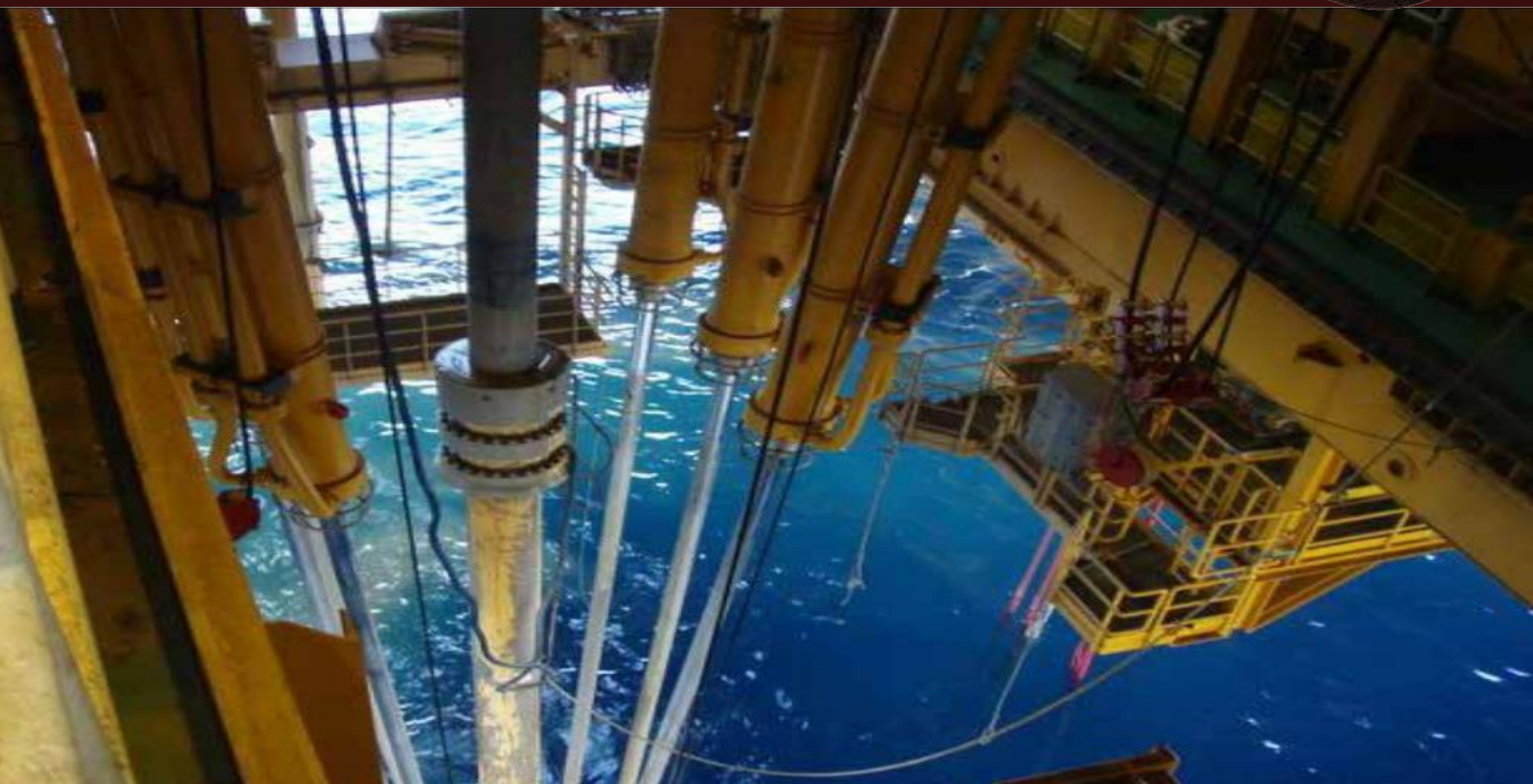


# Introduction to the Upstream Oil and Gas Industry



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## a. Description of the Industry:

### *What is Upstream Oil and Gas?*

The petroleum industry is broadly divided into three segments namely: upstream (exploration and production), mid-stream (storage, refining and transportation) and downstream (supply and distribution).

