreating units[50].

Apart from the Khartoum refinery, Sudan has three small topping plants whose combined capacities have been stated as 22,000 bod.[51] They can distil crude oil into fractions, but can make little or no vehicle fuels at modern quality standards except that some of their output can be blended in with product from the Khartoum refinery. An old refinery at Port Sudan has been taken out of service. Plans agreed

47 A similar argument is made by Kolstad and Kinyondo (2015) in a general context.
48 Map from Wikipedia Commons. By OCHA, CC BY 3.0, https://commons.wikimedia.org/w/index.php?curid=32650016
49 Source: BP Statistical Review of World Energy, 2018
50 Website of the refinery company, http://www.krcsd.com
51 Energy Information Administration: Sudan and South Sudan international analysis, 2014. www.eia.gov.

with Petronas, Malaysia's national oil company, for a much larger refinery at Port Sudan have not come to fruition. In the years following separation from South Sudan, Sudan's consumption of refined petroleum products was around 110,000 bod, while production of such products was around 90,000 bod, mainly from the Khartoum refinery. The deficit, which was mainly for diesel and LPG, was imported. Over the 20 years to 2014, the consumption of refined petroleum products grew much more in Sudan (275%) than in all of Africa (79%)[52]. Most of that growth in Sudan happened in the decade from 2000 to 2010, when Sudan saw strong economic growth fuelled by oil production at strong prices.

4.4.2 A strong role for Chinese and other Asian firms

The oil fields which formed the basis for Sudan's first major oil developments were discovered by Chevron, a large American oil company, around 1980. The discoveries were made in a region marked by violent conflict and security issues. Chevron and other Western firms suspended or terminated operations in Sudan. Relations between Sudan's government and Western governments deteriorated. Sanctions were imposed on Sudan, led by extensive sanctions by the United States from 1997. These were lifted only in 2017. There were occasional attempts in the 1990s and later by Western firms to enter Sudan's petroleum sector, which did not materialise.

Instead, Chinese interests, notably China National Petroleum Company (CNPC) stepped in as main sponsors of Sudan's petroleum developments. The Chinese engagement was authorised at high political level on both sides, and complemented by Chinese sponsored infrastructure projects in Sudan[53]. Malaysia's Petronas and India's Oil and Natural Gas Corpoation (ONGC) also took significant positions. The main oilfield developments were undertaken by two incorporated joint venture firms. They were the Greater Nile Petroleum Operating Company (GNPOC) and Petrodar Operating Company (PDOC). The said three Asian firms along with Sudapet, the Sudanese state company, are shareholders in GNPOC. Shareholders in PDOC are Petronas, CNPC, another Chinese firm and an investor-owned firm based in Egypt.

China's CNPC also stepped in as part owner and main sponsor of the Khartoum refinery, which was built simultaneously with field and pipeline developments. The other shareholder is Sudan's Ministry of Energy and Mining.[54]

The terms of agreement leading to the incorporated joint venture firms, petroleum licenses and the refinery are not made public. The refinery was built by the Chinese interests by agreement with Sudan's authorities.

52 Based on data form EIA and BP statistics as per previous footnotes.
53 Yagoob et al (2015)
54 Ownership in the refinery was initially 50%/50% and has since become 90%/10% Sudanese/Chinese.

Many countries now accept the principles of due process with community interests as a basis for petroleum operations. These include environmental and social impact assessments, constructive local community relations and compensation to those negatively affected by the operations. In Sudan's case, there has been a smaller role for positive community relations and a larger role for armed force in clearing the way for petroleum operations.

When crude oil production from Sudan peaked prior to South Sudan becoming an independent nation, Sudan was a significant supplier of crude oil to China. The Chinese government attached strategic significance to this. With Sudan no longer a significant oil exporter, and with reduced volumes of South Sudanese crude exported from Sudan's terminal, Sudan's importance to China is now reduced. China has large interests in South Sudan, where the agreements originally made with Sudan continue to be applied. In times of conflict and disputes between the two Sudans, China is often seen to promote solutions which would not impair oil exports while taking an impartial stance.

4.4.3 Regulated pricing of petroleum fuels

The Khartoum refinery was built for the main purpose of supplying Sudan's own market. Some marginal volumes could be exported to neighbouring countries. Location of the refinery near Khartoum is suited to a domestic supply strategy.

The Government has taken a central role in the supply of fuels in Sudan. It sets pump prices. As a consequence, fuel prices have been politicized and often significantly

lower than international market prices. The Government sustains the system of administered prices in part by using the oil to which it is entitled under the license agreements covering the producing fields. The government supplies its oil to the Khartoum refinery at prices which have at times been set administratively below world market prices[55]. As of early 2018, the transfer prices for oil supplied to the refinery have become more aligned with world market pricing with deduction for transport costs. The government's shares of oil from the fields are usually not sufficient to keep the refinery fully supplied. Additional oil can be bought from the licensees in Sudanese and South Sudanese oil fields, at prices which must be agreed with them.

The official retail price of diesel was 21 Sudanese pounds per imperial gallon as of March 2018 ($0.26 per litre at the official exchange rate of US$1 = SDG 18)

As in several other countries operating similar systems, the tendency for administrative prices to deviate from world market prices has been strongest when world market prices for oil have been high, such as during 2010-2013 as world oil prices mostly exceeded $100 per barrel. As of early 2018, with the market price of Brent crude oil around $70 per barrel, fuel subsidies (including implicit subsidies as explained below) are still large, as evidenced by the pump prices prevailing in Sudan: The official retail price of diesel was 21 Sudanese pounds per imperial gallon as of March 2018 ($0.26 per litre at the official exchange rate of US$1 = SDG 18)[56]. This was about 50% of the world market price for diesel (gasoil) in bulk trade at the time.[57] Without explicit and implicit subsidies, the price of diesel at Sudanese pumps would need to be more than twice the actual level to match international bulk market prices with adjustments for regional price differentials for bulk traded gasoil, retail margins, and normal consumption tax such as VAT.

The artificially low prices for fuel have inflicted costs and losses on Sudan's government explicitly and implicitly:

55 James (2014) reported that the government's transfer price for crude oil supplied to the refinery was $49 per barrel for the Nile crude oil blend and $38 per barrel for the lower-quality Fula blend, at a time when world market prices were around $100 for good quality crude oil.
56 Fuel prices in Sudan are set in Sudanese pounds (SDG) per imperial gallon (4.55 litres).
57 Gasoil futures prices on the Intercontinental Exchange were around $600 per tonne for most of the 1st quarter, 2018, corresponding to $0.51 per litre. https://www.theice.com/products/34361119/Low-Sulphur-Gasoil-Futures/data

Explicit subsidies

- Transfers of public funds have been required to keep the pump prices at the desired level;

Implicit subsidies

- The government loses revenue from crude oil if it is delivered to the refinery at below market prices;
- Losses of tax revenue due to tax exemptions;[58]
- A currency difference on the cost of imported fuels when the official exchange rate for Sudan's currency against the U.S. Dollar is significantly different from market equilibrium.[59]

The first bullet point above shows up directly in the government's budget and accounts. Sudan also subsidises the price of wheat, and the subsidies of fuels and food amounted to nearly 20% of government expenditures during 2013-2015. Fuel subsidies accounted for some ¾ of that, so nearly 15% of government expenditures. The other three bullet points above represent financial burdens, mostly as lost revenue, which are less visible but still real and significant. A precise determination of the magnitude of implicit subsidies is challenging.[60]

Another likely consequence of subsidized fuel prices are occasional shortages of fuels. The official Government position is that the country has been consistently well supplied with fuels except for a small number of incidents of technical disturbances over the years. News stories and informal accounts indicate that fuel shortages and curtailments have been rather common, resulting occasionally in long line-ups of cars at service stations and other practical limitations.

Over the years there have been several initiatives in Sudan to reduce fuel subsidies, and some have been implemented. They have met with resistance in the streets and in the system of government. Adding to the problem for Sudan is the erosion of its currency, which tends to make the subsidies grow again once they have been lowered. Inflation in consumer prices has mostly been well above 20%, sometimes 40%, per year during 2013-2017. The official exchange rate was adjusted to 18 Sudanese pounds to one U.S. dollar in early 2018. It was 2.50 pounds to one dollar

58 IMF (2017b) noted a significant fiscal loss from tax exemptions for energy products, estimated at 3.8% of GDP for 2014 but apparently reduced since then. Information was received for this study that fuel sales are now subject to VAT.
59 The currency difference on imported fuels has been pointed out by IMF (2017b) to occur as a consequence of Sudan's official exchange rate against the dollar, which is set by the government. It has at times deviated strongly from market realities, and large devaluations have been necessary on several occasions. When dollar based costs of imports are converted to Sudanese pounds at the official rate, the imports appear to be cheaper than they really are, as the use of dollars to pay for the imports is a costly drain on limited currency reserves.
60 An approach to measuring subsidies is proposed by IMF (2017a).

at the beginning of 2011[61]. Even with a flat oil price in dollars, the pump prices in pounds would need to increase gradually to avoid rising subsidies. They do not rise gradually; they tend to be kept at a politically determined level until the burden on the state finances becomes excessive, and then raised sharply. This delivers an abrupt economic burden to consumers who struggle to keep up with rising prices, so there have been protests.

4.4.4 The strains on Sudan's economy

The economic and fuels sector developments in Sudan should be considered on the background of the difficulties to which the country has been exposed.

The separation from South Sudan took away some ¾ of Sudan's oil production. Some of the loss can be recovered by transit fees paid by South Sudan for moving its oil through Sudan's pipelines and export terminal, but these are inevitably lower than the value of the oil itself, and South Sudan's oil production has also been lower than before the separation. Arguably, Sudan had good opportunity to adjust to this. As recently as 14 years before the separation, the country had less than 5,000 bod of oil production; after the separation, more than 100,000 bod. The separation in 2011 was a consequence of the Comprehensive Peace Agreement, signed between the two parties in early 2005.

Another cause of difficulties for Sudan's economy were the sanctions imposed by the U.S.A. and, to lesser extents, other Western nations. The sanctions curtailed Sudan's access to much expertise which could have been provided by oil firms and supplier firms from those countries. The sanctions also reduced the range of sales opportunities for Sudan's oil. This may have been a significant constraint at least for the Dar crude oil, which has contaminants making it unsuitable for many refineries. The issue of the causes of the sanctions and whether this was a self-inflicted damage on Sudan's part, is left aside here. Sudan found new partners in China and other Asian nations to fill the void left by Western sanctions, as long as Sudan accepted the mode of co-operation offered by them.

Table 3 summarizes selected economic indicators for Sudan and, where available, averages for sub-Sahara Africa.[62] The first for rows, GDP per capita, PPP in fixed (2011) dollar values[63], indicate the level of economic development in terms which are comparable across time and between countries. The following features of Sudan's economy stand out:

61 Central Bank of Sudan, www.cbos.gov.sd
62 Sudan is usually not classified as part of sub-Sahara Africa in international reports.
63 GDP is Gross Domestic Product, a measure of the value of all economic production. PPP stands for Purchasing Power Parity, meaning that the GDP amounts have been converted to U.S. dollars in a way which adjusts for differences in price levels between countries. Prices in the United States as of 2011 is the common reference point for this.

i. Sudan overtook sub-Sahara Africa in terms of economic development in the first decade of this century. Sudan's growing oil production was a driver of growth in this decade.
ii. Sudan's GDP per person made a jump from 2010 to 2012 due to the exclusion of the poorer South Sudan.
iii. Sudan's economy continued to grow after separation from South Sudan; at a slower pace than earlier, but still higher than sub-Sahara Africa.
iv. Sudan's external economy is weak, with imports 89% higher than exports during 2012-16 and large external debts. Since separation, Sudan no longer has a trade surplus in oil, and has few other exportable goods[64].
v. High inflation, large public debt and large external debt are indicators of a strained economy.
vi. Sudan is a country of low taxes and low expenditures on public services; these indicators being much lower in Sudan than in sub-Saharan Africa. Sudanese children can expect to receive 2.7 fewer years of schooling than children south of the Sahara.
vii. The Human Development Index for Sudan is lower (poorer) than the average for the continent south of the desert.

