



# **VALUE CHAIN SYSTEM IN THE EXTRACTIVE INDUSTRIES**

## **(MONITORING UP TO SELLING POINTS)**

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# Scheme of Presentation

- ☐ Introduction to Extractive Industries, Crude oil (3-5)
- ☐ Geological Time Scale, Block Allocation in India and Value Chain (6-9)
- ☐ A few important Audit Initiatives (10)
- ☐ Value Chain – Petroleum (6-7)
- ☐ Quick recap of E&P activities – E&P cycle, Seismic survey, data analysis and sequencing, Rigs, drilling, oil processing and evacuation (11-18)
- ☐ Methods of Accounting of cost of Wells (19)
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# EXTRACTIVE INDUSTRIES - INTRODUCTION

- Industries involved in the process or activities that lead to the extraction of raw materials from the earth (such as oil, gas, metals, mineral coal etc.), processing and utilization by consumers.
- Onshore or offshore.
- Extracted materials are in the liquid, gas or solid state – Requires further processing.
- Could impact Environment, Economic and Social life.
- Impact on Environment is always considered negative.
- Social impact – Mixed, but mostly negative.
- Despite negative impact, sustainable development calls for extraction.

# EXTRACTIVE INDUSTRIES – Contd..

- **Liquid and gas- focus on fossil fuel-petroleum.**
- **Solid minerals such as Iron ore, coal, copper, zinc, stones, sand etc.**
- **Fossil fuel**
  - Trapped fossil fuels over millions of years.
  - Very miniscule per cent is explored as trapping and extraction requires conducive geological sub surface like sedimentary basin, source rock, cap rock, permeability, porosity etc.
  - Mainly two Petroleum cycles – Upstream and Downstream.
  - Upstream includes Exploration and Production (E&P) in offshore and onshore.
  - Downstream includes Refining and Marketing.

# What is Crude oil

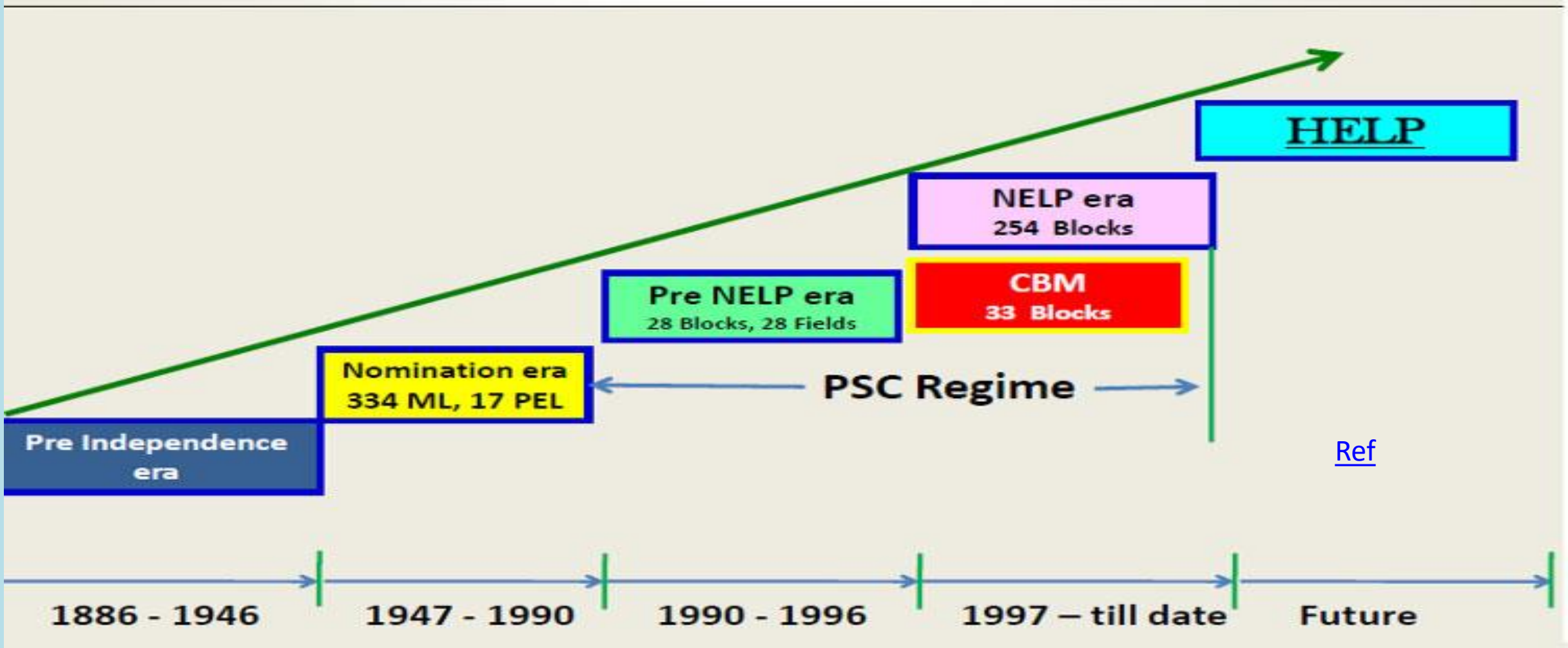
- A liquid mixture of thousands of organic chemicals found underground. It is the result of organic matter decaying over millions of years; hence the name Fossil Fuel.
- Volatile liquid hydrocarbons (compounds composed mainly of hydrogen and carbon), though it also contains some nitrogen, sulfur, and oxygen.
- Found all over the world and varies tremendously in density, aromatics, Sulphur and metal content.

# Geological Time Scale

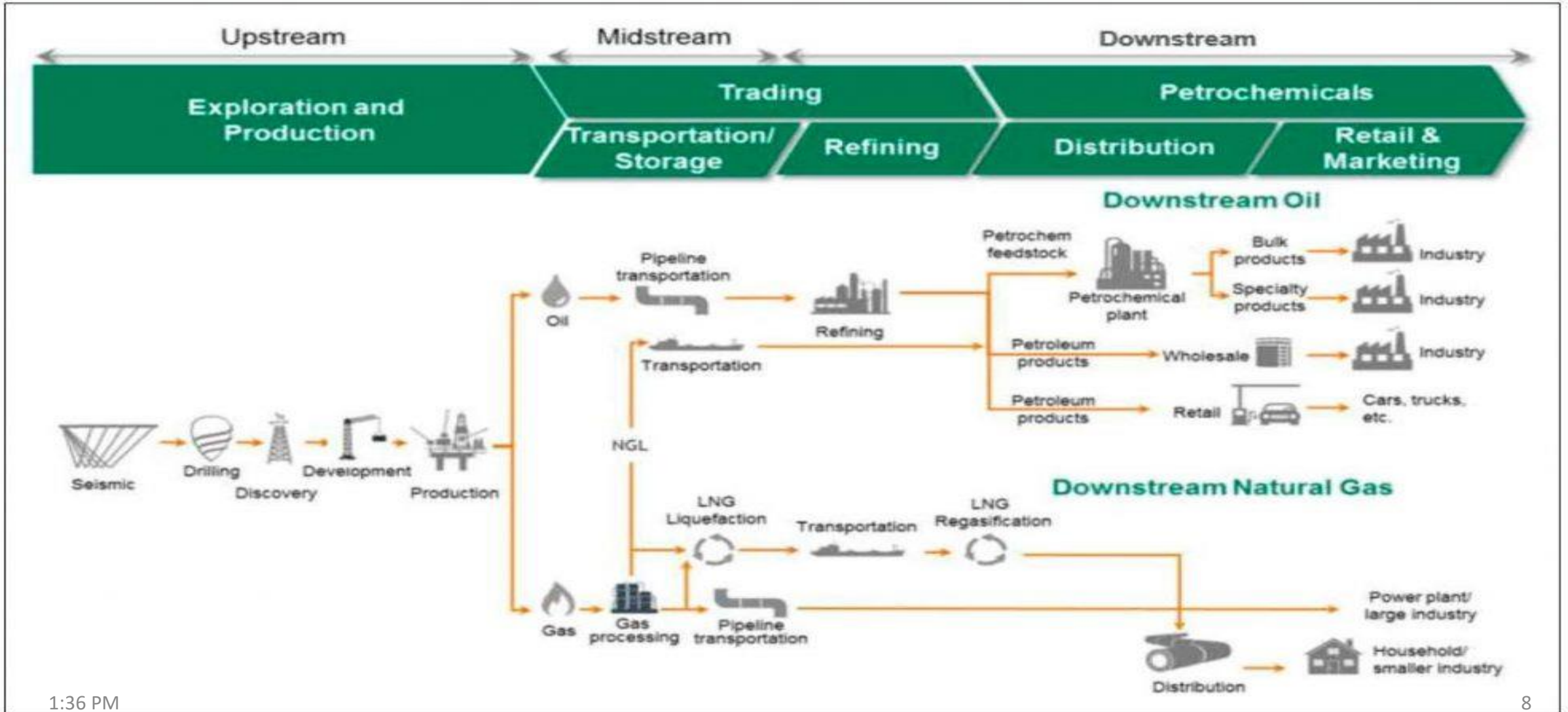
EON	ERA	PERIOD	MILLIONS OF YEARS AGO	KEY EVENTS
Phanerozoic	Caenozoic	Quaternary	1.6	Humans evolve
		Tertiary		
	Mesozoic	Cretaceous	138	Extinction of Dinosaurs
		Jurassic		
		Triassic		
	Paleozoic	Permian	240	Permian mass extinction
		Carboniferous	330	
		Devonian	410	Invertebrates become common
		Silurian		
		Ordovician	500	
Cambrian				
Proterozoic		Also known as Precambrian	3500	Earliest life
Archean				
Hadean				