The upstream segment primarily involves the processes of exploration, development and production of crude oil and natural gas. As there is no production in Kenya today, this segment is primarily involved in exploration.

The midstream segment involves processes around storage, refining and transportation of the crude oil into consumable oil and gas products. There is only one refinery in Kenya today which is the Kenya Petroleum Refineries Limited located in Mombasa.

The downstream segment involves the process by which refined products are made available to the consumers through supply and distribution e.g. at industries and petrol stations. There is a fairly well developed network of transport pipelines, storage and retail outlets in Kenya today with a multiplicity of players.

The upstream segment, which is not familiar to many due to its relatively limited level of operations, is the main focus of this information brief.

## b. State of the Industry

Crude oil has been in use since approximately 2,000BC. In 500B.C. the Chinese, used crude bamboo pipelines to transport oil used for the heating sea water to produce salt. In 347AD, oil wells were drilled/ dug to a depth of up to 240m using bits attached to bamboo poles.

In the 1840s kerosene was used in lamps to light homes and streets in cities. The discovery and use of kerosene is widely believed to have saved the Blue Whale from extinction, as this was hitherto, the main source of lighting and heating oil. In 1859, the first modern well was drilled in Titusville, Pennsylvania and started off a major boom in the industry. In fact, this is said to have started the modern oil industry of today.

Until recently, Eastern Africa was zoned as an agricultural region and as such not much oil and gas exploration went on in the region. The first well drilled in Kenya was drilled in 1960. Since then, approximately 30 more wells were subsequently drilled with no commercially significant discoveries. It was not until Ngamia 1 well was drilled in 2012 and made a significant oil discovery that Kenya started gaining significance as a potential oil producer. A number of wells have been subsequently drilled, with several other discoveries and some with only minor oil and gas shows.

Kenya's discoveries are currently undergoing appraisal\* with more wells being drilled to evaluate the oil quality and quantity.

\* See pg 7 for definition of Appraisal





The upstream oil and gas activities in Kenya are governed by the Petroleum (Exploration and Production) Act Cap 308 of 1984, as revised in 1986. The policy and regulatory framework is, however, currently undergoing some review, to ensure that Kenya has a

good upstream policy and law that encourages growth of the industry. The Ministry of Energy and Petroleum is leading the process with support with various donor organisations and international experts.

### c. Common terms used in the upstream oil and gas industry

<b>Basin:</b>	A large, natural depression on the Earth's surface in which sediments, generally brought by water, accumulate. This is the environment in which oil and gas can be found.
<b>E &amp; P:</b>	Exploration and Production. This is also used in reference to the upstream segment of the oil and gas industry.
<b>ESIA</b>	Environmental and Social Impact Assessments
<b>Hydrocarbon</b>	Naturally occurring oil, gas or other related products below the surface of the earth
<b>Exploration Acreage:</b>	An area at sea or land that has been identified as potential for oil and gas exploration. This is then divided into several exploration blocks.
<b>Exploration Block:</b>	An area that has been demarcated for oil and gas exploration for which a Production Sharing Contract (PSC) has been or can be signed between an oil exploration company and the Government of Kenya.
<b>Production Sharing Contract (PSC):</b>	An agreement between a host government and an International oil company outlining obligations of each party and defining a mechanism for reward in the event oil and gas is discovered and is economically recoverable. The PSC also gives an oil exploration company the rights to explore for hydrocarbons in a country.
<b>Exploratory well:</b>	A well drilled, to depths of approximately 2,000m to 5,000m, to find new oil or gas. Also known as a wildcat when drilling in an area where no other wells have been drilled or drilled successfully.
<b>Appraisal well</b>	Refers to a well drilled in a reservoir or in a field previously discovered, to assist in evaluating the quality and quantity of the discovery.
<b>Development well:</b>	A well drilled in a proven oil field to the stratigraphic depth known to be productive for the purpose of production. Also known as production well.
<b>Barrel (bbl):</b>	A measure of volume for petroleum products; 1 barrel = 42 US gallons or 158.98 litres
<b>Barrel of Oil Equivalent (BOE):</b>	A measure used to aggregate oil and gas resources or production with one BOE being approximately equal to 6,000 standard cubic feet of natural gas.
<b>Bopd</b>	Barrels of oil per day. The global standard measure of oil produced.
<b>TCF:</b>	One Trillion cubic feet of natural gas
<b>BCF:</b>	One billion cubic feet of natural gas
<b>Liquefied Natural Gas (LNG):</b>	Natural gas that has been converted to a liquid by refrigerating it to ultra-low temperatures. Liquefying natural gas reduces the fuel's volume by 600 times, enabling it to be shipped economically from distant producing areas to markets.