64 30 tonnes of gold provided 29% of Sudan's total export revenues in 2014. Gold was the largest export commodity, followed by crude oil, sheep, sesame and camels. Source: Central Bank of Sudan annual report 2014, www.cbos.gov.sd

Table 3:Macroeconomic indicators. Sudan vs sub-Sahara Africa

	Sudan	Sub-Sahara Africa	Diff. Sudan - Sub-S. Africa
Population growth,% per year, 2012-2016	2.4%	2.8%	-0.4%
GDP per capita, PPP, $(2011): 1998	2 206	2 391	-185
GDP per capita, PPP, $(2011): 2010	3 336	3 239	97
GDP per capita, PPP, $(2011): 2012	4 097	3 329	768
GDP per capita, PPP, $(2011): 2016	4 385	3 453	932
Growth in GDP per capita, 2000-2010, p.a.	6.2%	5.3%	0.9%
Growth in GDP per capita, 2012-2016, p.a.	3.2%	2.4%	0.8%
Consumer price inflation, 2012-15 average	30%	5%	25%
Imports/exports ratio, 2012-16 average	1.89	1.12	0.77
Current account, % of GDP, 2012-16 average	-6.3%		
External debt, % of GDP, end-2017 projection	95%		
Human Development Index 2016	0.49	0.52	-0.03
Expected years of schooling	7.2	9.7	-2.7
Tax revenues, % of GDP, 2015-16 est.(IMF)	5.3%	16.8%	-11.5%
Gov't final consumption, % of GDP, 2012-16 ave.	6%	15%	-9%
Public debt, % of GDP, end-2017 projection	100%		

Data from IMF, World Bank, UNDP

4.4.5 Issues for petroleum policy

Following is a selection of policy issues which Sudan has faced since the 1990s, and indications of the policy choices selected by it.

i. Licensing method. The predominant mode of petroleum licensing in recent decades internationally has been competitive licensing rounds involving commercially oriented oil firms. Sudan chose a different approach in the 1990s, with a larger role for foreign state-owned firms and complex deals with high-level political involvement. This policy choice can be considered in the context of Sudan's strained relations with many countries and unsettled internal security situation at the time.

ii. Refinery in Khartoum. There was a policy decision to seek a refinery to be built in Khartoum, suited to meeting much of the country's demand for fuels based on its own oil production. Chinese sponsorship of the refinery could be obtained by linking it to upstream licensing. Given the opacity of agreements and finances in the country, it is hard to assess accurately whether this has been a success in economic terms. The alternative to the refinery would have been to import nearly all refined fuels while exporting more crude oil. The refinery is located at a spot which seems appropriate for the country's supply situation, and has for many years fulfilled its intended purpose of meeting most of the country's need for refined fuels.

iii. Government role in fuels supply and fuels pricing. The government controls most aspects of the fuels supply sector. Fuel prices are set by the government, and there is widespread sentiment of holding the government responsible for them. Many other African nations have government controlled fuels prices; some do not. For Sudan, the fuels pricing regime has been a large burden on the government budget. The alternative policy for Sudan would be to develop a competitive market framework for fuels retailing. The Khartoum refinery would continue to have a central position in such a framework, and the arrangements under which it procures crude oil and sells refined fuels would need to be considered carefully.

4.5 INTEGRATED OIL SUPPLY CHAIN: OIL FIELDS, PIPELINES AND REFINING IN UGANDA

No significant amounts of oil have been produced in Uganda as of early 2018. Quite substantial oil discoveries have been made in 2006 and later, of several fields near the Lake Albert, in the Western part of the country. The Petroleum Authority of Uganda states the discoveries as 6.5 billion bbl. in place, of which 1.4 billion bbl. recoverable.[65] Gas resources are smaller and are mainly associated gas.

Petroleum licenses in Uganda have been granted in the form of Production Sharing Agreements between the Government and international oil firms (the licensees). Licensee interests in the Ugandan discoveries have changed over the years resulting from transactions between the firms. As of early 2018, the licenses containing discoveries were held by three firms: Total, Tullow and CNOOC.[66] Earlier in 2017 Tullow reduced its interest and the two others correspondingly increased theirs. Also in 2017 a licensing round was held, resulting in the entry of two more firms:

65 https://www.pau.go.ug/exploration (April 2018)
66 http://ug.total.com/en/total-uganda/total-uganda; https://www.tullowoil.com/operations/east-africa/uganda; http://www.cnoocltd.com.

Oranto and Armour Energy.[67] Oranto is a firm from Nigeria, thus a firm in private African ownership and with ambitions across the continent, of which there are not many.

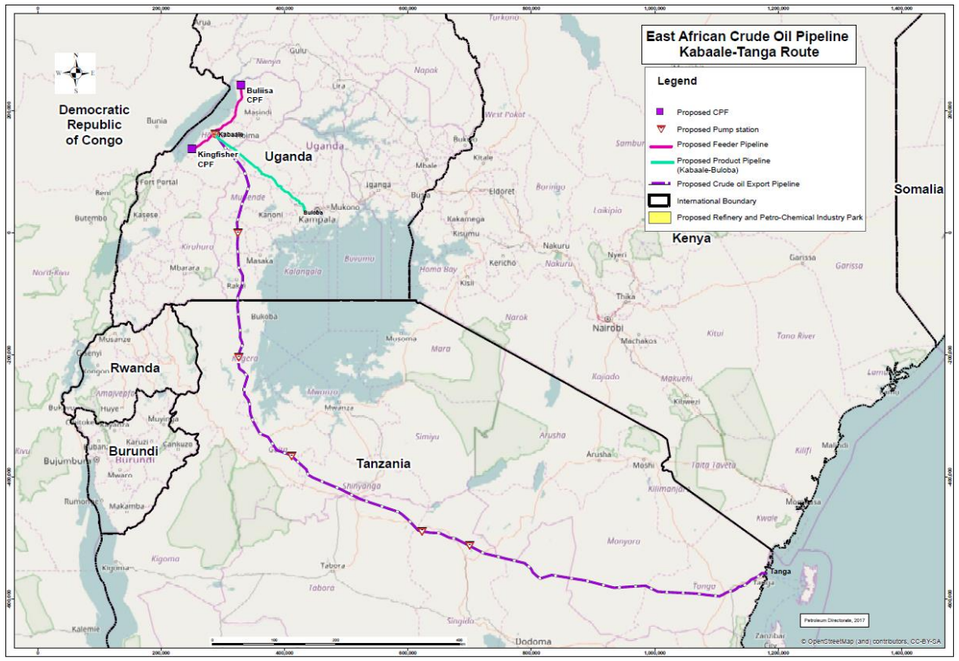


Figure 17: Uganda; proposed oil infrastructure[68]

Uganda's petroleum sector is currently regulated under three Acts, addressing the upstream, the midstream and the downstream (petroleum supply) sectors respectively.[69] The oil and gas sector is managed for Uganda's Government by the Ministry of Energy and Mineral Development (MEMD).[70] It oversees a Petroleum Directorate composed of three departments with responsibilities for the upstream, midstream and downstream segments. The 2013 legislation provided for a Petroleum Authority of Uganda (PAU), which has been established also with regulatory responsibilities for upstream and midstream.[71] It is not entirely evident from available public documents how these apparently overlapping regulatory responsibilities are delineated. In addition, the Uganda National Oil Company (UNOC) was established in 2015.[72] It is mandated to hold the State's participating interests in Production Sharing Agreements, which include rights for the state to opt into projects being developed. It manages the national strategic storage of petroleum and an industrial park for petroleum activities. UNOC is also intended to participate in the planned crude oil export pipeline, refinery and product storage facilities.

Uganda has a population of more than 40 million, growing fast. It is therefore a significant and growing market for refined fuels, notably automotive fuels (petrol and diesel), aviation fuel and kerosene. There is no refinery in Uganda, nor any operating refinery elsewhere in East Africa between Sudan and Zambia. Uganda is currently dependent on importing petroleum fuels mainly through Kenya by a combination of pipeline (to Eldoret and Kisumu in Western Kenya), rail and road tankers. These supply operations are cumbersome and costly. Several international and indigenous firms supply fuels in Uganda. Prices are not subsidised or controlled by Government. Grid electricity is provided mainly from hydropower stations on the river Nile including from a large power station completed in 2019.

4.5.1 Petroleum infrastructure challenges, and attempts to solve them

Uganda's Government and the companies holding licenses covering the significant oil discoveries there have understandably been keen to get petroleum production started. They have submitted several field development plans, which provide for a co-ordinated development of several adjacent fields using two common processing facilities.[73] The main obstacle to developing the fields has been the lack of offtake infrastructure: No refinery, far from the coast and no pipeline for exporting the oil. This, in combination with the challenges of supplying refined fuels to Uganda, soon drew attention to an obviously appealing solution: Why not build a refinery to convert Ugandan crude oil to the refined products which the country needs. The Government has indeed stated its intent to have a refinery built. Deciding and implementing this, or any other solution to the infrastructure challenges, has proven difficult. Both strategic dilemmas and implementation issues can be identified as reasons for this.

From the purpose of converting oil reserves into economic value, an offtake solution for oil production is needed. The practical alternatives are refinery and/or pipeline. Either of these would cost several billion US$. The pipeline costs are increased by the need to heat the crude oil inside, because it is high in wax content and will solidify at ambient temperatures. Other alternatives, such as transportation by rail or road, are infeasible on the scale required and given the available infrastructure in the region. Although a seemingly elegant way of solving

67 http://atlas-oranto.com/portfolio/uganda/; https://www.armourenergy.com.au
68 Map from Petroleum Authority of Uganda, https://www.pau.go.ug/maps (legend adjusted).
69 Petroleum (Exploration, Development and Production) Act 2013; Petroleum (Refining, Conversion, Transmission and Midstream Storage) Act 2013; Petroleum Supply Act (2003).
70 http://www.energyandminerals.go.ug
71 www.pau.go.ug
72 http://unoc.co.ug
73 Common processing facilities (CFP) at Kingfisher and Buliisa, as shown in the map.

both crude offtake and fuels supply, a refinery as the sole offtake option would raise serious concerns for resource management, particularly from the companies' perspective. Refinery sizes of 30,000 or 60,000 bod have been mentioned as alternatives. Much larger sizes have also been mentioned, but would clearly exceed the demand capacity for Uganda and adjacent regions which could be effectively supplied from there, creating the need for long distance exports. Long distance transportation is generally more costly for refined petroleum fuels than for crude oil, and would tend to render fuels from the Ugandan refinery uncompetitive in the distant markets in which they would need to be sold. A refinery of 60,000 bod crude intake capacity could be a reasonable match with fuels demand in Uganda and adjacent regions.