# Exploration & Production Regimes in India

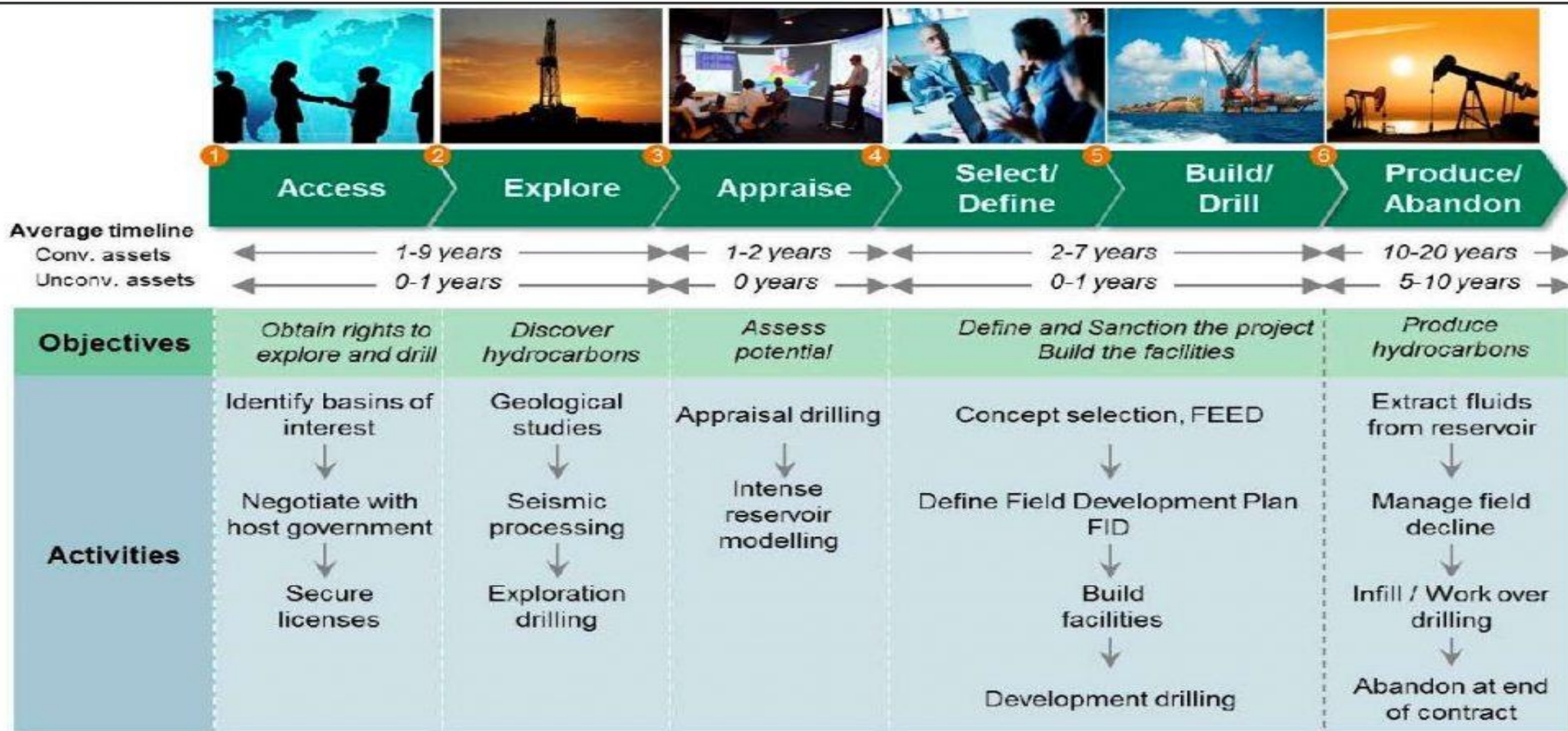


# Value Chain in Petroleum Sector



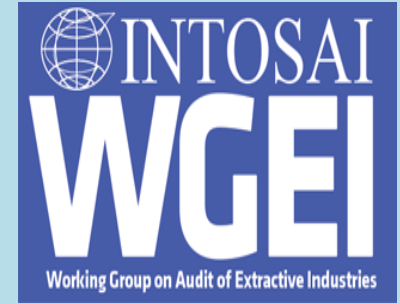


# Value Chain in Petroleum Sector





## Some of the Audit Initiatives of SAI India



**Natural Resource Accounting (First of its kind in India)**  
(<https://gasab.gov.in/gasab/pdf/NR-Accounting.pdf>)

**Special Audit on Hydrocarbon Production Sharing Contracts** (<https://saiindia.gov.in/cen/delhi-v/en/audit-report/details/2366>)

**Performance Audit on Rig utilization in ONGC**

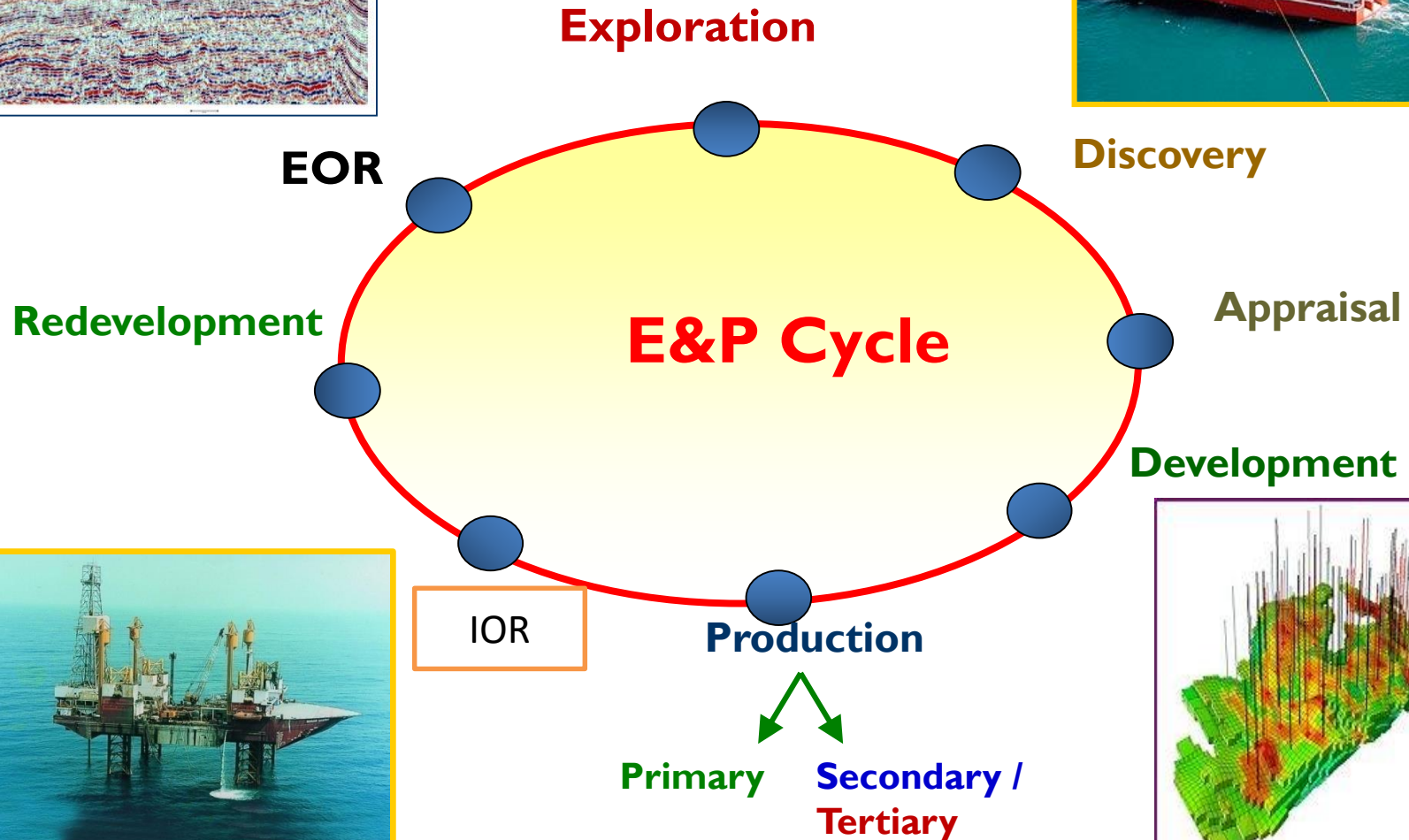
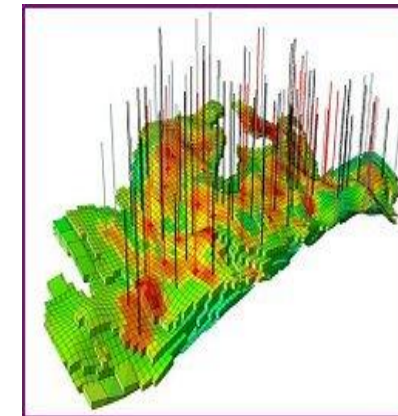
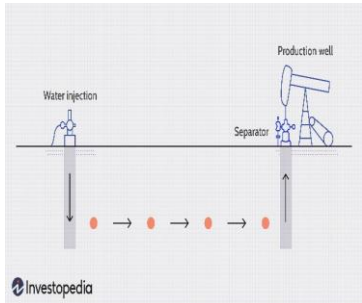
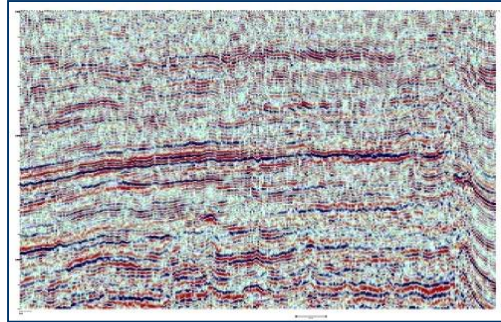
**Performance Audit on Deep water exploration in ONGC**