<b>Reservoir:</b>	A subsurface, porous, permeable rock formation in which oil and gas is found.
<b>Resources:</b>	Quantities of oil and gas estimated to exist in naturally occurring accumulations. A portion of the resources may be estimated to be commercially recoverable and another portion may be considered to be unrecoverable.
<b>Reserves</b>	The portion of oil and gas resources that are confirmed to be commercially recoverable.
<b>Casing:</b>	Thick walled steel pipe placed in wells to isolate underground fluids (such as fresh water) from the well. Also prevents collapse of the well and to ease the extraction of oil if the well is productive
<b>Decommissioning:</b>	Is the term used for removing the drilling or production facilities and restoring oil and gas sites that are abandoned for lack of discovery or are no longer profitable?
<b>Drilling Rig:</b>	The equipment used to drill a well.
<b>Dry Hole:</b>	A well incapable of producing saleable hydrocarbons in sufficient quantities to justify commercial exploitation.
<b>Farm in:</b>	The acquisition of part or all of a company's interest in an oil or natural gas exploration venture from a third party.
<b>Farm out</b>	The sale of part or all of a company's interest in an oil or natural gas exploration venture to a third party.
<b>International Oil and Gas Producers (OGP):</b>	This is a unique global forum in which members identify and share best practices to achieve improvements in every aspect of health, safety, environment, security, social responsibility, engineering and operations.
<b>American Petroleum Institute (API):</b>	An oil and gas industry trade organization that standardizes petroleum industry equipment and procedures. API's research and engineering work provides a basis for establishing operating and safety standards and specifications for the manufacturing of oil field equipment and furnishes statistical and other information to related agencies. There are similar organizations in other places such as British Standards (BS).
<b>FEED:</b>	Front-end Engineering and Design – A process performed at the beginning of large oil and gas projects to design their structure and estimate their detailed costs.
<b>Floating Production, Storage and Offloading (FPSO):</b>	Floating production facilities based offshore. Provides alternative to pipeline to the shore, stores oil production and loads vessels for movement to markets. Used in offshore oil and gas installations.
<b>National Data Center</b>	A place where all past exploration data and samples are stored for use by the government and other parties who can benefit from it in future.
<b>P &amp; A</b>	Plug and abandon

## d. Definition of roles

### **Government**

The Petroleum (Exploration and Production) Act (cap 308) is the fundamental law governing upstream activities in Kenya. It vests the ownership of hydrocarbons to the national government while granting powers over the sector to the Cabinet Secretary of the Ministry of Energy and Petroleum (MoEP).

The National Government is the licensor to the oil and gas companies and is in charge of regulating and monitoring the sector. The MoEP is the entity responsible for formulation and articulation of policies governing the sector, legal functions of negotiating and licensing process, providing an enabling environment for all stakeholders, and mobilization of resources (both human and financial).

The Constitution of Kenya 2010 gives powers for vetting of licenses to the Parliament. The implementation of this part is not yet effective as it is to be set out in a law that has not yet been enacted.

Under current legislation, the Cabinet Secretary is the chief authorising officer and is in charge of policy and legal functions as well as licensing and monitoring of operations in accordance with the law and any signed petroleum agreements. The Cabinet Secretary is empowered to sign petroleum agreements on behalf of the government.

The County Government has role to play in the field operations in oil and gas exploration. The County Government issues various permits and licenses and is more involved in the direct field operations of the oil companies operating in Kenya.

### **National Oil Company**

There exists a National Oil Company by name National Oil Corporation of Kenya (NOCK). The company has an E&P department that manages exploration activities on its licensed blocks.

NOCK also carries the following functions on behalf of the Cabinet Secretary:

- Assists in the negotiation of exploration licences.
- Maintains the National Data Centre for all exploration data.

The company is also expected to be the holder of Government Participation share in development of oil and gas fields when that time comes.