Many African nations determine fuel prices by political decision rather than competitive markets.

This refinery size however raises a time issue: If Uganda's recoverable oil reserve of 1.4 billion bbl. is to be fed through a 60,000 bod refinery, it will take 65 years to deplete the reserve. This is unappealing to oil firms, which generally want to produce much faster, and certainly at higher rates during the early years of production. The oil reserve may turn out to be much higher than 1.4 bn bbl.. Another problem of a refinery-only offtake solution, from the oil firms' perspective, is that it would expose them to the political risk of distorted pricing of oil. Many African nations determine fuel prices by political decision rather than competitive markets. The oil companies can hardly ignore the risk that this could happen in Uganda in the future also, in which case it might become difficult for them to obtain a value fairly reflecting world market prices for their crude delivered to the refinery. It is therefore unsurprising that the oil companies involved in Uganda's oil discoveries have not shown much enthusiasm for building a refinery, preferring instead an export pipeline.

The Government has tended to favour both a refinery and an export pipeline, with priority to the refinery. The Government has acquired land to be made available for a future refinery and other petroleum related facilities not far from the oil discoveries. If a refinery would be built first, a pipeline might then be contingent upon the amounts of reserves to be proven. A problem with building a pipeline first, from the Government's perspective, is that the existence of a pipeline weakens the economics of a refinery, because the export pipeline precludes the refinery from being the sole outlet for oil production in Uganda.

A feasibility study for a refinery was commissioned in 2009 from Foster Wheeler, an engineering consultancy. It highlighted another issue with a refinery in Uganda: Although of modest size by world standards, it would need to be highly complex, and therefore costly, to avoid producing large volumes of products for which there will be little need in Uganda and the greater region. Uganda has a growing demand for automotive fuels, but not for other refinery products such as heavy fuel oil and naphtha. Heavy fuel oil might have been used for power generation, but this need is set to be well covered by new hydropower capacity on the Nile. Uganda's refinery would need highly sophisticated cracking and other processing to convert as much of the crude bbl. as possible into automotive fuels. Foster Wheeler's recommended cases for a 60,000 bod refinery included no less than three cracking units, each of them expensive, and a number of other processing units. Such complexity is unusual for refineries anywhere, and even more so for refineries of such modest throughput capacity. It would inevitably make the Ugandan refinery very costly relative to its throughput capacity by international comparison.

There have been two attempts to establish a refinery in Uganda since oil was discovered. In the early years after the first discoveries one of the licensees, Tullow, developed plans for a very small and simple refinery (4,000 bod was one referred alternative), with the intent that it should be able to produce some diesel and kerosene and but feed the major part of output to power production. This plan was abandoned due to difficulties of implementation as well as increasing irrelevance. In 2015, the Government awarded a contract for building a refinery to RT Global Resources, part of a Russian state corporation with mainly defence related business interests. This followed a tender in which a proposal was also received from a South Korean bidder. The Russian firm eventually gave up the project.

In 2015, the Government awarded a contract for building a refinery to RT Global Resources, part of a Russian state corporation with mainly defence related business interests.

A project for strengthening Uganda's supply logistics for refined fuels also collapsed. A contract for extending the Kenyan petroleum product pipeline to Kampala was awarded to Tamoil, a firm from Libya, in 2007. It would have simplified logistics by eliminating the need of transferring fuels from the pipeline system in Kenya to trucks and rail to reach Uganda. Tamoil failed to deliver the project, leading to contract cancellation in 2012.

4.5.2. Status (early 2018)[74]

The Government eventually agreed to the oil companies' preference for an oil export pipeline. The project organisation has been established and preparations are in progress. [75] It plans for completion in 2020, with construction of the pipeline to be done mostly in 2019. A 1,445 km export route to Tanga, on Tanzania's coast,

74 The status as of early 2018 is derived mainly from the web site of the Petroleum Authority of Uganda, http://pau.go.ug/
75 East African Crude Oil Pipeline, http://eacop.com/

has been selected (Figure 17). A route through Kenya would have been shorter and was considered, but the Tanzanian route was selected following high-level interventions. The pipeline will have a capacity of more than 200,000 bod. The cost of building the pipeline and an export terminal on the coast, has been estimated at $3.5 bn. An inter-governmental agreement between Tanzania and Uganda was signed in 2017, establishing the framework for the pipeline to be laid in the two countries. Owners will be the two national oil companies UNOC and TPDC, and the three licensees in the Ugandan discoveries, CNOOC, Total and Tullow. [76]

The export pipeline will be decisive in allowing for production of Uganda's oil, for which the requisite field development plans have been prepared.

The Government continues to pursue its intent for a refinery in Uganda, with a capacity of 60,000 bod and located near the Western city of Hoima. Land for the refinery has been acquired, and a resettlement plan for the people who lived there, has been implemented. They were offered cash compensation or relocation to new houses and farm land. The refinery construction cost is estimated by the Petroleum Authority of Uganda at $3-4 bn, which includes a pipeline for refined products to Kampala, the capital city. The Government intends the refinery project to be led by a private sector company with participation by UNOC and possibly some neighbouring countries.

4.5.3 Issues for petroleum policy

The following issues for petroleum policy can be identified from Uganda's case as described above. The focus here is on issues which are directly or indirectly related to petroleum infrastructure, for which Uganda faced challenges deriving from its location far inland in Africa and remote from any existing crude oil infrastructure.

i. **National petroleum development strategy, including infrastructure.** The map at the beginning of this section outlines the planned infrastructure for Uganda's oil. It includes the two common processing facilities at the fields, local pipelines to the refinery site near Hoima, the refinery site itself, the export pipeline to the Tanzanian coast and a products pipeline to Kampala. The installations as shown on the map are the result of strategic choices. The selected strategy has implications for other aspects of petroleum sector development, such as the pace of development and production, which would have been restricted without the export pipeline. This in turn has implications for exploration and licensing. There are also implications for local content, which is influenced by the pace of development and by the types of development options chosen. Costs and economics must be an integral part of the development strategy for common infrastructure components. The

76 Company acronyms: UNOC – Uganda National Oil Company; TPDC – Tanzania Petroleum Development Corporation; CNOOC – China National Overseas Oil Company.

reality that all discoveries were within fairly short distance of another and had the same three licensees, has facilitated a co-ordinated approach to field development, as evidenced by the two common processing facilities. If the licensees had been different, there would possibly have been more tendency to develop stand-alone, un-coordinated and ultimately more costly solutions, and the authorities would then need to intervene to avoid sub-optimal developments. Petroleum development strategy is a dynamic process: It is quite possible that Uganda's future map of petroleum infrastructure will look different than this, as more discoveries are made. Strategy should therefore ideally have in-built flexibility to allow for different and yet unknown future developments.

ii. **State involvement in refining.** Uganda's Government has expressed an intent for having a refinery built in the country. This raises the question of Government commitment of resources to it. There are several ways in which a Government can facilitate a refinery: By direct financial participation (partial or full ownership), by providing certain inputs (such as the land dedicated to a refinery in Uganda, road connections and other infrastructure), or by pricing arrangements. The latter would entail that the Government causes crude oil to be supplied to the refinery at prices favouring profitability at the refinery, and/or shielding the refinery's output from competition from imported products. Such pricing arrangements risk distorting markets, imposing disadvantages on oil companies, fuels customers and taxpayers.

iii. **Methods for tendering and project partner selection.** Tendering procedure is a favoured method for Governments to select contract

partners for procurements and other arrangements. It can have several advantages, including the competitive element, transparency and objectivity. It can also have disadvantages. In Uganda, two important projects failed after the tendering procedure had led to selection of contract partners which failed to deliver. Tendering procedures often impose rigidities on the project development process, unless designed with extreme diligence. If the Government insists on reducing the competitive parameters to a very small number which can be selected on a non-discretionary basis, it risks imposing a rigour which stifles innovative approaches on part of the contracting partners. In a complex venture such as refining, it would be potentially valuable to encourage bidders to propose innovative solutions, including solutions which the authorities did not expect when preparing the terms of reference. This would require that the Government abstains from a tendering procedure based on a rigidly defined delivery or with no room for discretion in assessing proposals. If a government intends to invite a competition for establishing complex infrastructure or other facilities, it needs to carefully consider and design a contracting method which does not unnecessarily restrict the scope for proposals.

iv. **Regulated access to infrastructure. I**n the case of Uganda's crude oil export pipeline, two national oil companies and three international oil companies have been designated as shareholders. In the future, there may be more companies than these engaged in production of Ugandan crude oil. This raises a question of access to this important infrastructure for firms which are not the initial owners of it. On one hand, there is a danger of monopolistic abuse by the incumbent owners, causing the newcomers to pay excessive fees for using the pipeline. On the other hand, the incumbent firms can reasonably claim that they took a substantial investment risk in establishing the pipeline, and should therefore have access to it at more favourable terms than newcomers. This is an issue which has called for government regulation in other countries, invoking the principle of mandatory third-party access at non-discriminatory terms. In Europe this is has been an issue more often for gas pipelines than oil pipelines as evidenced by the European Union's gas market directives, but the fundamental issue is the same for oil as for gas pipelines. It would be reasonable for African countries to reserve the right to make construction of large petroleum infrastructure contingent on licenses to be granted by the government, and to make requirements for third-party access part of the conditions attached to such licenses.

4.6 REGULATORY ORGANISATION: NATIONAL OIL COMPANY AND REGULATORY AGENCIES IN ALGERIA

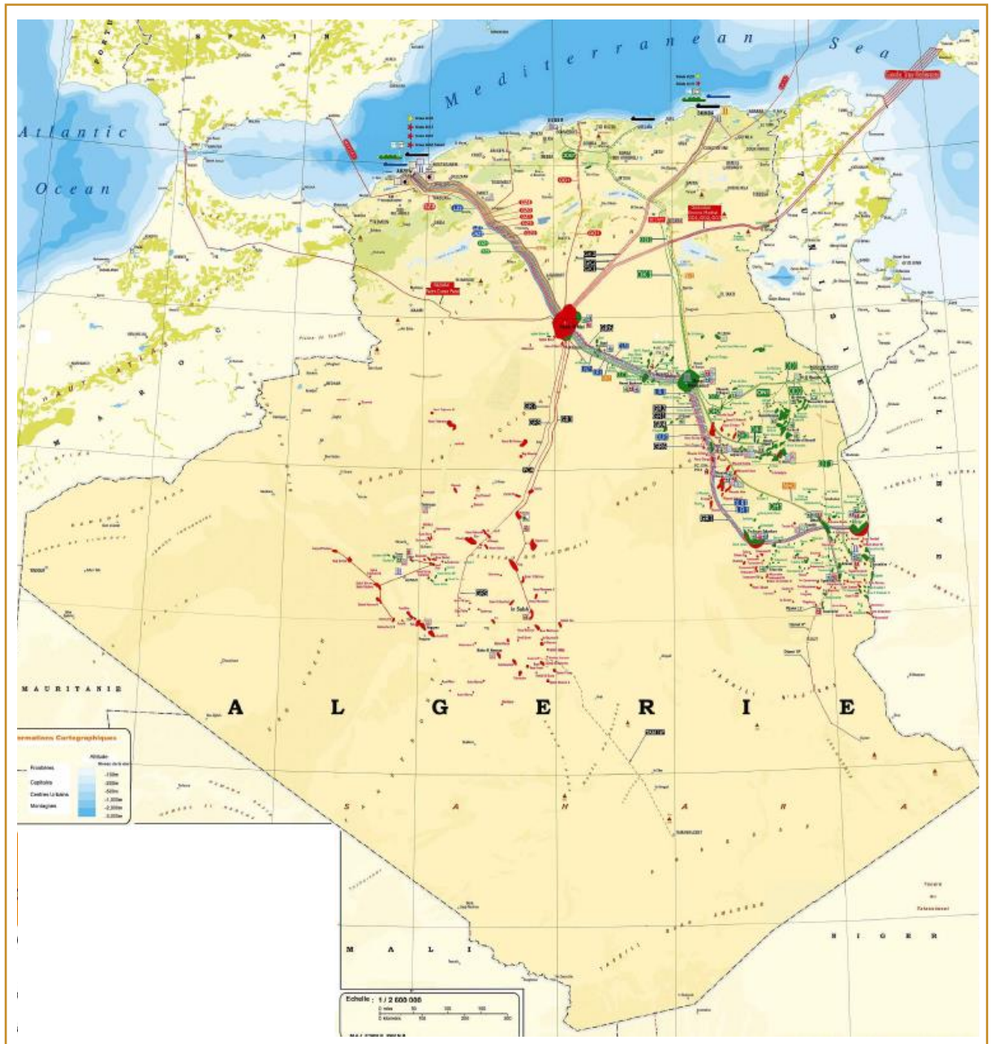


Figure 18 Oil and gas map of Algeria.