Quick recap of  
how crude/Gas  
is extracted

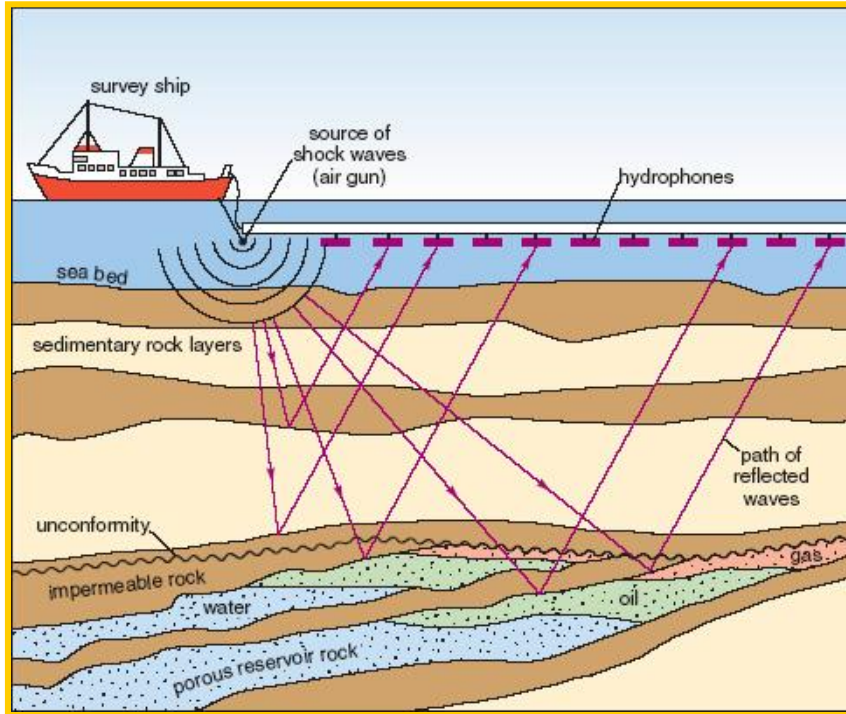




# The Exploration and Production cycle



# Seismic Data Acquisition and Interpretation



- **Seismic reflection is the principal method by which petroleum industry images hydrocarbon bearing structures**
- **Compressed air guns towed behind a seismic vessel discharge high pressure pulse of air just beneath the sea surface.**
- **High pressure pulse penetrate the subsurface and are reflected back towards the hydrophones / Geophones from the rock interface**

# Sequencing of E&P functions

- Discrete data is converted into continuous data.
- Data interpreted in data center.
- Prospects are identified for focused attention.
- Exploratory wells are drilled.
- Geological modelling is done and analysed.
- Delineation wells are drilled to explore the extent of reservoir.
- Commercial viability is established before development.
- Development wells are drilled and platforms put in place.
- Production commences.