### **International Oil & Gas Companies (IOCs)**

International oil and gas companies in the upstream sector are licensed by the government to carry out exploration and production activities. They take the role of the contractor under the PSC.

International oil companies working in the upstream segment are of different sizes and structures. Some companies fully integrated with both downstream and upstream activities while others focus on upstream only. Other upstream oil companies which are much smaller focus on opening new frontier areas for exploration and leave their larger counterparts to progress with the work.

### **Oil & Gas Supply Chain Companies**

Service companies are the providers of goods and services that are used in the exploration and production life cycle.

Services in the upstream oil and gas industry in Kenya can be classified according to the following criteria: Specialist Services, Direct Services and Indirect Services

### **i. Specialist Services**

Specialist services usually require heavy investment, adherence to strict standards to safeguard safety in operations and high technical expertise in the technology and labour skills used. The labour used in the provision of specialist services are required to have long global experience working in the oil and gas industry. To keep up with technological requirements large spending in research and development is also a characteristic.

These services are not available in Kenya are therefore provided by international service companies. These services include, drilling services, well services, rig hire, seismic acquisition etc.

### **ii. Direct services**

These are services that directly complement the specialist services allowing the specialists to focus on their primary technical activities. These services require less technical specialisation than the specialist services but also require strict compliance to safety and operational standards. Provision of these services also requires significant capital investment.

Some of these services are available in Kenya and are provided by international and local companies. Examples of these types of services include: field and camp construction, infield transport and logistics, civil works as well as mechanical and electrical services, environmental services (EIAs), site preparation, and provision of construction materials, among others.

### **iii. Indirect services**

Indirect services are peripheral services to both specialist and direct services. They are much less specialized in terms of the level of technical expertise

and labour skills required compared to the above two types. Also, the level of capital investments needed is substantially lower. These services are widely available and well serviced in Kenya, and are mainly offered by local and regional companies. Examples of these types of services include office supplies, unskilled labour, emergency services, IT services, security and general trades.

## **e. Other important Industry Aspects**

### **i. Country Economic Profile**

It is important to note, that the amount of oil a company can produce at a profit will be different depending on circumstances in the jurisdiction within which the oil is found. For example, even if circumstances such as physical infrastructure and distance to market were the same, a 300 million barrel discovery in one country with favorable policies concerning tax and other factors can be commercial while in a neighbouring country it will need a 500 million barrel discovery because the terms are not so attractive. Countries therefore attract investment and compete with each other based on risk profile of a country and currently East Africa is still considered high risk.