Oil fields and pipelines in green; gas in red. For further details, see http://www.sonatrach.com/images/pdfs/carte_TRC_compressed.pdf . Source: Sonatrach.

4.6.1 Algeria's petroleum sector

With oil production of 1,579,000 bod in 2016[77], Algeria is Africa's third-largest oil producer, after Nigeria and Angola. The fields are in the interior of the country. Oil production in Algeria started in 1958, still under French rule. Algeria is also Africa's

77 Quantities referred in this sub-section are from BP's statistical review of world energy 2017.

largest gas producer. It is a major gas supplier to Europe by pipelines crossing the Mediterranean Sea and by ships as liquefied natural gas (LNG). When related to production in 2016, Algeria had 21 years of proved oil reserves and 49 years of gas reserves at the end of 2016. Not included in those numbers are estimated resources of shale gas, which can potentially yield much larger volumes of gas.

Algeria has three large refineries and two small ones. It refined 584,000 bod of oil in 2016, 40% more than its own consumption of fuels. Algeria consumed 26% of its own oil production and 44% of gas production in 2016.

Algeria's national oil company, Sonatrach, was established in 1963. It has had a prominent role in the country's petroleum developments. It remains under full state ownership and controls the majority of oil and gas production in Algeria.[78] Several large international oil firms are also active as partners in oil and gas fields. Fuels retail sales are undertaken by NAFTAL, which is a state owned enterprise, and several enterprises in private Algerian ownership. The large international oil companies are not active in the Algerian retail fuel market, but have some sales of specialty products such as lubricants and asphalt.

4.6.2 Regulatory reforms in 2005

For international oil firms, having to deal with Sonatrach for licensing and other regulatory issues could be seen as a drawback when considering investment in Algeria.

Before 2005, most aspects of Algeria's petroleum sector were managed by Sonatrach, reporting to the ministry which had responsibility for the sector. No clear separation was made between Sonatrach's commercial business as a company, and functions of a regulatory nature performed by Sonatrach. Deliberations leading to reforms in 2005 highlighted two problems with this: Relations with foreign firms, and operational safety. Although Sonatrach had developed some impressive operational capabilities as an oil company, it was recognized in Algeria that foreign oil firms were also needed for the country to realize its potential for development supported by its petroleum sector. The security situation had improved since the 1990s. Sonatrach had the dual regulatory and commercial role, with commercial ambitions sometimes crossing those of the international firms. For international oil firms, having to deal with Sonatrach for licensing and other regulatory issues could be seen as a drawback when considering investment in Algeria.

A new hydrocarbons law was passed in 2005, which provided regulatory reforms.[79] Two new regulatory agencies were created, to fill regulatory functions previously

78 www.sonatrach.dz
79 Loi n° 05-07 du 19 Rabie El Aouel 1426 correspondant au 28 avril 2005 relative aux hydrocarbures

with Sonatrach: ALNAFT[80] and ARH[81]. ALNAFT has responsibilities for petroleum resource management, including licensing and approval of development plans. ARH has responsibilities for overseeing operational integrity (safety and environmental protection) and for commercial regulations of transport infrastructure and fuel sales. In addition, the reform created more scope for participation in the sector by international oil companies, and Sonatrach's mandatory role in licenses was reduced. This part of reform was partly reversed by a presidential order in 2006.[82] There is a legal requirement for Sonatrach to hold at least 51 % in all licenses.

One reason for the partial reversion of reforms in 2006, was that the reforms of 2005 were controversial within Algeria's system of government and within Sonatrach's organisation. Earlier attempts at introducing similar reforms had stalled. The legislation was also modified in 2013, aiming at making operating terms more attractive and less restrictive for participating firms.[83]

4.6.3 ALNAFT: Regulator for petroleum resource management

ALNAFT's mission can be summarized as maximizing the value of Algeria's oil and gas through regulatory measures.

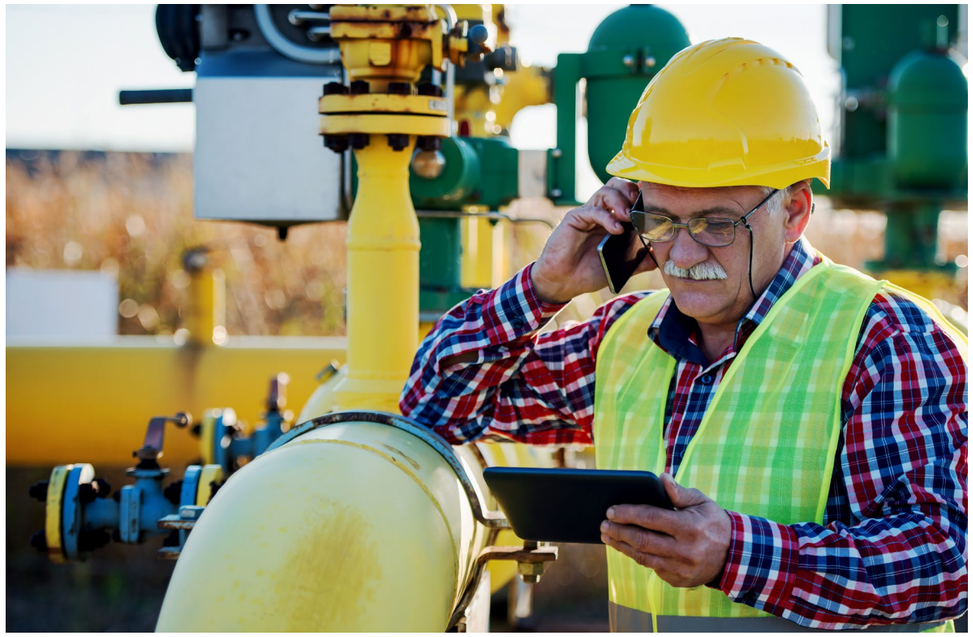
License for companies to explore and exploit petroleum is granted in the form of contracts made between ALNAFT, representing the Algerian state, and oil companies. There are usually two or more oil companies participating as partners, and always including Sonatrach. The petroleum contracts are called Contrat de recherche et d'exploitation d'hydrocarbures (Contract for exploration and production of hydrocarbons). Earlier arrangements were production sharing contracts or risk service contracts, and such existing contracts remained in force after the 2005 reforms. The fiscal system is based on taxes, royalties and Sonatrach's participation as a state-owned company. ALNAFT's task include the following:[84]

a. Carry out studies of geological basins;
b. Promote investments in petroleum exploration and development;
c. Maintain a database on hydrocarbon exploration and production;
d. Assess and approve development plans;

80 www.alnaft.gov.dz. Alnaft's full name in French is Agence Nationale pour la Valorisation des Ressources en Hydrocarbures (National agency for valorisation of hydrocarbon resources).
81 www.arh.gov.dz. ARH's full name in French is L'Agence Nationale de Contrôle et de Régulation dans le Domaine des Hydrocarbures (National agency for control and regulation in the hydrocarbons sector). ARH kindly provided written responses to a set of questions for the present study.
82 Ordonnance n° 06-10 du 3 Rajab 1427 correspondant au 29 juillet 2006 modifiant et complétant la loi n° 05-07 du 28 avril 2005 relative aux hydrocarbures.
83 Loi n° 13-01 du 19 Rabie Ethani 1434 correspondant au 20 février 2013 modifiant et complétant la loi n° 05-07 du 19 Rabie El Aouel 1426 correspondant au 28 avril 2005 relative aux hydrocarbures.
84 www.alnaft.gov.dz

e. Grant prospecting permits (for early exploration work);
f. Carry out licensing by calling for and evaluating tenders for exploration and production activities;
g. Enter into contracts for exploration and production of hydrocarbons, and act as a contracting party under the contracts;
h. Ensure optimal exploitation of hydrocarbon resources;
i. Contribute to developing sectoral policy and drafting regulations for petroleum operations;
j. Monitor, control and audit the costs under the petroleum contracts;
k. Determine and collect the royalty and forward the proceeds to the Treasury;
l. Monitor licensees' payment of taxes, and collaborate with the tax administration;
m. Submit to the Ministry a medium and long term plan for the sector based on plans submitted for the licenses;
n. Prepare statements of gas reserves and gas supply and demand balances;
o. Ensure that the national market is supplied by the contractors as required;
p. Periodically determine reference prices for gas, crude oil, condensate and LPG.

The above list of tasks contains many items which are essential to the good management of a nation's petroleum resources. Items f), licensing, and d), approval of development plans, are important decision processes in the interaction between the Government and the companies. Items a) and c) concerns the systematic acquisition and processing of information on the nation's sub-surface petroleum resources.



The licensing activity is usually carried out by conducting competitive licensing rounds, in which companies are invited to submit proposals in respect of defined areas. Several licensing rounds in recent years were disappointing as they attracted rather little interest from international firms. ALNAFT drew criticism for this, but there is also a recognition that the low interest was caused by fiscal and other licensing terms which ALNAFT was in no position to change.

ALNAFT'S organisation has grown gradually since its formation to 174 employees in 2017. The organisation has benefitted from training which the oil companies are required to provide under the petroleum contracts.

4.6.4 ARH: Regulator for operational integrity and mid / downstream commercial issues

ARH covers several regulatory functions not covered by ALNAFT. According to ARH's web site, these include:

- Integrity of petroleum operations for safety and environmental protection;
- Approval of environmental impact assessments and environmental management plans;
- Authorizations for oil and gas infrastructure and rules for third-party access including tariffs;
- Market regulations for domestic fuel sales.

Several acts of law form the basis for ARH's work in these areas.[85] Production permits for oil and gas producing installations are granted on the basis of provided documentation and site inspections at different stages of project implementation. Requirements must be met for environmental impact assessment, risk analysis, hazard and operability study (HAZOP), and systems required for protection against accidents of various kinds and against pollution. There is also an approval procedure for wells, including requirements for protection of groundwater. ARH conducts site inspections for construction activities, handling of solid and liquid waste, hazardous products, control systems, well integrity, leak protection and general compliance with regulations. Procedures are implemented for operators to report accidents and incidents on daily basis and annual reconciliation.