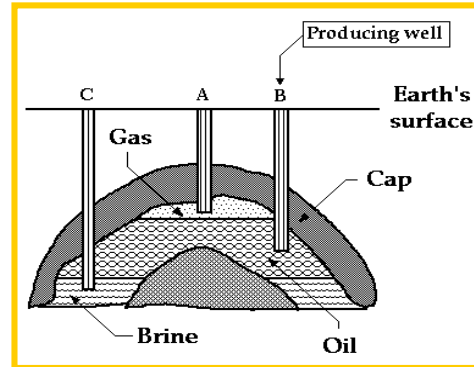
# Drilling- Different Options



Onland Rig



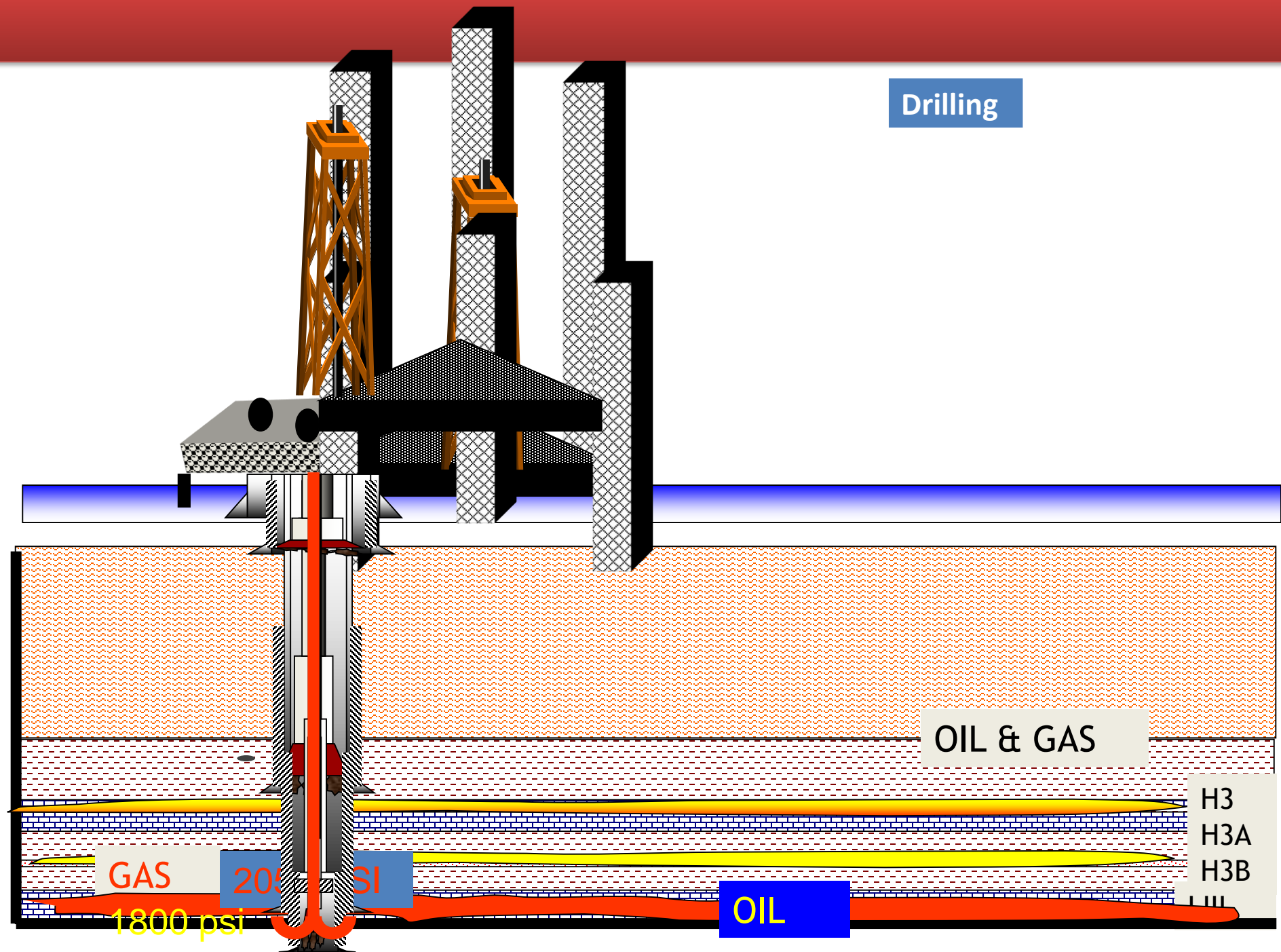
Drill Ship

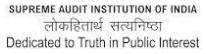


Jack Up Rig

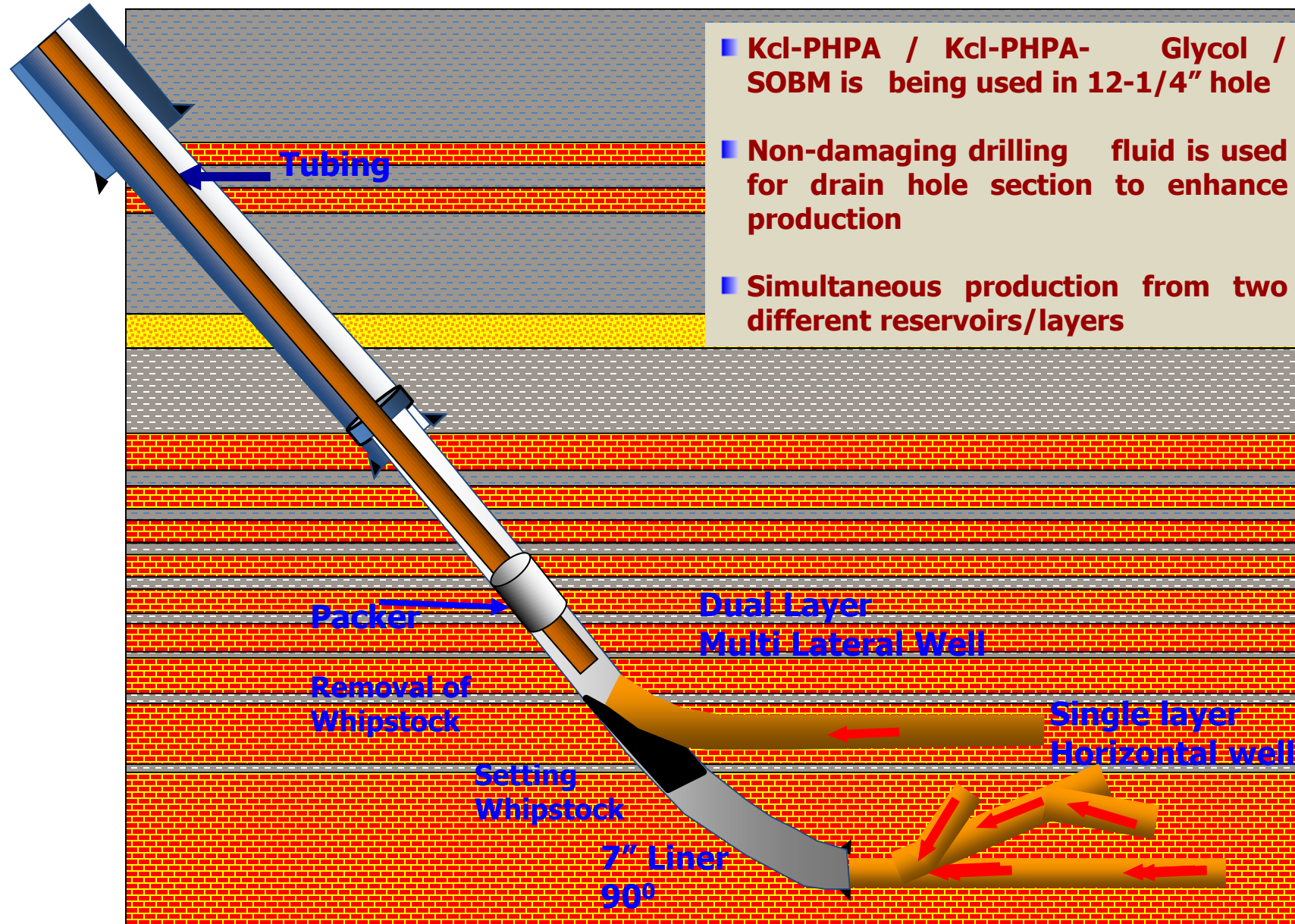


Semi Submersible Rig

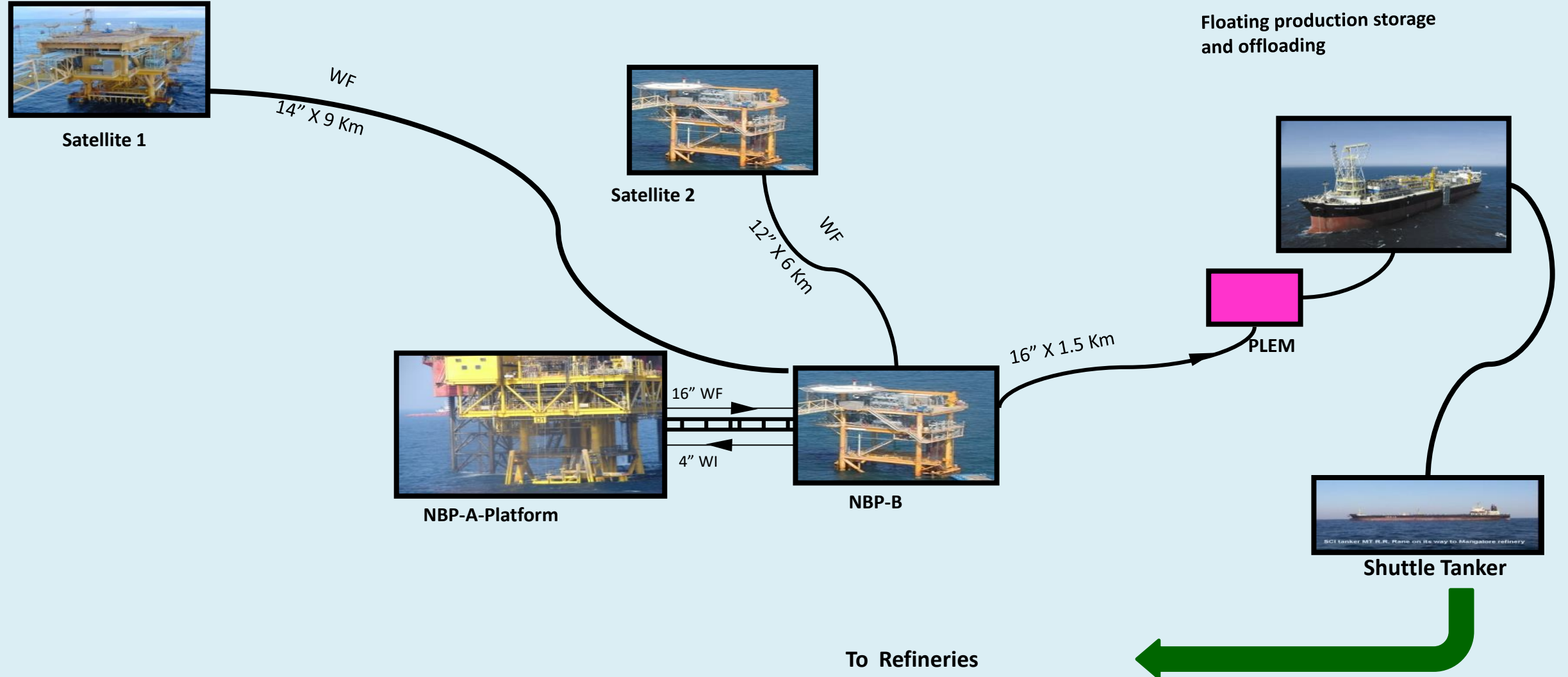




## A Typical Hi-Tech Well in Offshore



# TYPICAL OIL PROCESSING AND EVACUATION SYSTEM



# Methods of accounting of cost of wells

- **Full cost Method:** Entire cost of well is capitalized, irrespective of the results of drilling. (Note: Success ratio is generally 1:8)
- **Successful Efforts Method:** Only those wells that are oil/Gas bearing and can produce economic quantities are capitalized, leaving the rest to be charged to revenue.
- Drilling inventories in both the cases are initially booked as Capex Inventory under CWIP.

## Drilling and production– Adverse Impacts

- Environmental (Water contamination, Riserless wells - Sea bed filled with debris, possible radio active substances used in well logging, too much of supply and support vessel movements, non restoration of site after abandoning the wells if found dry, Disturbance to the marine species, change in marine ecology etc.)
- Social (Fishermen loosing fishing days, possible loss of fishing area if found oil or gas bearing)
- Subsurface deterioration in back injection
- Catastrophic Accidents (Eg: Deep water disaster)
- Friendly oil can turn enemy - Gulf oil spill (Man made disaster)
- One oil well off the southeastern coast of Louisiana, owned by Taylor Energy, has been **leaking** since 2004, spilling between 300 and 700 barrels per day. The well's reserves could keep it **leaking** for the next 100 years if it isn't capped, meaning it will one day eclipse the **Deepwater Horizon** spill in terms of volume.



## The Deep water Disaster in Gulf of Mexico

- The ***Deepwater Horizon* oil spill** was an industrial disaster that began on 20 April 2010, in the Gulf of Mexico on the BP-operated Macondo Prospect, considered to be the largest marine oil spill in the history of the petroleum industry. (Capping cement failed, BoP failed, annular cementing gave way, Casing pipes and tubing tilted, top kill and static kills failed, two wells drilled to reach the leaking spot, finally capped from depth)
- The US Federal Government estimated the total discharge at 4.9 million barrels (210 million US gal; 780,000 m<sup>3</sup>).
- After several failed efforts to contain the flow, the well was declared sealed on 19 September 2010.
- Reports in early 2012 indicated that the well site continued to leak. The *Deepwater Horizon* oil spill is regarded as one of the largest environmental disasters in American history.

# The Deep water Disaster in Gulf of Mexico

Controlled fire- Chemicals and dispersants used- oil collected- still damage caused.