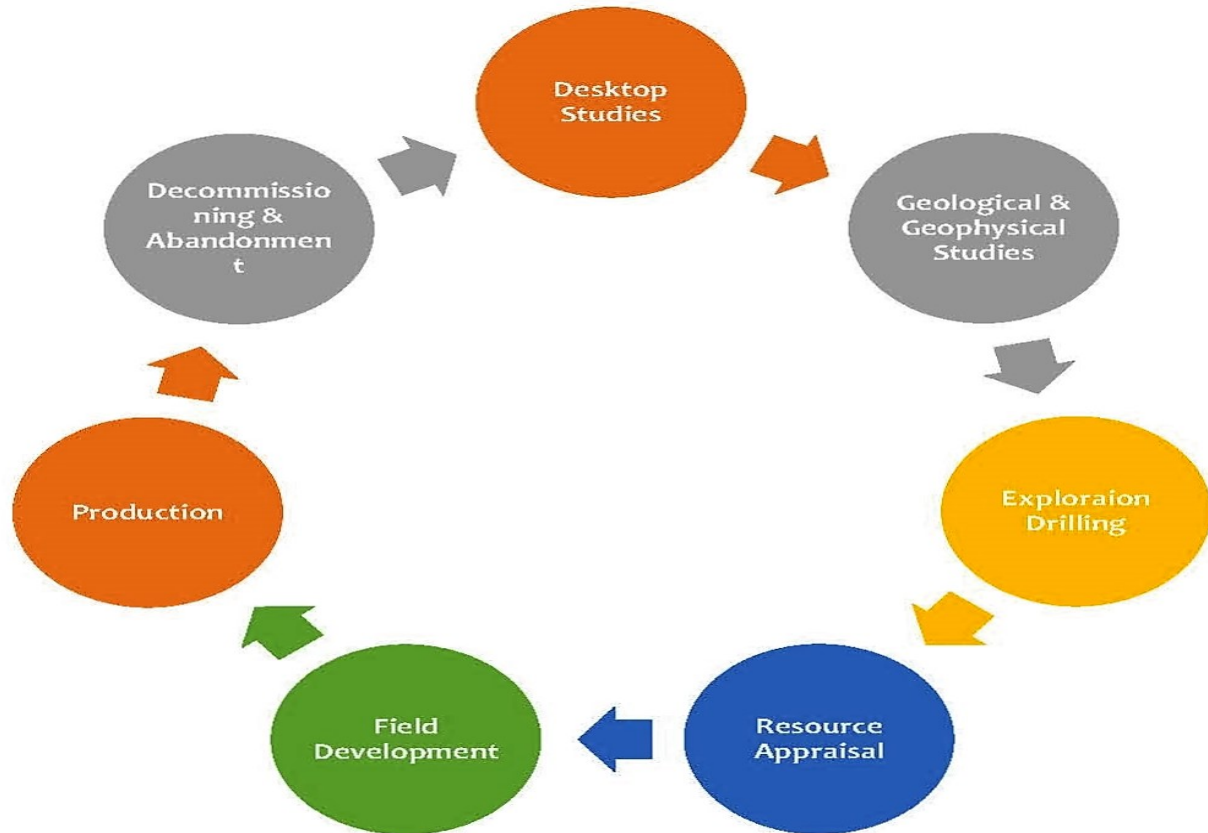
### **ii. Farm in and Farm out**

It is normal industry practice for companies to spread risk by bringing in new partners (farm in) during the life cycle of oil exploration. In the case of Kenya, small to medium sized companies, who were willing to take higher risk in the initial exploration activities have now had larger companies farm in to the exploration areas after they have collected data and de-risked exploration to an acceptable level.



## Section II:

# The Exploration To Production Life Cycle



**Figure 1 : Exploration to Production Life Cycle**

### a. Licensing

Before a company can engage in prospecting for oil and gas in any part of Kenya, it must first obtain a license in the form of a Production Sharing Contract. This document spells the terms under which the company

is licensed to explore for oil and gas, its obligations and also the obligations of the government. The PSC also sets out how the company will be compensated if the results of exploration are successful (cost recovery). There is no compensation in the case no success.

## b. Geological and Geophysical Studies

After a license is obtained, geological and geophysical surveys are carried out by to evaluate the possibility of hydrocarbon accumulation in the earth's subsurface.

Geological surveys are carried out on the earth's surface through observation, collection and analysis of rock samples, water samples and also general understanding of the geology and geological history of the area.

Geophysical surveys involve imaging of the earth's sub-surface (either sea bed or land) to identify areas where there is the highest possibility of hydrocarbon generation and accumulation. These surveys usually include processes such as gravity and magnetic surveys to identify presence and depth prospective rocks and seismic surveys to identify appropriate rock formations that may contain hydrocarbons.

Geological and geophysical surveys can take up to 3 years in the exploration life cycle. Their main purpose is in the identification of prospects and identify areas where exploration drilling will be located. These processes do not discover presence of oil or gas. Only drilling can.

## c. Exploration Drilling

There is no known means besides drilling in to the earth's sub-surface (either sea bed or land) that can identify presence of oil or gas accumulations or both. Exploration drilling is the process by which a well is drilled to targeted depth to confirm the presence or absence of hydrocarbons.

The first well drilled in a new area is normally referred to as a wildcat. This type of well is usually a very high risk well with a very high degree of uncertainty. The primary purpose of an exploration well is to find oil and gas accumulation. There are also wells drilled with a primary purpose of gaining more understanding of the geology. In all cases however, drilling helps understand

better the structure of the earth's sub-surface as well as provide more data for evaluation and understanding of the sub-surface. Rock and fluid samples may be collected for analysis. All data obtained here is also harmonized with all other data previously collected to improve the understanding of the geology.