The last point of the list above relates to Algeria's policy of subsidized fuels. Fuel prices at the pump are approved at high level of Government. ARH is charged with implementation. Domestic prices for petroleum fuels and natural gas were set and kept unchanged at levels far below world market prices from 2005 to 2015. From

85 Loi no 88-07 relative à l'hygiène, à la sécurité et à la médecine du travail; Loi no 99-09 relative à la maîtrise de l'énergie; Loi no 01-19 relative à la gestion, au contrôle et à l'élimination des déchets; Loi no 03-10 relative à la protection de l'environnement dans le cadre du développement durable; Loi no 04-20 relative à la prévention des risques majeurs et à la gestion des catastrophes dans le cadre du développement durable; Loi no 05-12 relative à l'eau (modifiée par Loi no 08-03);

2016, they have been increased as the Algerian economy has come under pressure from lower export prices for oil and gas.[86] Algerian fuel prices are still lower than international market prices, corresponding to approximately 0.36 $per litre for the highest grade of gasoline and 0.20 $per litre for diesel as of early 2018. The issue of administrative fuel pricing is discussed in section 4.4. in relation to Sudan. ARH had 94 employees in March 2018.

Algeria also has a separate agency for promotion of clean fuels and energy efficiency, named APRUE (Agence Nationale pour la Promotion et la Rationalisation de l'Utilisation de l'Energie).[87]

4.6.5 Issues for petroleum policy

Following is a selection of policy issues which Algeria and other countries have faced in relation to petroleum regulatory functions. These issues are discussed further in chapter 5.

i. **Separation of regulatory functions and commercial interests of the state.** On a general level, ALNAFT and Sonatrach are mandated to pursue the same goal, which is to maximize economic value from petroleum operations for the Algerian nation. But they operate on different levels: ALNAFT as a regulatory entity applying sovereign power; Sonatrach as a commercial entity operating in value chains and markets. Some countries combine the regulatory and commercial interests in one entity, others separate them. There has been a general tendency of separating regulatory from commercial functions where they were previously combined, with Tanzania as a recent example.

ii. **Sector vs. general regulations.** Algeria, like many other countries, have established a regulator (ARH) with responsibilities for overseeing safety and environmental protection specifically in the petroleum sector. ARH covers the upstream and downstream parts of the overall petroleum sector. Safety and environmental issues are not confined to the petroleum sector; they concern many other industries and activities in society too. The question is then: Should those issues be subject to separate regulation applicable to the petroleum sector, or should it be done jointly for all sectors of society? There are pro's and con's of both alternatives. Any separation of regulatory responsibilities to different agencies risks creating problems of delineation, where the assignment of responsibilities to agencies can be overlapping and ambiguous. On the other hand, if regulation of such issues poses very different challenges or is more pressing in the petroleum sector than elsewhere, this may be a valid reason for a dedicated regulatory function.

86 IMF: Algeria, selected issues, 2016. http://www.imf.org/en/Publications/CR/Issues/2016/12/31/Algeria-Selected-Issues-43905
87 http://www.aprue.org.dz

iii. **Regulatory strategy for safety in petroleum operations.** What can a state agency really do to reduce the risk of safety hazards (accidents) in petroleum operations? What regulatory strategy could have prevented large disasters such as the Deepwater Horizon disaster in the Gulf of Mexico in 2010?[88] Inspectors from a state agency cannot be expected to know better than oil companies how to safely operate petroleum installations. Many regulators have concluded that sending inspectors to give oil companies specific instructions on how to operate, is not helpful; it risks having the counterproductive effect of diluting responsibilities. There is broad acceptance that states have a responsibility towards its citizens for overseeing safety and integrity in petroleum operations, but the way in which the state goes about its regulatory function, needs to be considered carefully. The issue is discussed further in chapter 5.

iv. **Ownership and third-party access to infrastructure**. In Algeria, pipelines and other petroleum infrastructure are needed to bring oil and gas from the deep interior to the coast, and for exports to Europe. They are usually built to serve a field or group of fields which were being developed at the time. Should companies who find further oil and gas fields later, be entitled to use the pipelines etc. which others have already built? If not, there is a risk of wasteful construction of several pipelines where one would have sufficed, or a risk of pipeline owners appropriating nearly all profits from nearby fields. In Algeria, Sonatrach exclusively performs oil and gas pipeline transport activities. This gives Sonatrach yet another tool for strategic influence on sector development. The European Union and many countries have implemented the principle of mandatory third-party access to gas infrastructure on non-discriminatory terms. The owners of pipelines receive tariffs from those who use them.

v. **Extent of regulation in the downstream petroleum sector.** Most European countries do not have a regulatory agency dedicated to the downstream petroleum sector, no state-owned company operating there, and little specific regulations for it other than third-party access regulations as indicated above. In some European countries, there has been more such state involvement in times of the past. In Algeria, as in some other countries, the state remains quite active in the sector, with market regulations, subsidized prices and an active state-owned company operating there.

88 The Deepwater Horizon floating rig, which was drilling for BP on the Macondo oil discovery in the Gulf of Mexico, had a blowout, exploded and sank in 2010. 11 lives were lost, and large-scale pollution caused. A movie has been made of the accident, https://www.youtube.com/watch?v=m1FKKJmxIaw (movie trailer)

05
Governance of the oil sector

Being a substantial economic activity, the operations of exploring for and producing oil need to be subject to regulation in many respects: Safety, environmental production, land use, building permits, working conditions, taxes and others. Being an extractive industry, it requires regulations also for another reason: To ensure that resources which originally belong to the nation, are extracted in an effective manner and for the benefit of the nation. This raised different regulatory challenges than those found for other industries which do not extract natural resources. This section outlines the requirements and highlights some policy issues in addressing them.

5.1 NATIONAL MANAGEMENT OF PETROLEUM RESOURCES: THE STATE AS RESOURCE OWNER AND REGULATOR

Ideally, a government should not initiate petroleum operations and issue licenses before an adequate institutional and regulatory framework is in place, and several other preparations for licensing have been made. In practice, countries tend to become impatient in the face of perceived oil opportunities and sweet overtures from petroleum explorers. Many have ongoing petroleum operations, initiated with or without adequate preparations. Work on the institutional and regulatory framework for petroleum operations in many cases means working to improve or replace something which is already exists.

5.1.1 Petroleum policy, legislation and institutions

Most countries assert national ownership of their petroleum resources. This assertion is found in legislation, sometimes even in the national constitution. The major exception is onshore in the U.S.A., where it is possible for private individuals and firms to own resources in the ground. International maritime law allows states to also assert sovereign rights and ownership of resources in parts of the ocean facing them.[1]

With national ownership to resources established, a petroleum policy is needed to guide further actions by the government. Section 6 reviews the nature of petroleum policy and key issues for it.

Legislation follows policy, formed by the different legal traditions of countries. There is usually need for a petroleum Act. In the absence of such an Act, some countries have tried to apply a mining Act, etc. on petroleum operations, which but it is often do not suited to the requirements of the petroleum sector. A petroleum Act may be where the state's assertion of ownership to resources is made, followed by a requirement that petroleum can only be extracted in accordance with a specific permit (license) granted by the government. The petroleum act can authorise the government to issue licenses, specify responsibilities of the parties and important requirements for the activities. The petroleum act usually does not go too much into specifics, which can be more adequately covered by regulations to be issued by the government as authorised in the act.

To ensure that resources which originally belong to the nation, are extracted in an effective manner and for the benefit of the nation

The petroleum act can outline the main institutional arrangements for managing the sector. Many countries have three institutions involved in managing the resources on behalf of the state:

- A ministry, responsible for policy, often with final authorisation to issue licenses and approve major plans;
- A petroleum authority, with responsibility for building knowledge of the underground resources, technical authorisations and preparation of licenses and plans for the ministry's approval;
- A national oil company (NOC), carrying out commercial activities in the interest of the state.

Algeria has this arrangement following the legislation from 2005 as outlined in section 4.6. It is recently in 2019 that Angola created a separate petroleum authority[2], as was also the case for Algeria before 2005. Without such an authority the national oil company often takes on several regulatory functions otherwise covered by the petroleum authority.

1 The main international instrument for nations' sovereign rights in the ocean is the United Nations Convention on the Law of the Sea. http://www.un.org/depts/los/convention_agreements/texts/unclos/unclos_e.pdf
2 Section 4.1

There are often other regulatory entities involved with the petroleum sector in addition to the three mentioned above. There may be a separate entity with responsibilities for safety monitoring, either as an authority specifically for the petroleum industry (such as ARH in Algeria, section 4.6 above) or an authority covering industrial safety more broadly. Similarly, there may be designated authorities for environmental protection and labour conditions. The responsibility for impact assessments for petroleum operations is often with a national environmental authority responsible for environmental stewardship including Impacts Assessment as indicated in section 4.2. A revenue Authority is often responsible for Tax collection. from the petroleum industry is often handled by a revenue authority.

5.1.2 A national oil company?

A national oil company (NOC) is an entity owned by the state (usually 100%) and organised as a company to undertake petroleum operations. They are established with the ambition to acquire similar capabilities as the international oil firms. By being an active partner in licenses with the international firms or by eventually becoming an operator, the national oil company can allow for a more direct national involvement in petroleum operations which would otherwise be the exclusive domain of international firms. One of the objectives of a NOC is develop national content.

National oil companies come in many forms and shapes. The largest one by most measures is Saudi Aramco of Saudi Arabia. In some countries, the NOC alone carries out petroleum operations, though they may hire the services from supplier industry firms for many of the tasks to be carried out. In some other countries, including Angola before the creation of the petroleum authority, the NOC is the national concessionaire, having been granted exclusive rights for to all resources in the country. Those NOCs may issues licenses[3] to other oil companies allowing them to explore and produce petroleum on agreed terms. In yet other countries the NOC does not have a concession for the whole country but is granted participation licenses along with other oil firms, often with certain privileges for the NOC. This is currently the case in Algeria. Quite a few NOCs are active also outside their own country. Sonangol of Angola, for example, has interests in Iraq. Petronas, the Malaysian NOC, has extensive interests outside Malaysia, including in Sudan. Saudi Aramco has large downstream petroleum interests in the U.S.A.

A study by researchers from the World Bank in 2011 reviewed 20 national oil companies in terms of their objectives, governance and performance.[4] The study draws some tentative conclusions on relationships between parameters of governance, objectives and performance. Although their statistical model had limited explanatory power, the case studies and general comments yield useful insights in the contributions which national oil companies can make to value creation and other national objectives.

Some NOCs have developed impressive capabilities, and are readily considered as competent partners by other oil companies. There are also NOCs in Africa and elsewhere for whom this is hardly the case. A study by Hartley and Medlock (2013) found that NOCs were generally less efficient than investor-owned firms, but that the gap had been reduced over the period of the study (2001-2009). A recent study by the Natural Resource Governance Institute (2018) surveyed 81 NOCs. They found that only 9 out of these 81 NOCs and other national resource firms surveyed had achieved a good standard of transparency and accountable governance. These observations indicate that a NOC does not always guarantee effective management of resources in the nation's interest. National control in the sector is an argument for establishing a NOC, but this also gives rise to a question of how the NOC is controlled within the national system of government. Therefore, the questions of whether to establish a NOC and defining its mandate, authorisations and financial arrangements constitute very important policy issues.

Whether to establish a NOC, its mandate, authorisations and financial arrangements are important policy issues for a country with petroleum reserves.