# Effect of oil spill





# IMAGES- POST GULF WAR



# Downstream Petroleum Value Chain - Refining Process



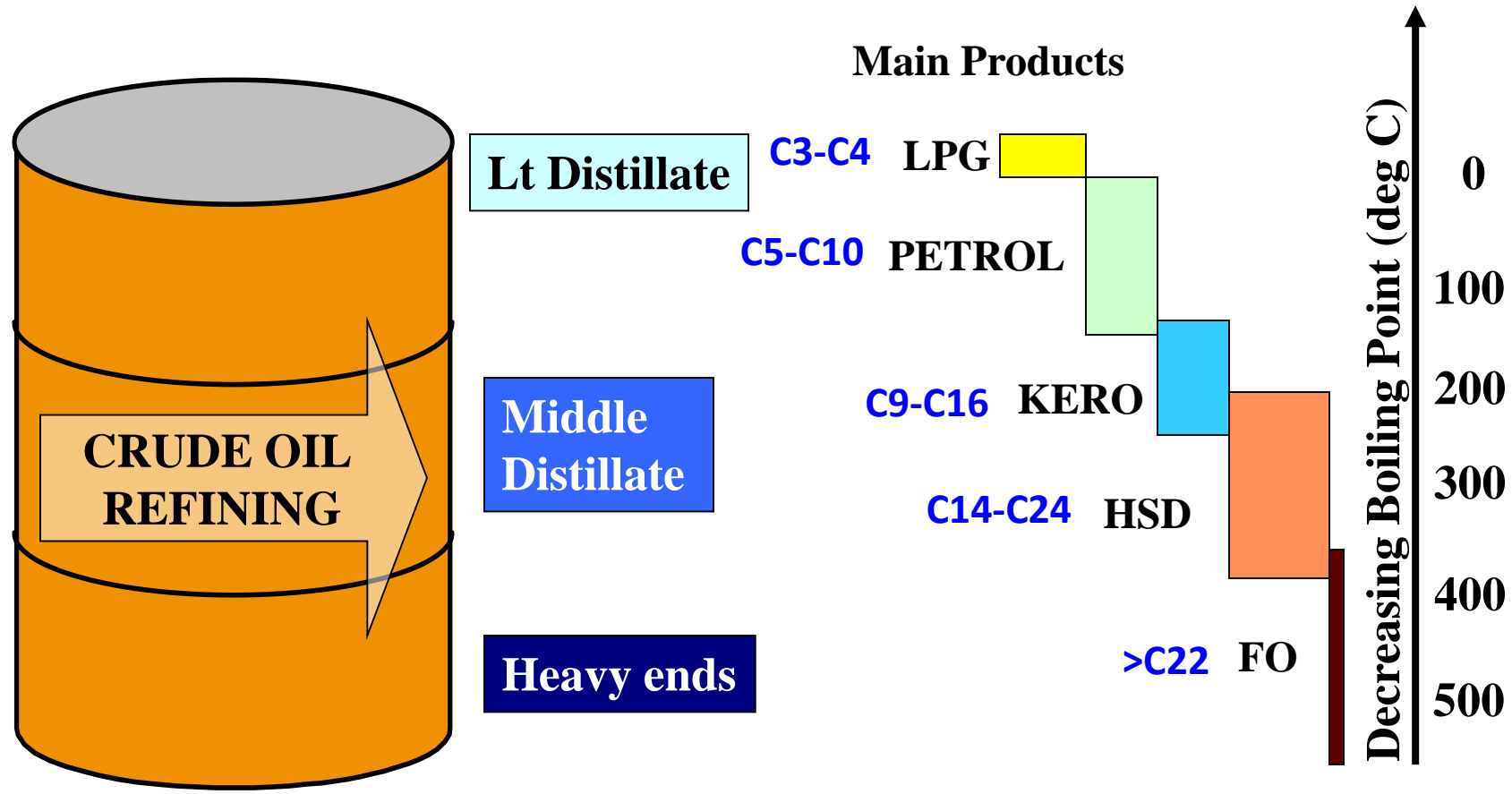




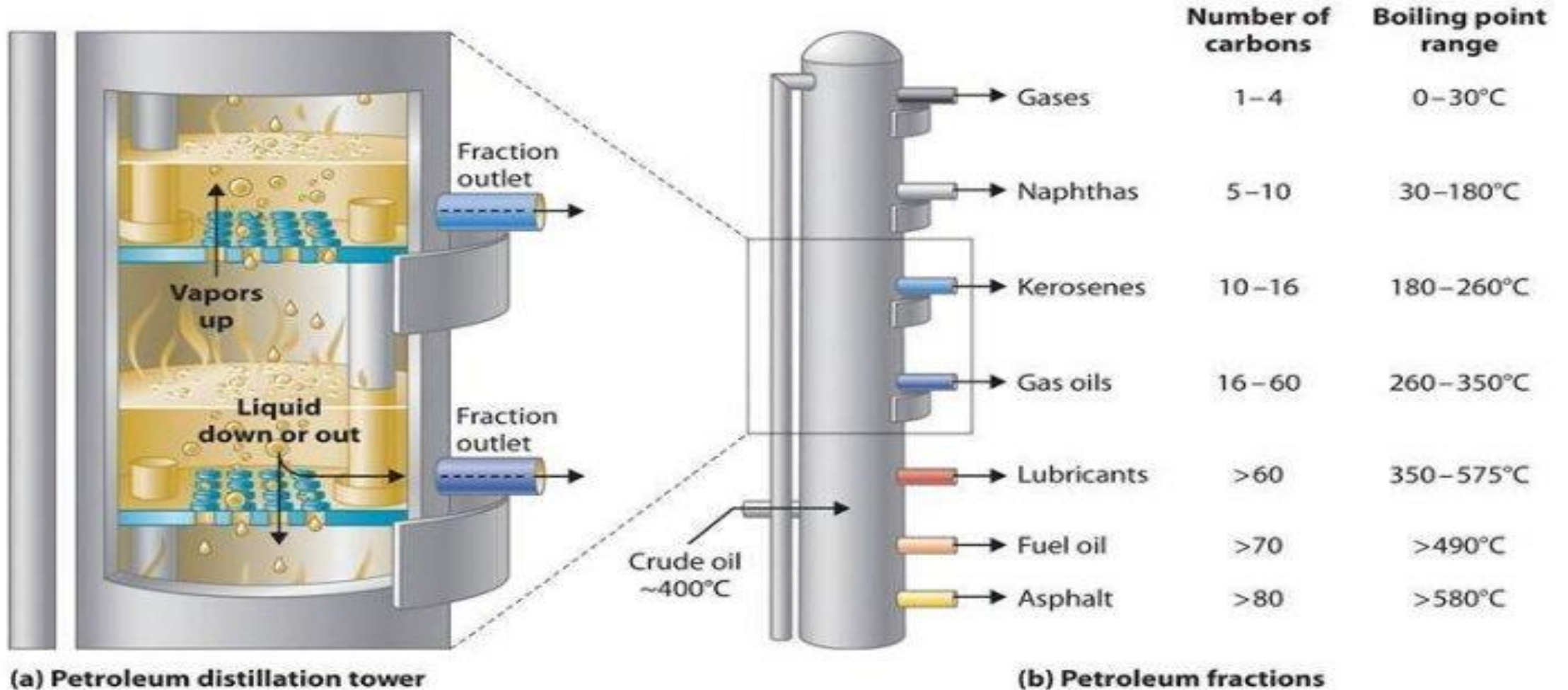
# How crude is separated in Refinery

- Crude oil contains hydrocarbons of varying carbon numbers. These different hydrocarbons boil at different temperatures and this property of the hydrocarbons is used to separate different products. The major products are LPG, Naphtha, Petrol, Jet Kero, Diesel and Furnace oil.
- The lighters like LPG boil between  $-30$  deg C to  $+2$  deg C while heavy ends start boiling only after  $550$  deg C. The other products boil between these two extremes.
- Crude oil is separated into different streams by Distillation which is the basic refinery process. The physical quantities of different products that can be separated by simple distillation process vary depending on the type of crude.