**In the event that the well is not successful** and no hydrocarbons are encountered, best practice requires that the well is plugged and abandoned and the site is restored. The process of plugging and abandonment involves a well being filled with cement and packed at high pressures to ensure that no fluids or components can escape from down the well and mix with other materials on the ground surface or near surface water aquifers. The site is also restored to its original state.

**In the event that the well does encounter hydrocarbons** that are not in high quantity or quality to make a commercially viable development, best practice is still to plug and abandon the well, and restore the site to original state.

**In the event that a well is drilled and significant oil or gas is discovered**, extensive analysis is done at the well to determine the quality and possible quantity of the oil and gas discovered. Well testing is done at this stage to check that the oil or gas discovered can flow to the surface. In addition to this, numerous processes are set in to motion to determine the viability of the discovery. There are cases where oil has been discovered but after evaluation of the well, it is determined to be below commercial quantities.

At the point of a discovery further geological and geophysical surveys are conducted and more wells are drilled. This stage in the oil and gas exploration cycle is known as the **Appraisal Stage**. As the word suggests, the purpose in this stage is to establish the quantity and the quality of oil and gas, quality and type of the reservoir, and whether the oil and gas discovered can be recovered at a profit.

# Section III: Post Discovery

## a. Appraisal

When promising amounts of oil and gas are discovered in an exploratory well, a programme of detailed field appraisal may begin. The purpose of this phase is to reduce the uncertainty about the size and properties of the oil or gas field.

Appraisal wells are drilled and additional seismic surveys conducted to collect information and samples from the reservoir. The data collected is analysed and calculations are made of the volume of oil or gas that

the accumulation contains so as to determine whether it is commercially worthwhile to develop a field for production. The quality and production rate of the field is also determined. All this will help determine the type, size and the cost of production facilities required to produce the field.

Appraisal may take several years (3-6 years) to complete and is itself very costly. It is also important to note that appraisal does not always lead to production. In rare cases new information may come out of the process that renders development unviable.



## b. Field Development

The field development stage takes place after appraisal results have confirmed the economic potential of the oil or gas reservoir. A development plan will be formulated to develop the oil or gas field and presented to the government for approval. This plan will cover all aspects of the development including design, size, production plan, environmental management, target markets and the required infrastructure and costs.

The main activities and stakeholders involved include:

- n To form a plan to develop the oil or gas field, including how many wells need to be drilled to produce the oil or gas. Skills required are geologists, geophysicists and reservoir engineers.
- n To decide the best design for the production wells. This is done by drilling engineers.
- n To decide what production facilities are required to process the oil/gas before it is sent to a refinery or customer. This is done by facilities engineers.
- n To decide what the best export route might be for the oil and gas. This is done by logistics engineers and other logistics experts.
- n To decide on environmental management strategies. This is done by environmental experts.

The field development phase is itself very costly and could take a period of 3-10 years depending on the complexity of the discovery. Onshore developments are typically much cheaper than offshore developments. They may also take a shorter time depending on availability of other infrastructure. In cases where no other petroleum infrastructure exists, onshore developments tend to be very challenging and costly too.

## c. Production

Once the development stage is complete and all the necessary field installations and facilities have been set up, production may begin. The hydrocarbon resource is extracted to the surface, and then transported by pipelines and/or tankers to refineries where it is refined and distributed to consumers as either petrol, diesel, liquefied gas, kerosene, bitumen or other by-products.

It is important to note that crude oil cannot be used by consumers in its raw state. It requires being refined and broken into usable products as mentioned above. Natural Gas, once cleaned and separated from liquids, may be used in its raw state as an energy source or as a raw material for petrochemical industries such as fertilizer plants.

Production can last several years with some wells known to produce up to 40 years or more. The length and quantity of oil produced from a field depends on the size of the oil or gas field and how expensive it is to keep the wells and production facilities running.