5.1.3 Licensing and fiscal regime

Two important and related questions issues for regulating the sector are:

- How will the government engage with oil companies and grant licenses for petroleum operations?
- How will the government collect revenues from petroleum operations?

3 The term license is used here for all instruments by which the state or NOC grants permits to oil firms for petroleum operations, including cases where this is granted in the form of a Production Sharing Agreement or other form of agreement.
4 Tordo (2011)

These two questions concern the licensing regime and the fiscal regimes, which usually overlap.

For the licensing regime, there are several kinds of legal instruments in use, notably concessions, production sharing agreements, service agreements and variations of these. As discussed in section 4.1. in respect of Angola, it is common in many countries for the government to hold licensing rounds, which are structured processes by which oil companies submit applications by a given deadline. It usually comes with a prequalification procedure, the purpose of which is to disqualify companies not having the appropriate capabilities. for the operations. Some countries prefer having licensing rounds in which the highest qualified bidder wins the license, i.e. essentially without any discretionary judgement by authorities. This can be a way of ensuring transparency and objectivity in license award, but also comes with limitations. Other countries have chosen licensing procedures which involve discretionary judgements and award the license to a qualified but not highest bidder for some reasons by authorities, for instance in putting together license groups of several oil companies and appointing one of them as operator.

For the licensing regime, there are several kinds of legal instruments in use, notably concessions, production sharing agreements, service agreements and variations of these.

Depending on national legislation, it may be possible to award licenses without holding a licensing round. This is often referred to as an open-door approach. It can be a relevant method in some circumstances, for instance, if a licensing round was attempted and not successful. Nevertheless, the open door approach sometimes draws the suspicion of non-transparent and non-objective dealings, even of involving illicit payments.

The fiscal regime is the system for allocating value from petroleum operations between the state and licensees. The fiscal regime may consist of fiscal instruments, which are taxes, usually set by legislation, and fiscal provisions in PSAs or other agreements. The following fiscal instruments are found in most fiscal regimes: Following are fiscal instruments in common use for petroleum operations, where the fiscal regime for one nation usually contains some but not all of these:

i. Royalty: percentage of gross production, without deduction of production cost, for the state as resource owner.
ii. Production sharing: Sharing of production value, after deduction of costs, between state and firms. Usually governed by a table which allocates a larger percentage value for the state if profitability of the field is high.
iii. Signature bonus: An amount payable by the firm to the state upon signing the agreement.
iv. Production bonus etc.: Amounts payable to the state once production reaches certain levels, or is triggered by other events such as a discovery.
v. Corporate income tax: A tax charged on company profit.
vi. Petroleum resource tax: A tax charged on company profit from petroleum operations. Sometimes calculated differently than for corporate income tax.
vii. Privileged state participation: Right for the government, usually through a national oil company, to participate in the license on privileged terms. Privileged terms are often carried exploration costs, sometimes also carried development costs, requiring the oil firms to pay these costs on behalf of the NOC.

There are two important goals for the fiscal system, from the state's perspective: It should allocate a high share of resource value to the state. And it should preserve the firms' incentives to make decisions and manage operations for maximum value creation. The firms will not be attracted to agree licenses if the fiscal system does not allow them reasonable opportunity to make profits which can justify the investments and the financial risks they are undertaking. To preserve their incentives for value-maximising decisions and operations, the fiscal system must allow profits for firms to increase if the profitability of operations increases as a result of their good management. Vice-versa the fiscal system must allow the State's share to increase if the profitability increases.

An additional consideration for the investing firms is the perceived stability of the fiscal system, i.e. the confidence which they can have that the rules applicable when they make their investments will still apply in the future when returns from those investments can be obtained. Such confidence can be built partly by contractual provisions subject to international conflict resolution and , partly by the country's reputation for stability of its political and legal systems.[5]

5.1.4 Regulatory issues in active licenses

Once a license has been awarded to one or several oil firms, there will be further issues for authorities to address. Of particular importance is the process leading to an approved field development plan. This is a plan submitted by licensees for how they will develop a discovery made. Several aspects of a field development plan are of concern to authorities: Reservoir management strategy with implications for how much oil can be recovered; facilities which can possibly be used for nearby discoveries; development of pipelines and other infrastructure with implications for optimal development in a larger regional perspective; implications for national content; etc. It is generally advisable for firms and authorities to engage in dialogue

5 Forthcoming book on petroleum fiscal systems: Jarlsby and Pereira (2018)

in the process of preparing the plan, to clarify expectations and concerns. This can reduce the risk of government not being able to approve a plan presented, which can cause project delays and additional costs.

Certain operations in licenses may require the approval or consent of authorities, such as permits to drill individual wells, an appraisal plan following a discovery, and a decommissioning plan after cessation of production. Some licensing regimes also provide for annual plans and budgets to be submitted for government approval. There may also be regulatory requirements in relation to national content, as discussed in chapters 4 and 6, for example submission of plans for approval in this regard

A particular challenge concerns the licensing process, which inevitably comes up at an early stage and before the national authorities have had much chance to acquire experience.

Safety regulations for the petroleum sector is an area of particular concern. There have been debates on what the appropriate role of authorities should be in this area, as briefly mentioned in section 4.6.5 in relation to Algeria. Authorities in several countries have moved away from an approach of detailed prescriptions, where inspectors would be sent out with checklists to point out things which the operator was required to rectify. This approach is now often considered inappropriate for at least two reasons: The inspector does not really know better than the operator how to run installations safely, and these kinds of interventions on the detail level tend to confuse responsibilities. A more modern approach is referred to as a functional approach, where authorities set requirements for the level of safety to be achieved, but not how to achieve it. Norway and other nations have applied this approach over several decades.[6]

5.1.5 Capabilities and resources for regulatory processes

The various processes for national management of petroleum resources require deep insights on a range of issues, insights on which countries new to the sector may not fully have. A particular challenge concerns the licensing process, which inevitably comes up at an early stage and before the national authorities have had much chance to acquire experience. The licensing process has major and long lasting implications, with a risk that a country commits to ill-advised provisions in agreements which will bind them for 30 years. A good licensing process needs to be well prepared well, by establishing at least some knowledge of the resource potential, by preparing a model petroleum agreement, and by carefully designing the licensing procedure.

6 The Norwegian Petroleum Safety Authority has issued a simple publication explaining its approach to safety: http://www.ptil.no/safety-status-and-signals/new-publication-safety-and-responsibility-article13354-1062.html

Beyond licensing processes, governments can benefit much from developing highly competent administrative resources for long term management of the sector. This includes the ability to accumulate knowledge and make independent assessments of the resource potential on the basis of geoscience, ability to design and implement effective licensing strategies, assess field development plans against national policies, design and implement effective functional safety requirements, and monitor operator plans and performance for optimal resource recovery.[7]

5.2. REGULATORY REQUIREMENTS FOR OTHER PARTS OF THE OIL VALUE CHAIN

The upstream and downstream petroleum sectors serve different purposes: Upstream extracts natural resources for which there is a global market, whereas downstream serves the needs for refined petroleum. The regulatory requirements for the mid- and downstream parts of the petroleum sector are different, and generally less, than for the upstream sector. If the parts of the petroleum sector are appropriately delineated (including pricing issues), then the fiscal and other regulatory issues arising from the extraction of natural resources can be limited to the upstream.

5.2.1 Different extents of downstream regulation

A number of African countries have legislation and regulatory agencies with designated responsibilities for the downstream petroleum sector. Algeria's ARH is a notable example of this, even though ARH also has certain responsibilities in the upstream sector as reviewed in section 4.6. Sudan's system of administratively determined fuel prices, reviewed in section 4.4, requires special legislation and regulatory oversight. Similar price-setting systems are found in many African countries, particularly in the Northern (Arab) parts (IMF 2017a).

In contrast, most countries in Western and central Europe have little legislation and no regulatory agencies specifically addressing downstream petroleum. There are two important reasons for this difference between Europe and North Africa. First, European governments do not subsidise or try to decide the prices for fuels, leaving this to competitive markets.[8] Second, European countries have well-

7 Some international knowledge resources on this topic: https://resourcegovernance.org , http://www.ei-sourcebook.org , http://ccsi.columbia.edu and https://www.oxcarre.ox.ac.uk. For courses, see www.petrad.no . Norway has a programme for international development assistance in petroleum resource management, targeting selected countries: https://www.norad.no/en/front/thematic-areas/oil-for-development/
8 Most countries in Western and central Europe apply excise taxes as well as VAT to petroleum fuels.

developed regulatory oversight of economic activities in general, which is applied to the petroleum sector as well. The absence of legislation and regulatory agencies dedicated to petroleum does not imply that this sector is unregulated. Refineries, fuels service stations and other downstream activities are subject to a wide range of regulation for safe handling of hazardous goods, other safety issues, environmental protection, road traffic, construction permits, land use, working conditions, gender equality, marketing, customer rights, competition, VAT, taxes and other issues. These regulations apply to society in general, including the petroleum sector, and not the petroleum sector in particular. This normally provides a better basis for regulatory consistency, simplification and cost-efficient use of taxpayers' money.

5.2.2. Regulatory needs for a competitive downstream framework

Even where the downstream petroleum sector is subject to general and not sector-specific regulation, there is a limited number of issues likely to require some specific provisions for the downstream petroleum sector. These include:

- Fuel quality standards for diesel, grades of petrol, etc.;
- Excise taxes on fuels;
- Emergency stocks of fuels;
- Development of large infrastructure.

Fuel quality standards and excise taxes can normally be covered under general legislation for product quality and for taxes, supplemented by a specific regulation or clauses. within a more general regulation. The appropriate agency for collecting taxes is usually a revenue authority, not a petroleum sector authority. Emergency stocks and development of large infrastructure have strategic implications, depending on the situation and priorities of the country. Two goals are common in this respect:

- Security of fuel supply;
- Provision of a competitive sector framework when large installations might otherwise cause natural monopolies.

The last point on competitive sector framework has been a major issue with natural gas and electricity in the European Union (EU) and in other parts of the world. In the EU it has led to energy directives mandating that those who own natural gas pipelines and electricity grids, shall not use these assets to acquire monopolistic power in the product markets. Third-party access to energy infrastructure at non-discriminatory terms and separate ownership of the infrastructure assets from the fuels business are key principles applied for this purpose for natural gas and electricity.

Excise taxes are at rates determined as an amount per litre. Excise and VAT are imposed in ways which are intended not to distort competition between suppliers.

This has been less of an issue in the EU in respect of liquid petroleum fuels, which generally require less costly transportation infrastructure and therefore tend to be less exposed to monopolistic positioning. In Africa, maintaining a competitive fuels supply sector can be a challenge especially in regions which are at large distance from ocean ports with adequate capacities for importing fuels. Fuels can be supplied effectively to such regions by long distance pipeline or by refining capacities using crude oil from the same region. In either case, those who control the pipeline or the refinery can be in a position to acquire monopolistic market power. Governments may make regulatory or institutional interventions to avoid this, to maintain healthy competition and avoid abusive pricing.

One example of such government intervention is the Kenya Pipeline Company, which operates a pipeline for petroleum fuels from the port of Mombasa to the inland capital of Nairobi and beyond. The pipeline company is 100% government owned. It offers transportation and storage services to petroleum marketing firms for tariff fees and does not itself engage in marketing petroleum fuels. The availability of essential infrastructure services from a provider who is not a competitor, is an important condition for maintaining effective competition between fuels marketers. The North American continent also has a number of such pipeline systems for petroleum fuels (and for natural gas), except that they are owned and operated by commercial service providers and not by governments. Irrespective of ownership to the infrastructure, government may have a role to ensure by regulation that services will be offered on non-discriminatory and not excessive terms.