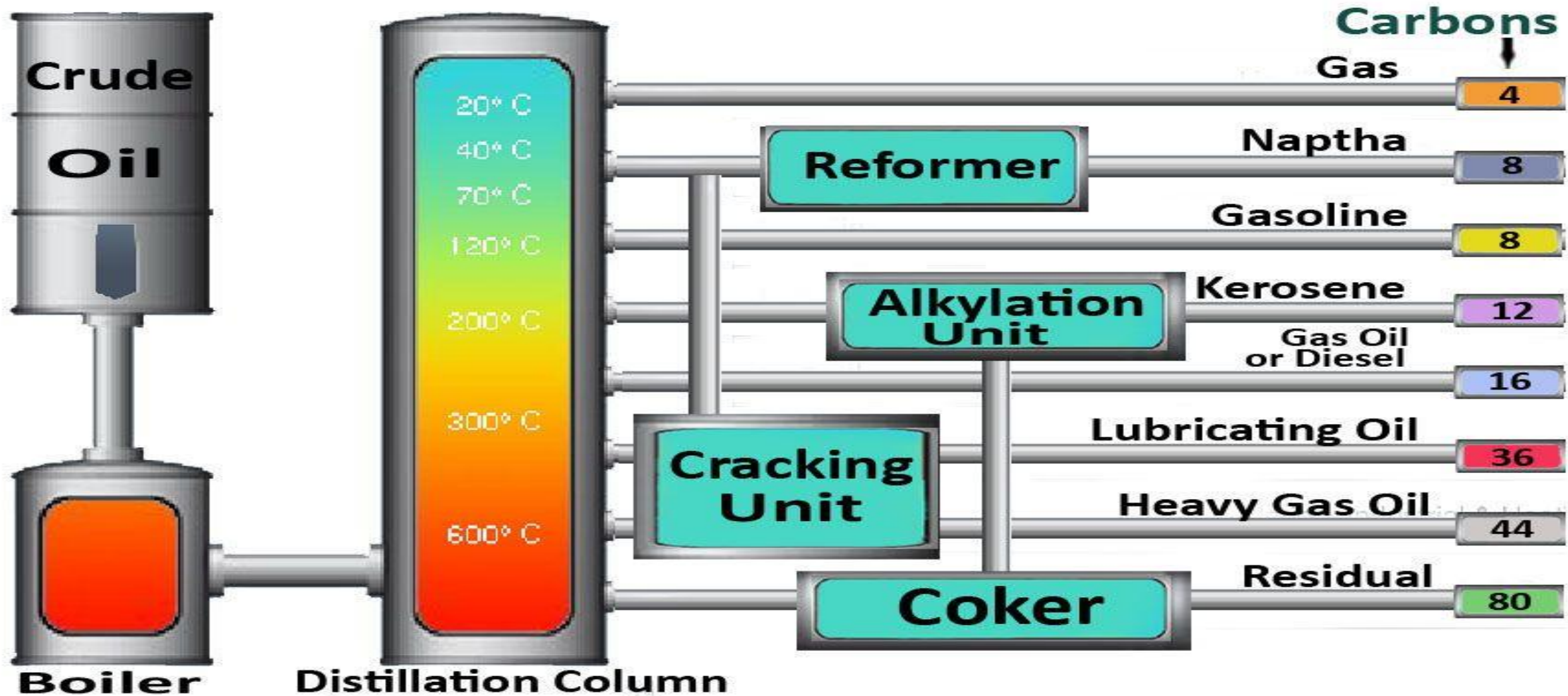
# Crude oil to products



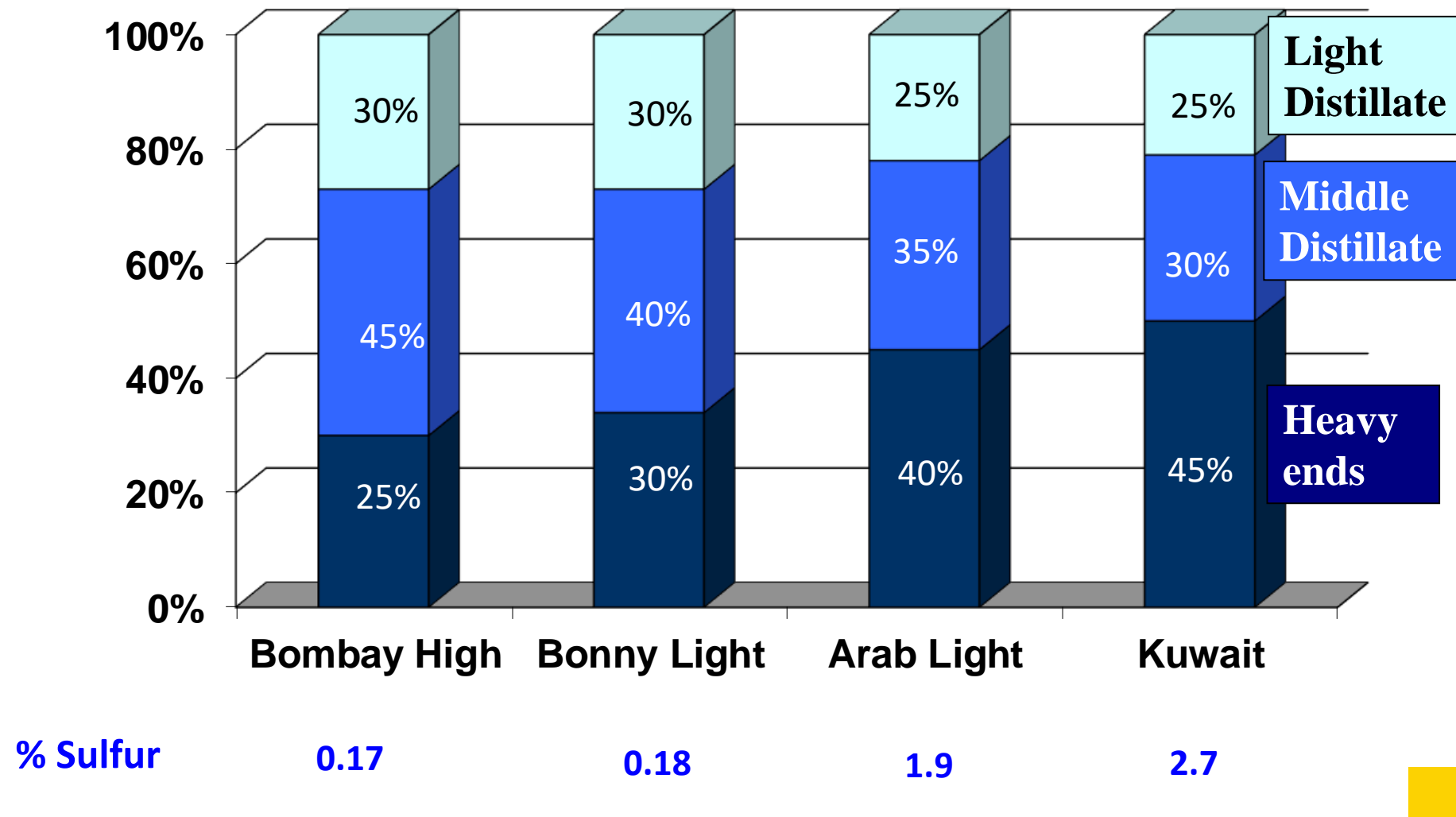
# Basic Refining



# Secondary processing



## Different crude – different yields with simple distillation

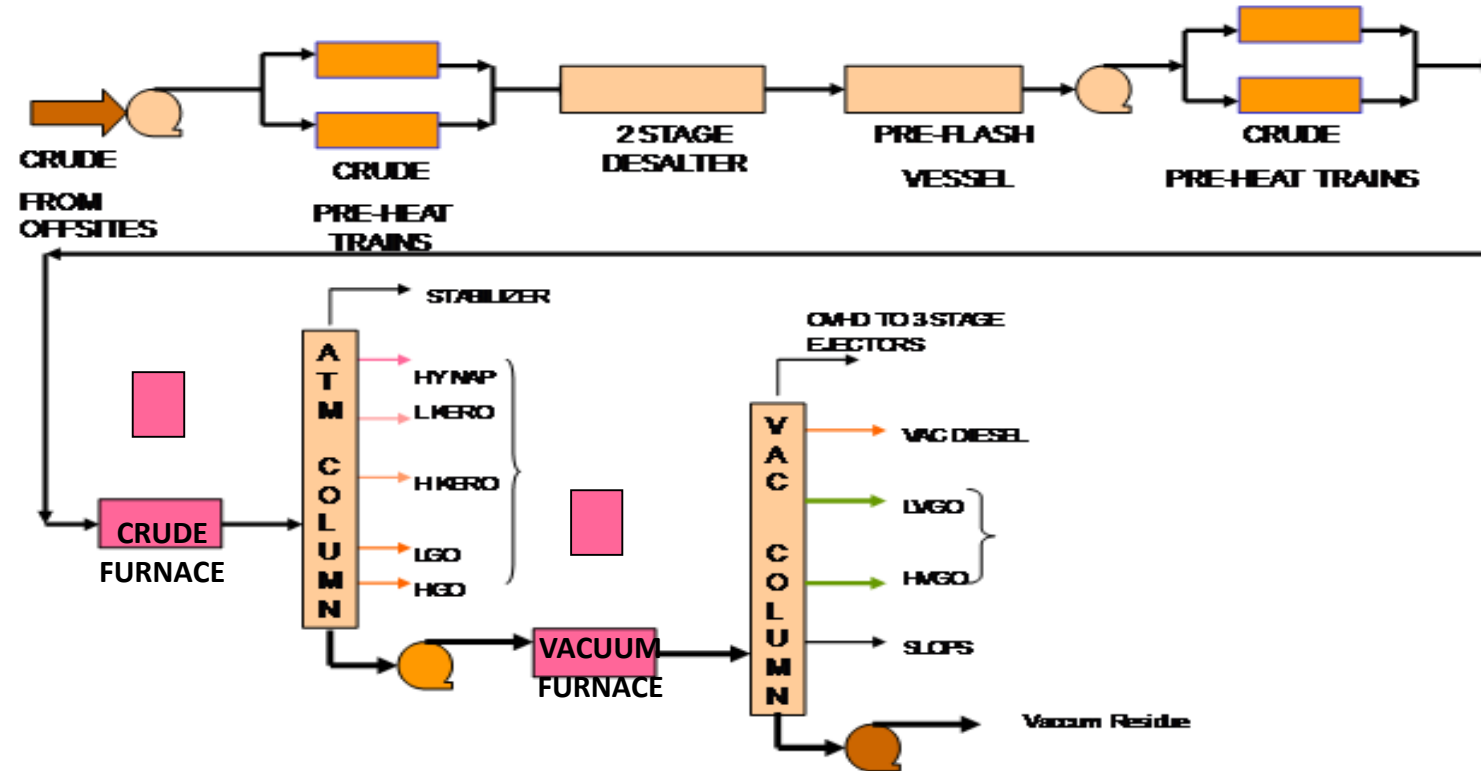


# Mumbai Refinery - Products

C3	NTPC NAP	HSD IV	BITUMEN
LPG	SKO	LDO	LSHS
PETROL	ATF	FO - 3	SULFUR
LAN	LABFS	BENZENE	LUBE OILS
HAN	KEROSENE	TOLUENE	MTO
NAPHTHA	NG HSD	SBP	
RIL NAPHTHA	HSD III	HEXANE	



# Crude & vacuum distillation unit



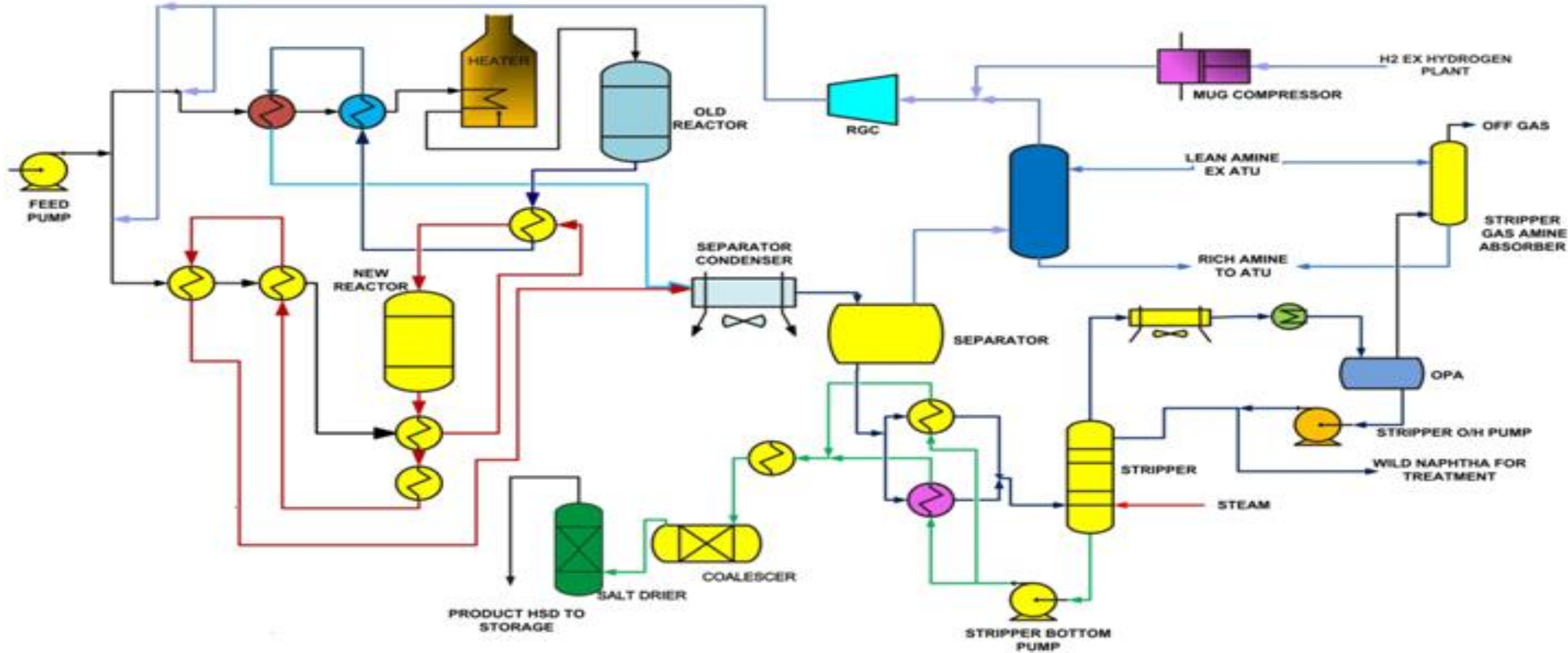
Audit to check optimum use of crude.

Maximum light and middle distillates and minimum heavy ends

Minimum Fuel and Loss

Crude Distillation Unit (CDU) separates crude oil into various fractions based on boiling points for further processing in downstream units

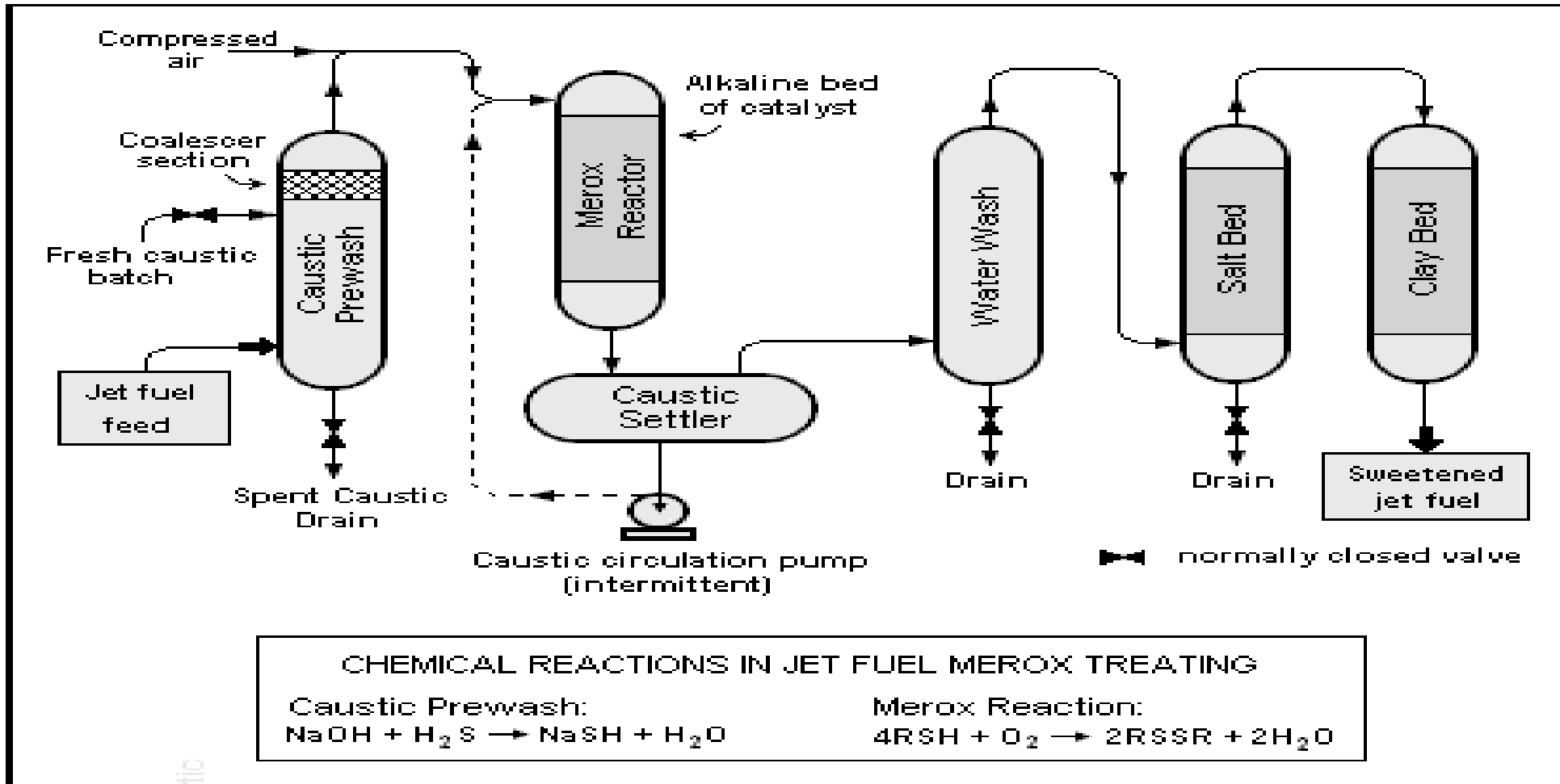
# HDS



Audit to ensure products conforming to respective standards.