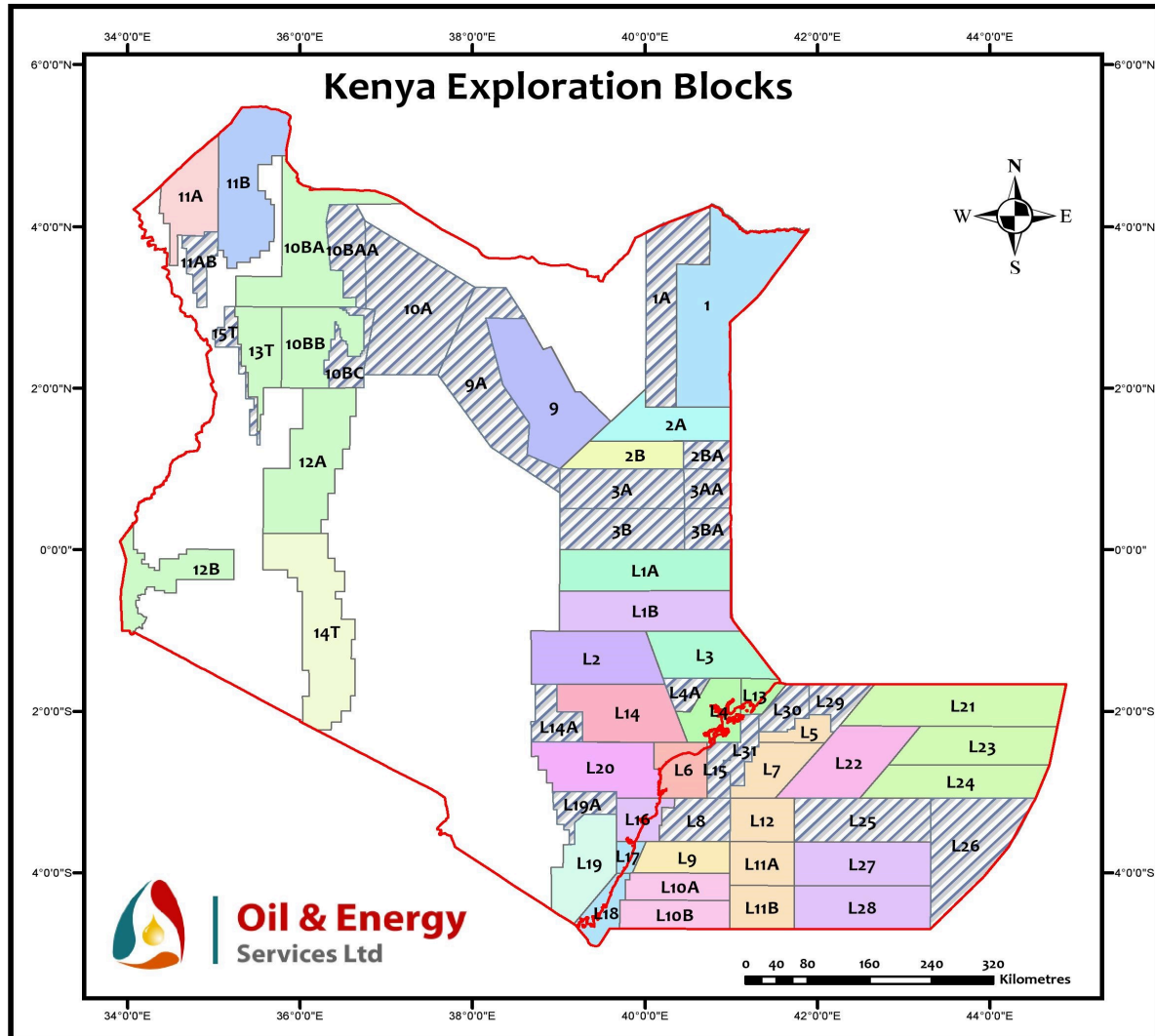
## d. Decommissioning and Abandonment

Once an oil or gas field no longer contains sufficient quantities in its reservoir to justify its economic profitability, it then undergoes decommissioning and subsequently abandonment. Following decommissioning, the field site would be restored to its approximate original condition or to some standard that results in stable environmental conditions. This entails plugging of the wells, dismantling and removal of all surface site facilities and equipment.

This phase can take a period of up to 1 to 5 years.



# Section IV: Exploration Block Map



# Appendices

## Appendix One: Frequently Asked Questions

### 1. *What is oil exploration?*

Oil exploration is the process that involves the efforts of many trained professionals such as geologists, geophysicists and engineers working with both the National and County Governments as well as local communities in search of oil and gas deposits beneath the Earth's surface.