A similar but more complex issue arises if oil refining capacity is established at an inland location, based on crude oil from nearby sources and serving nearby markets. The history of refining in Africa has tended not to give credibility to governments as effective owners and operators of refineries. If an inland refinery will be owned by a private party and located far away from other refineries, there is a public interest in preventing the refinery owner from acquiring unchecked monopoly power over crude oil production as well as fuels marketing in the region.[9] Regulations can be enacted and a regulatory agency mandated for this purpose.

The need for regulation to avoid monopolistic power in relation to a refinery or a pipeline can be related to the discussion in section 4.5 concerning plans for a refinery in Uganda. An export pipeline for crude oil to the Indian Ocean is currently (2018) in preparation. For some future period, this pipeline is likely to be the only available option for bringing significant volumes of Ugandan crude oil to market, as export by trucks or rail will hardly be practical options for the volumes at hand. If the pipeline was controlled entirely by profit-maximizing firms without any Government intervention, those firms would in effect be in a position of controlling all oil production in Uganda by virtue of controlling the pipeline. Uganda's authorities have of course recognized this danger and have taken action to prevent it. Uganda also has ambitions for a refinery in the country, and at times in the past, the possibility of having a refinery before an export pipeline was a considered option. This would have created even stronger regulatory challenges than the pipeline option, for two reasons: A refinery would have smaller capacity than a pipeline for receiving crude oil production and thus impose more restrictive constraints on oil production; and it could potentially give rise to market dominance also in the refined fuels sector.

9 Such monopoly powers were an important cause of the rise of Standard Oil as a dominant force in North American petroleum in the late 19th century, leading eventually to the forced break-up of the company following a U.S. Supreme Court decision in 1911.

5.2.3 Fuel subsidies

Government subsidises fuels in many African countries in Africa and elsewhere. pursue a practice of fuel prices being determined and/or subsidized by the Government. In other countries, fuel prices result from competitive market mechanisms and are not subsidized. They are rather, on the contrary, often subject to excise taxes and VAT which increase consumer prices above the costs of production and distribution.

It is possible to have different views on what should be called a subsidy, particularly in respect of resources produced and consumed within a country. If the cost of producing oil is much lower than world market prices, is it then a subsidy if that oil is supplied within the country at prices lower than could have been obtained from exports? Yes, that would be a subsidy, according to most scholarly and professional literature on the subject. One definition supporting this view, is that a subsidy is any measure that keeps prices for consumers below the market level or keeps prices for producers above the market level or that reduces costs for consumers and producers by giving direct or indirect support (de Moor and Calamai 1997). A different view is argued by Spitzy (2012), who suggests that supplying domestic oil to the domestic market at prices below world oil market prices should not be called a subsidy, as long as the domestic price covers the costs of production. Irrespective of terminology, if a government causes oil to be sold to the domestic market at prices below that oil's value in international markets, then this weakens the government's financial position and reduces its financial capacity to provide other services to the population, as the example of Sudan shows (section 4.4). A similar effect arises if fuels are exempted from VAT or other broadly based consumption taxes. In the present report, the term subsidy is used to include such situations, in line with the definition proposed by de Moor and Calamai (1997).

Fuel subsidies are an issue in several oil producing countries. They are particularly common in the Arab dominated countries, including those in North Africa, where they are connected with a widely held belief that the state has a fundamental responsibility for supplying affordable fuels to the population, in particular if the state participates in the extraction of petroleum resources.

The large economic international organizations OECD, IMF and the World Bank, as well as numerous economists and business practitioners, have strongly cautioned against such subsidies, as IMF also has in Sudan's case[10]. Other than Spitzy (2012), who wrote on behalf of OPEC[11], fuel subsidies are overwhelmingly characterized as wasteful in economic literature.

10 IMF 2012, 2017 and others. See also El-Katiri and Fattouh (2015), de Moor and Calamai (1997).
11Organization of Petroleum Exporting Countries. www.opec.org.

Fuel subsidies create benefits to consumers in the form of lower prices on fuels. The distribution of those benefits among segments of the population is uneven, tending to favour those already well-off. Subsidized petrol benefits mainly those who can afford to drive in a car. In Sudan, IMF has calculated that the 20% of the population having the lowest incomes received only 3% of the benefits to consumers generated by subsidies in 2012[12]. The 20% highest earners received 48%. Subsidies therefore tend to increase differences between the poor and the rich in the country.

The following damages from fuel subsidies have been pointed out in respect of Sudan and other countries which follow similar practices:

- A drain on public revenues which would have been better spent on schools, health, infrastructure, etc.;
- Fuel subsidies overwhelmingly benefit those who are already most favoured economically;
- Artificially low fuel prices increase the consumption of fuels, which further increases the drain on public funds;
- Incidents of fuel shortage are likely to occur[13], when demand at suppressed prices exceeds the supply which the government is in a position to provide;
- Large price differences between neighbouring countries encourages illicit trade. Subsidized fuels are smuggled to neighbouring countries where they are not subsidized, further increasing the drain of public funds and increasing crime at borders. Governments may seek to counter this by imposing tighter border controls, which is costly and tends to also impede legitimate trade;
- Lower fuel prices lead to more driving, more clogged-up roads and more pollution. Globally, they contribute negatively to climate change.

The reasons why so many governments still maintain fuel subsidies even though their disadvantages are well documented, are reviewed by El-Katiri and Fattouh (2015). One reason is that it is politically difficult to remove them. Once introduced, some segments of the population adjust to it, and protest vehemently when the government tries to lift them. This happened in Sudan in 2013 and has also happened in many other countries over time. Lack of trust in governments can add to the problem: Price increases at the pump are immediately felt by consumers, while the translation of those added public revenues into better schools and other public services takes time and may be distrusted. Removing fuel subsidies is perceived by politicians as a political hazard, even though many other countries do not have them and do not see much public protest for that reason. Recognizing that the removal of fuel subsidies is economically desirable but politically and socially difficult, IMF has recommended some approaches to make the process more manageable for government and more acceptable to citizens:[14]

- Gradual withdrawal, to allow time for adjustment by households and enterprises;
- Begin with items which are less important for low-income households;
- Targeted social protection, to shield poor households from shock of price increases;
- Energy price reform with gradual move away from administered prices, while protecting the population from extreme price volatility.

One reservation against these recommendations from IMF may be that they are designed to mainly favour the poor (2nd and 3rd bullet point above). While this may be laudable on ideal grounds, it may do less to reduce the political hazards of subsidy reform, as long as the better-off segments of the population are politically more potent than the poor.

5.2.4 Political and administrative price setting for fuels

Governments can make a policy choice on whether it will decide fuel prices or leave this to the suppliers. With the latter option, effective competition between suppliers is required for avoiding excessive pricing due to monopolistic power. This issue is related to but still different from the issue of subsidy: In principle, it is possible to provide subsidies and still have price formation in a competitive market, and it is also possible in principle to have politically controlled prices which do not entail subsidy. In practice, the two often go together: Where fuel prices are determined politically, they are usually set at levels which require subsidies. This may change over time, as seen in the case of Sudan (section 4.5). One reason given for politically determined fuel prices is to avoid the large price fluctuations of the international markets. So the politically determined prices are kept unchanged, in national currency, over some length of time. If the national currency is weak and prone to devaluations, then those prices are likely to become lower than international market prices after some time, even if they initially were more aligned.

One reservation against these recommendations from IMF may be that they are designed to mainly favour the poor (2nd and 3rd bullet point above).

To prevent subsidies from re-emerging each time they have been lowered, IMF advises against setting politically determined prices for fuels: Better let them move with market forces, and deal with the undesirable effects by other means.

12 IMF (2012)

13 There were reports of fuels scarcity in late 2017, though not confirmed by Sudanese authorities. https://reliefweb.int/report/sudan/sudanese-continue-suffer-scarcity-bread-fuel

14 IMF (2012)

Another variation of Government price setting for petroleum fuels is seen in South Africa. Its Department of Energy publishes a monthly regulation with official prices for petrol and other fuels in Rands (the national currency).[15] The prices are set for four different qualities of petrol and for more than fifty price zones (locations). The prices are calculated on the principle of import parity, which links petrol prices in South Africa directly to the price of petrol quoted in US dollars at refined petroleum export orientated refining centres in the Arab Gulf etc. Freight costs including associated costs such as demurrage, insurance, coastal storage, etc. are added in. Diesel prices are not regulated at the retail level, although a monthly reference wholesale price for diesel is calculated, and somewhat different methodologies are applied to other petroleum fuels. South Africa has several large oil refineries, but the costs of supplying fuels from them are not reflected in the regulated prices. South Africa applies regulations (price regulations and license requirements) to most activities of the downstream petroleum sector, including importation and exportation of petroleum.

By the principle and methodology stated, the South African system of regulating fuel prices does not have the effect of creating subsidized prices, nor does it shield consumers from the month-to-month fluctuations of international oil prices.[16] The system is configured to determine and impose market-based prices ("arms-length" prices) for fuels. Why market prices need to be determined by a Government agency and not by the market itself, is not entirely clear from the documentation available on the government web site. The monthly regulations are mandated by an act from the apartheid era[17], when South Africa was subject to international sanctions and took extraordinary measures to maintain a functioning fuels sector. Some changes to the system were introduced in 2003, but the fundamental approach of market related prices regulated by the state remains. A review by two researchers from the University of Johannesburg in 2014[18] found that the system works much in favour of domestic refiners at the expense of consumers, in continuation of policy from the apartheid era when security of supply was the predominant main priority for the sector.

A policy of price regulation in which Government determines the prices of fuels inevitably generates work for regulators. Their tasks will be different under a Northern Africa style system of subsidized and politically determined fuel prices and a South Africa style regulatory determination of market linked prices. In either case, the regulatory challenges are significant. Regulatory impositions inevitably have unintended side effects of distorting efforts for efficiency.

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15 http://www.energy.gov.za/files/petroleum_frame.html
16There are provisions in the system for a levy payable into an equalisation fund, to equalise fuel prices. At present (April, 2018) there is no levy.
17 Petroleum Products Act 120 of 1977 (Republic of South Africa)
18 Mondliwa and Roberts (2014)

06
Conclusions

A number of important issues for petroleum policy and choices in oil value chains have been identified and discussed in previous chapters. It is common to have policies on the oil sector jointly considered with gas as petroleum policy. This chapter is intended to integrate the discussions on petroleum policy by providing three perspectives: First, a view on the nature of petroleum policy and how it can fulfil its function in the management of the petroleum sector. Second, an overview in tabular form of petroleum policy issues and policy alternatives, and references to other sections of this report where the issues have been presented and discussed. Third, a summary of key policy recommendations which are presumed to be relevant for many African countries.

6.1 THE NATURE OF POLICY

Policy is needed to guide actions by governments in the petroleum sector, especially concerning the management of petroleum as a valuable natural resource for the nation. A basic principle usually underlying formal petroleum policy is that petroleum resources belong to the nation where they are located, and should be used to create lasting benefits for the nation (Al-Kasim 2013). The nation in this context is usually understood to be the nation state and its people, including future generations as far as the interest of future generations can be meaningfully addressed.