Minimum downgrades and rejections

Hydrodesulphurization (HDS) is a catalytic process used to remove sulfur (S) from petroleum products, such as gasoline , jet fuel, kerosene, diesel and fuel oils



KMU is Kero-Merox sweetening process used to remove sulfur (S) from jet fuel

Audit to check frequency of rejection and downgradation of ATF to SKO.

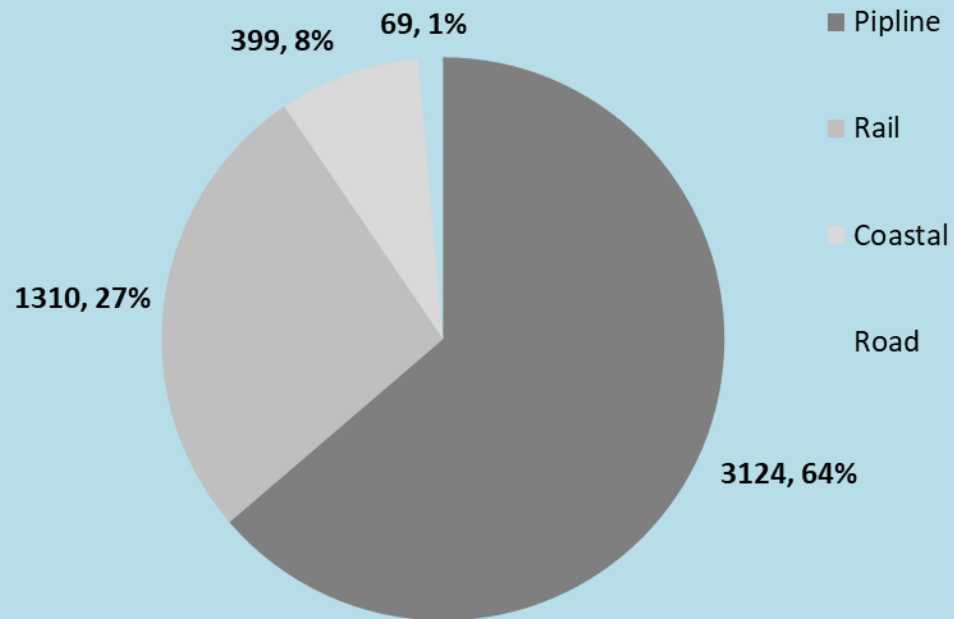
# Downstream Petroleum Infra.

- **Refinery** (Production unit and Bulk Dispatch)(Crude coverage, Crude mix, Swing config., demand supply balancing, zero or minimum flaring, Refinery Gross margin maintenance, containment management, dispatch management, HSE policy, periodical maintenance, shutdown management etc.)
- **Installations** (Bulk receipts from Refinery and Tankers and storage)  
(Receipt metering, storage management and accounting, Dispatch management).
- **Depots** (Receipts from Installations and Local storage and distribution).
- **Private depots** in the premises of large customers.
- **Retail Outlets** (Last mile delivery points).
- **LPG Bottling Plants** (Bulk processing unit).
- **LPG Distributors** (Last mile delivery point).
- **Lube oil plants.**

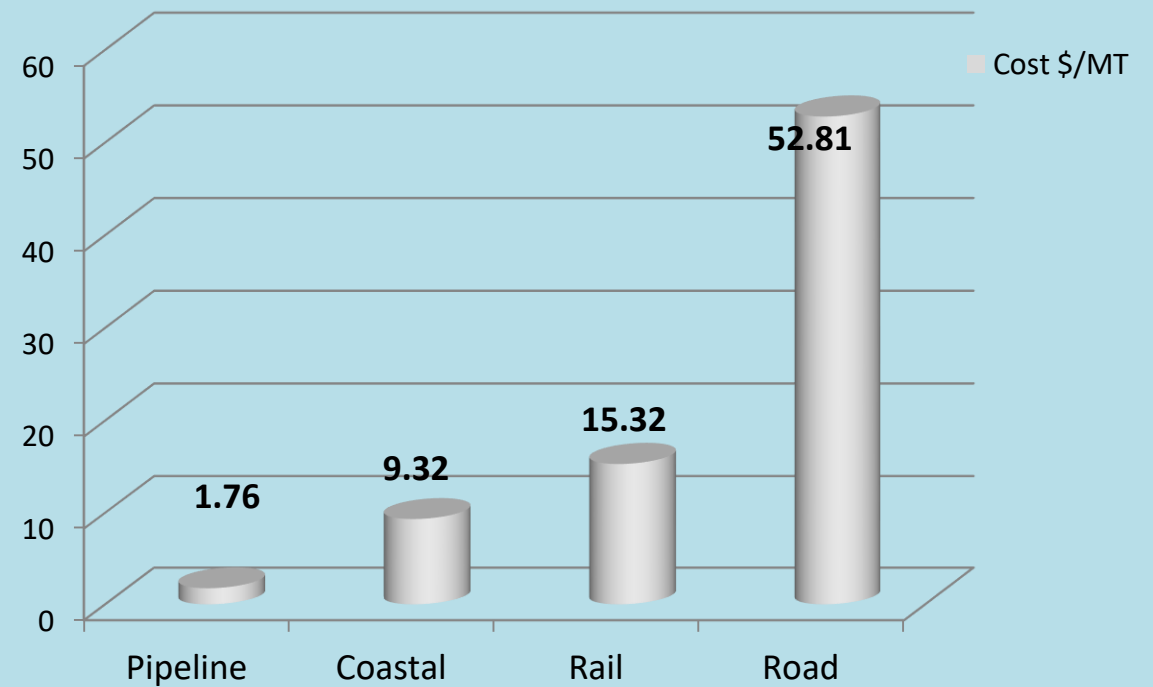
# Modes of transport

Modes of primary transportation – Pipelines, Coastal, Rail and Road

**POL products transported by various modes**  
(Quantity in TMT, percentage)



**Average cost of transport of POL Products by various modes**





# Audit checks in Storage and transportation

- Fixed roof tanks (for heavy products) Vs. Floating roof tanks (for light products to minimize evaporation loss)
- Calibrated meters at both the ends (Dispatch and receipts).
- Contract should have a clause as to which meter to depend.
- Water content and other external elements to be sampled at both ends.
- Pipelines to be maintained and pigged frequently.
- Pilferage and spillage to be monitored.
- Safety measures to be adopted.
- Ensure to have a plan for zero dry outs.
- Ensure product coverage of 45 days (plus Crude coverage of 45 days) to be eligible for Energy Security.
- Reconcile unconnected Tank Wagons with Railways frequently.
- Downgrading of ATF to SKO to be monitored and reasons analyzed.

# Further Audit checks in Pricing

- Existence of a sound and transparent pricing policy (Pricing based on Import Parity Price in India).
- Increased cost of production reduces margin (RGM and MM) as ceiling is fixed for selling price.
- Discount to bulk customers to be based on demand-Supply balance and unbiased.
- Pricing to be approved by the competent authority.
- Royalty and Cess to be assessed and paid correctly and timely.
- Recovery of dues to be monitored.
- Credit policy to be reviewed.

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- ☐ Illegal mining (56)
- ☐ Best practices (57)

# Value Chain

# Solid Minerals

# TYPES OF MINERALS

## MINERALS

### METALLIC

### NON-METALLIC

### ENERGY MINERALS

#### FERROUS

Iron ore, maganese, nickel, cobalt etc.

#### NON-FERROUS

Copper, Lead, tin, bauxite etc.