### 2. *Why has it taken so long to discover oil in Kenya?*

Kenya has had a long history for oil and gas exploration with the first oil well drilled in the 1960s. Despite exploration having occurred for over five decades, only in the last decade has any significant discovery been made. The delayed success may be attributable to historical low pace of exploration in East Africa which was hitherto zoned as an agricultural region with limited exploration activity taking place over the years. Also, recent technological advancements have allowed Geoscientists to further understand the earth's sub-surface and contributed to the exploration success.

### 3. *What is the Dutch Disease?*

The Dutch disease is an economics term used to refer to the apparent relationship between the increase in exploitation of natural resources and a decline in the manufacturing, services and/or agricultural sector. Simply explained, an increase in the foreign revenues from natural resources will make a nation's currency stronger compared to that of other nations, resulting in the nation's other exports (manufactured goods and agricultural produce) becoming more expensive for other countries to buy. This makes the manufacturing, services and agricultural sectors less competitive.

### 4. *What is the role of the Government in exploration?*

Ownership of all Hydrocarbons is vested in the people of Kenya through the National Government. The National Government is the licensor for oil companies and is responsible for regulating and monitoring the sector.

The County Governments have a critical role to play with regards to the field operations of oil and gas companies as they are expected to give access to land and also ensure environmentally responsible operations are conducted. They also form the interface between oil companies and the communities.

### 5. *Which are the regulatory bodies involved in oil and gas exploration?*

All Regulatory functions of the Upstream Oil and Gas industry are vested in the National Government through the Ministry of Energy and Petroleum. The National Oil Corporation of Kenya and other state organs provides support to the Ministry from time to time as required and also hosts the National Data Centre where all historical exploration data is stored.

### 6. *Who owns the oil and gas once discovered?*

According to the Constitution of Kenya 2010 and the Petroleum (Exploration and Production) Act (cap 308), the ownership of hydrocarbons is vested in the people of Kenya through the National Government. The Ministry of Energy and Petroleum manages the resources and all exploration and exploitation contracts on behalf of the National Government.

**7. *If oil or gas is found on my land will I be displaced or evicted?***

Oil and Gas operations do not ordinarily displace many people as they occupy small sizes of land as compared to the size of reservoirs exploited. It may happen that while oil may be discovered under your land, physical development may be done elsewhere and your land is not disturbed.

If physical development is planned to occupy your land, a specific size of required land will be determined by the oil company and discussions on compensation will be held with you in accordance to the relevant land laws. No land will be taken from you without your consent and compensation.

**8. *Will oil exploration affect the health of my family or my livestock?***

No.

Well managed operations work to limit the negative impact on people, animals and the environment. Environmental and Social Impact Assessment (ESIA) studies are always done before operations on the ground are conducted. These must be approved by the National Environment Management Authority (NEMA) prior to any seismic or drilling activities. All risks identified during these studies are adequately mitigated during operations. International Oil companies operating in Kenya are subject to very high Health and Safety standards which oblige them to ensure that human, animal and environmental degradation is avoided at all costs. This is one of the contractual obligations any oil company has with the National Government.

**9. *Where can I find information on the oil and gas industry?***

Information on the oil and gas is available from the Ministry of Energy and Petroleum. The National Oil Corporation of Kenya website provides a lot of information on the upstream oil and gas industry. You may visit the websites of the two organisations on [www.energy.go.ke](http://www.energy.go.ke) and [www.nockenya.com](http://www.nockenya.com).

Other sources include the several oil exploration companies who provide regular updates via their websites regarding their exploration activities in the various parts of Kenya, as well as the media and other upcoming information repositories.

**10. *How much oil has been discovered in Kenya?***

Kenya has had eight oil and gas discoveries since 2012. As mentioned in the oil exploration cycle, Kenya is currently in the appraisal stage in oil and gas exploration meaning that quantities will be established at the end of the process. Estimated oil resources of 600 million barrels have been discovered in Turkana. However, this is still under review and a decision to develop for production has not yet been made. Studies are still ongoing.

**11. *Is the oil in Kenya commercially viable?***

Kenya is still in the appraisal stage to determine whether oil resources discovered this far are indeed commercially viable. Numerous factors must be considered before the oil discovered is declared commercially viable. It is important to note that exploration activities are still ongoing in other areas, the results of which cannot be predicted until drilling takes place.