The form in which petroleum policy is expressed differs between countries according to their traditions. Some African countries have a specific and officially designated document to express this.[1] In other countries, it may be expressed in white papers or other government reports to parliament and modified by parliamentary debate. Even if a country does not have a formalised petroleum policy, it has an implicit one, more or less coherent and well-considered, which can be discerned from its actions. The process of establishing a formalised policy can be important for identifying pertinent issues and establishing consensus behind it.

A policy is a statement of principles and intents. It is not a legally binding document but forms the basis for legislation and regulations. It is not a plan or a commitment of resources but forms a basis for these. A petroleum policy can often be expressed in condensed form as a collection of 10-20 short statements, accompanied by some background and explanation. It should ideally be capable of remaining valid and relevant for a long period of time. A petroleum policy lays out in general terms what the country wants to achieve by its resources, and the main principles for managing them.

A policy for the petroleum sector can have a focused or a wider scope. Countries having petroleum resources, or reasonable hopes for finding some, need a policy for the exploration and production activities. Even if petroleum is known to be present, the question can be asked whether the nation is at all interested in extracting it, for the time being. The answer to the question is usually Yes, but it should not be taken for granted without seriously considering what the nation really wants, realistic expectations, and the potential dangers of becoming an oil producing state.

A wider scope for petroleum policy would be to also address the mid- and downstream sectors. Countries producing oil from offshore and coastal locations, have sometimes found that the upstream and downstream sector are not closely connected, since crude oil and refined products can easily cross borders and long distances on the ocean. In natural gas, the upstream and downstream tend to be more connected, since long distance transport is much costlier for gas than for oil relative to the value of the product. A petroleum policy can also be part of a comprehensive energy policy, which addresses the supply of various form of energy in the country. However, the issues of oil exploration and ownership to power cables may perhaps better be covered by separately developed policies.

One problem sometimes seen with attempts to formulate a petroleum policy is that it becomes too large and complicated a document, containing detailed statements which are more appropriately addressed by plans and budgets. If a statement entails commitment of financial or other resource for a specific purpose, it is more likely to belong in a plan linked to a budget, and not a policy. Such plans and budgets are updated often (usually in an annual budget process), where changes may occur due to changed circumstances, changed priorities, or because items of the plan have been implemented. A policy document should ideally remain relevant for much longer; a decade or longer is a relevant time frame. So, the policy should contain

1 Example from Uganda: http://www.energyandminerals.go.ug/downloads/nationaloilandgaspolicyforuganda.pdf

statements of a more general nature, stating principles and intents which are likely to endure.

6.2 ISSUES FOR PETROLEUM POLICY

Table 4 lists some key policy issues that may be considered for the exploration & production segment (upstream) including its relations to the supplier industries as national content. Some alternative policies for each issue are identified. The third column provides references to sections in this report where the issues are discussed. This table is followed by Table 5, which covers the mid- and downstream segments similarly.

Table 4: Key policy issues in the petroleum Upstream sector

Key policy issues	Policy alternatives (simplified)	Reference in report
Ownership to resources	National Sub-national Private land ownership	
National strategic management scope	Mainly market and commercially driven Commercially driven subject to national strategic management Comprehensive national economic planning	4.5, 5.1
Involvement of international oil companies	No (National oil company only) Yes, in limited roles Yes, in comprehensive roles	4.4, 4.5, 4.6
Institutional structure	Ministry – Petroleum authority – NOC Ministry – Petroleum authority Ministry – NOC	4.1, 4.6, 5.1
National oil company?	No In limited role; partnerships with IOCs In dominant sector role	4.1, 4.6, 5.1
Scope of NOC operations	Domestic only International	4.1, 5.1
Licensing framework	Concessionary Production sharing agreements Service contracts Other; combinations	4.1, 5.1
Licensing method	Open door Licensing rounds; discretionary Licensing rounds; non-discretionary	4.4, 5.1
Licensing and exploration strategy	Ad-hoc Systematic knowledge accumulation	4.1, 4.6, 5.1
Data management strategy	Ad-hoc National ownership to all data; systematic accumulation	2.3.2
Revenue management	Cautious; sovereign wealth fund Spending for current requirements	3.2, 4.1, 4.4
Pace & time scope of oil production	Modest, with caution Fast developments; strong preference for fast revenues	4.1, 5.1
Licensing & fiscal terms	Ambitious; high Government take Flexible, adaptable	4.1, 5.1
Transparency, anti-corruption	High; EITI standards & recommendations Less (e.g. no published contracts)	4.1, 4.2
Impact assessments	Require SEA, IEA by international standards No requirements for impact assessments	4.2., 3.9.
Environmental protection	Strict environmental requirements Tolerance of environmental damage	3.2
Safety management by authorities	Hands-off; reliance on oil companies Prescriptive approach Functional approach	5.1
Resource optimisation	Hands-off; reliance on oil companies Active authority engagement in securing optimal recovery & infrastructure	4.5., 4.6, 5.1
National content goals	Hands-off Indigenous dominance of petroleum sector International orientation with strong domestic supplier industries	4.3., 6.3
National content approach	Co-operative and enabling measures Assertive impositions	4.3., 6.3

Following is a similar table for the mid- and downstream segments, which include refining, transportation, fuels retailing and petrochemicals.

Table 5: Key policy issues in mid- and downstream petroleum

Key policy issues	Policy alternatives (simplified)	Reference in report
Refinery as a national priority	Private investors welcome; no state resources State willing to commit resources to securing refinery in the country	3.3, 4.4, 4.5
Preferred ownership of refinery	Entirely private Public-private State owned	3.3, 4.4, 4.5
Regulation of refinery	No particular regulation Non-discriminating third party access Market oriented price or margin regulation State determination of prices	3.3, 4.4, 4.5, 5.2
Fuels retailing structure	State ownership State and private Entirely private	3.5, 4.4, 4.6, 5.2
Fuels pricing	Competitive market, no price regulation Subsidised fuel prices Subsidies and government controlled prices Government controlled price, not subsidised	3.8, 4.4, 4.6, 5.2
Crude oil export system	Hands-off, leave it to oil firms Government strategic investment	3.4, 4.4, 4.5

Fuels supply infrastructure	No state involvement Gov't investment in large common infrastructure	3.4, 4.5, 5.2
Procurement and tendering for refinery, pipelines	Precisely defined in TOR, compete on cost only Open-ended solutions scope; discretionary assessment	3.4, 4.4, 4.5
Ocean shipping	No state involvement State investment in shipping	3.4
Road transportation	No state involvement (except safety regulations etc) State involvement as entrepreneur	3.4
Petrochemicals as national priority	Private investors welcome; no state resources State willing to commit resources to securing petrochemical industry in the country	3.6

6.3 KEY POLICY RECOMMENDATIONS

The preceding text of this report has sought to highlight and analyse issues with relevance for policy, without any intent to make direct recommendations for policy. National policies are for sovereign African nations to resolve. Some policy recommendations in relation to the oil value chain have been made based on the analysis reflected in this report. They are presumed relevant for many African nations. The recommendations aim at enhancing the benefits for African economies from oil value chains while avoiding their potential detriments.

6.3.1 National management of petroleum resources (Upstream)

i. Petroleum operations and licensing of petroleum rights should be based on an explicit policy, setting out the nation's main objectives and principles for petroleum extraction. The policy should be backed by a broad national consensus and be suitable to remain valid for a long period of time. The petroleum policy document as such should not contain legal obligations, specific plans or resource commitments, which are better covered in other public instruments. Petroleum extraction should be carried out by companies having the required capabilities for safe and effective petroleum operations.

ii. A solid legal and regulatory framework should be in place before any licensing of petroleum rights. There will be a number of important decisions for Government to make over the course of petroleum licensing and operations, for which adequate legislation, institutional mandates and competencies must be built.

iii. National oil companies can provide strategic advantages for African countries especially the development of national capabilities for oil sector operations. The national oil companies however require clear mandates, system of governance, monitoring, and appropriate financial arrangements.

iv. National strategic planning for the petroleum sector needs to be far-sighted and evolving. It should address the pace of exploration and developments, systematic knowledge building on resources, key infrastructure, development of regulatory and national capabilities for value chain participation.

v. The petroleum fiscal system should secure long term shares of high economic value for the state and avoid creating incentives for sub-optimal operational decisions. Predictability of the fiscal system and other terms affecting enterprises is an important consideration. Policies which significantly erode state revenues from petroleum extraction should be avoided.

vi. Transparency of contracts, regulatory decisions and payments related to petroleum extraction is strongly recommended to ensure that revenues are duly collected and applied for the national benefit.

vii. Petroleum operations should be preceded by impact assessments as tools for managing social and environmental externalities as well as public concerns and expectations.

viii. Data acquired during petroleum exploration, development and production is extremely valuable and should be managed by the state.

6.3.2 Mid- and downstream oil and related industries (Conversion and supply sectors)

ix. Countries should consider reducing the extent of regulation and state business involvement in oil refining and retailing. Governments should relinquish the role of determining or subsidising the prices of petroleum fuels.

x. Trade between African nations in petroleum fuels should be facilitated and barriers to such trade avoided. Harmonisation of fuel quality standards applicable in different countries would be a step towards reducing such barriers to trade.

xi. Construction of new refining capacity in Africa should be encouraged. New investment and business models for such refineries must be sought, without repeating earlier mistakes of ineffective state involvement.

xii. Depending on geographical and market conditions, governments may have an important regulatory function in preventing monopolistic market powers arising from large petroleum infrastructure and refining capacity.

xiii. Direct investment by African governments in petrochemicals should not be prioritised. Commercial investment in petrochemicals may be welcomed, but with caution regarding feedstock supply arrangements which could diminish the value of petroleum resources if subsidised. Government should focus on providing a conducive business environment for private investments in the oil sector.

xiv. African governments can facilitate the development of effective fuels retail sectors by improving the general conditions for doing business, for which the annual Doing Business reports from the World Bank is an indicator.

6.3.3 Value addition from participation in value chain activities (National content)

xv. The international nature of important supplier industry segments, and thus the important contributions of internationally based supplier firms to African petroleum sectors should be recognized. They should be encouraged to establish substantial bases of operations in African countries, with expectations that they will significantly employ Africans and use African subcontractors.

xvi. Collaborative approaches between International and local companies need to be encouraged.

xvii. The state should reserve the right to impose certain requirements for national content, at least as a fall-back solution in case the expected collaborative contributions from firms are not forthcoming.

xviii. The costs and risks to the state of imposing requirements for national content on value chain participants should be carefully assessed against expected benefits.

xix. National content requirements must be designed to fully preserve the standards for safety and the responsibility of licensees for operational integrity.

xx. Training for professionals, including on-the-job skills development, is an important enabling strategy for national content. Programmes for supplier development, which entails support for local firms towards becoming qualified suppliers to the petroleum sector, can also yield important benefits.

xxi. The state can provide important enabling conditions of national content in the forms of business parks, education (not least in vocational professions), affordable financing for indigenous businesses and improving general conditions for doing business in the country.

xxii. Certain categories of goods and services for petroleum sector activities can be recognised as lending themselves more readily than others to national content, depending on the national context.

xxiii. Any protection or incentives for indigenous suppliers to the petroleum sector should be of limited duration, in order not to create an enduring class of underperforming firms draining public resources. National content policy will be successful if resulting in many firms being based in the nation which, after some early support, can prevail in international and domestic competition without further state support.

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