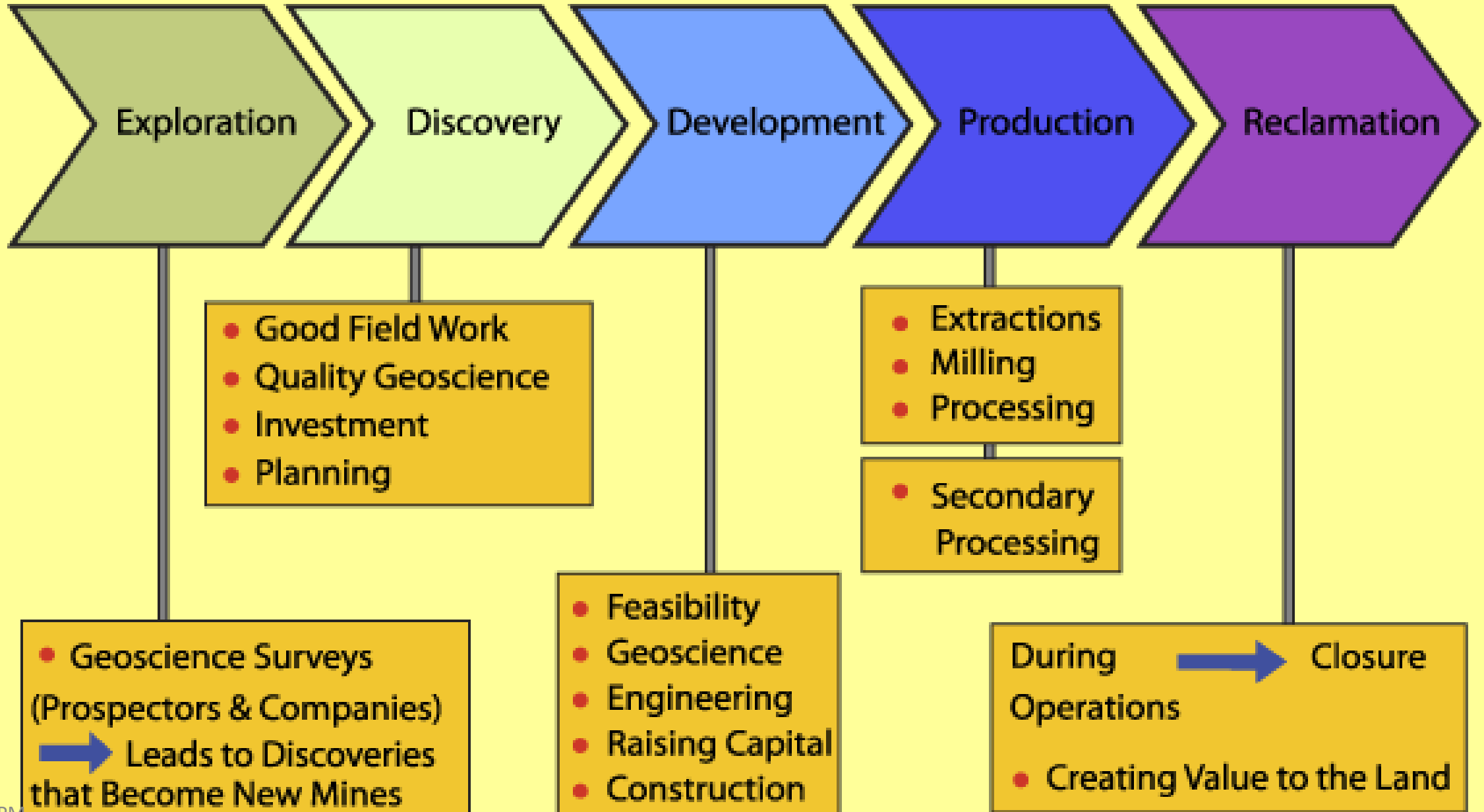
#### PRECIOUS

Gold, silver, platinum etc.

Mica, salt, potash sulphur, granite, limestone, marble, sandstone etc.

Coal, petroleum, natural gas





# Live Mine





# Live Mine





# Legal Framework on Mineral Mining in India

- **Mines & Minerals (Development & Regulation) Act, 1957 (MMDR Act 1957 amended in 2015, 2020 and 2021)**
- 10 Rules governing various activities
- National Mineral Policy
- Under MMDR Amendment Act **2015, E-Auction was made mandatory** for the grant of mineral concession to ensure transparent method of allotments of mineral wealth.
- Other salient features of the amendment were removal of requirement for various approvals under **Ease of Doing Business**, Creation of District Mineral Foundation Trust for the welfare of mining affected areas by using contributions from the mining companies, **stringent penal provisions to deter illegal mining** activities like provision for higher penalties and imprisonment up to 5 years. Constitution of special courts by the State Governments for fast-track trial of cases of illegal mining.

# Steps in E Auction - Coal

Intrinsic value of coal is established before bidding and Reserve Price is fixed

Nodal Agency appointed (Metal Scrap Trading Corporation Limited) (MSTC)

Bidding in Stage-I and Stage-II

Stage-I – Physical submission in Two bids. Technical and Financial envelops

Technical bid evaluated first to shortlist based on Tech criteria

If qualified in Technical bid, Financial bid envelop is opened.

Bids lined up in descending order – Highest bid first and so on.

From the above, first 50 per cent or 5 bids, whichever is higher, is made qualified for Stage-II

Stage-II (e-auction)

Max value in financial bid is reserve price

E- auctioneers to bid in multiples of Rs 2 at each stage above the displayed price



# E Auction – Coal ...contd...

- Preferred bidder is **sent to Ministry** of Coal for approval as successful bidder.
- Execution of the **Coal Mine Development and Production Agreement (CMDPA)** by Nodal Agency with the successful bidder
- Issue of **vesting Order after payment of dues by the successful bidder** (for the value of land and mine infrastructure, cost of preparation of geological report, cost of obtaining all statutory licenses, permits, permissions, approvals, clearances or consents relevant to the mining operations, transaction expense (collectively the ‘fixed amount’), **performance security and the first installment of upfront amount**)
- **Issue of Mining Lease.**
- **In 2020, the bidding system for fully/partially explored blocks was changed on Revenue sharing model** with 4 per cent as the basis point with 0.5 percent as incremental bid till the percentage reaches 10. Beyond 10 per cent, the incremental bid tranche is 0.25 per cent.

# Prospecting and Mining Leases

- Prospecting Licence not beyond 25 sqkm.
- Prospecting period 3 years plus extension of another two years
- Reconnaissance licence not beyond 10 thousand sqkm.
- Mining Lease to be Min. of 20 years and Max. of 30 years at the first instance. Renewal could be for further 20 years.
- Royalty/Dead Rent (minimum guaranteed royalty) to be paid as per scheduled rate.

# Role of Audit in bidding and post bidding

## To ensure that:

- The bidding process is fair and transparent.
- Interest of the Government is well taken care.
- Production figures are not under reported. (May impact Govt. revenue and Royalty).
- Pricing of products is based on the Grade and Formulae. (May impact Revenue Sharing).
- Royalty is paid to Government at correct rate on timely basis.
- Mine closure plan is in place and there are funds earmarked for the same. (Normally, capitalisation should include this cost too, so that closure cost is recognised in the initial stage itself).
- Quantum of Depreciation to have a direct bearing on the reserve.
- CSR initiatives and sufficiency of Funds.
- No collateral damage to the Environment- Sustainable Development Policy in place.
- HSE Policy is in place and are implemented strictly.

# <https://cag.gov.in/enExtracts from SAI India's Report on Allocation of Coal Blocks and Augmentation of Coal Production 2012 /audit-report/details/1837>

- As against the recommended 1.5 million drilling meterage per annum, the capacity achieved was only 0.34 million meters.
- Underachievement of production targets.
- New Coal Distribution Policy 2007 envisaged priority supply to small and medium consumers. But, no monitoring mechanism put in place to ensure implementation of policy.
- New captive coal blocks to be allotted with a reasonable distance. However, some of the blocks allotted were very near, which resulted in a large reserve of (48 million tonne) Government blocks inaccessible with further consequence of reducing the life of the mine from 24 to 20 years.



# SAI India's Report... contd...

- Production from underground mines stagnated at 43 million tonnes between 2006 and 2010, which came down further to 40 million tonne in 2011 (9.28 per cent decrease).
- Recorded minutes of meeting of Screening Committee to show how the blocks were allotted were not available, which indicated lack of transparency.
- Windfall gain by captive allottees were observed and bidding was recommended for such allottees also in 2004. Till 2012, the modalities were not finalised.
- Mean time, 142 blocks were allotted in conventional method till notification of the amendment to MMDR Act on 2 February 2012.
- The delay caused an estimated undue gain to the private allottees to the extent of Rs 1860 billion (\$ 25 billion approx.)
- 83 captive mining blocks were to produce 73 million tonnes by 2011. However, only 28 had commenced production to the extent of only 34.64 million tonnes.

## SAI India's Report... contd...

- Abnormal delays in obtaining Mining Lease, surface rights, land acquisition, rehabilitation and resettlement, obtaining Forest clearance etc. caused delayed production by captive mines.
- Coal Controller's Organisation, which is authorised to enter any mine and inspect, failed to conduct any physical inspection, rendering whole dependency on the data furnished by the allottees.
- Monitoring Committee (MC) met only in a quarter, instead of monthly, indicating lack of monitoring.
- MC adopted (2005) Bank Guarantee to safeguard Govt.'s interest against delayed production. However, it could not encash the BG submitted by 15 out of 24 allottees till 2011 due to the modalities of encashment not been decided. As of November 2011, The expired BG stood at Rs 31.18 million.

# Illegal Mining

- Very rampant and not generally accounted for.
- An occupation limited to the source.
- Very ill organised and unscientific.
- Does not take Environmental issues seriously.
- No sustainable development concept- Asset damage.
- No taxes and levies to Government.
- Lots of social issues (Child labour, safety, security, gender, human rights abuse, Groups and clashes, illiteracy, exploitation, slavery and bonded labour).

# Best practices

- Better regulation.
- Community involvement.
- Restoration provisioning at the beginning.
- CSR compliance.
- Environmental and social cost accountability.
- Recycling of water to the extent possible.
- Effluent discharge after treating.
- Site restoration to its original state.



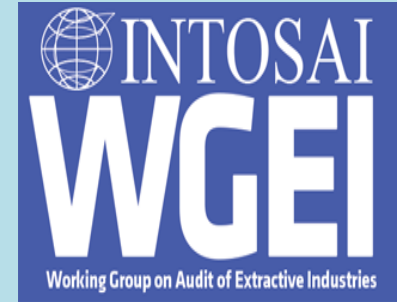
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**From SAI - India**







# Special Audit on Hydrocarbon Production Sharing Contracts



- Audit of JVs including private parties.
- Special mandate obtained from the Government with lots of resistance from the parties involved.
- Main issues observed:
  - **Non-relinquishment of area** as per PSC and declaration of the entire area as “Discovery” Area. (7645 Sqkm. in Deep Water area)
  - Operators **declared discovery without intimating the Management Committee**, in violation of the PSC provisions.
  - **Capex Cost for Initial Development Plan (IDP)** was estimated to be US\$2.4 billion in 2004. This was revised to US\$ 8.8 billion in 2006. Procurements commenced for the revised Capex even before submitting the proposal/obtaining approval made the authority to approve the same, defeating the very purpose of approval.
  - **One single tender case involving US\$ 1.1 billion for 10 years** contract was observed.
  - **Pre-qualified bidders were rejected during Technical Evaluation** of bids for High Value Contracts, leading to single bids being considered.
  - **No Audit Assurance could be derived on Capex Gold-Plating** in the absence of proper tendering mechanism and non-cooperation by the parties involved.
  - **13 discoveries declared during appraisal/development of the area which was already declared as delineated area with an intention to get extension in exploration period.**
  - **Non completion of work commitment** leading to the areas undeveloped.
  - **Well head gas pricing issues** leading to loss to the Government.
  - **Deficiencies in functioning of the Managing Committees, leading to loss of credentials.**

## Different Schemes of Licensing focusing HELP (New Policy)

- **India is the 3<sup>rd</sup> largest consumer of crude oil and petroleum products.** India's oil import bill is subject to global prices swings as the country is dependent on imports for around 80% of its crude demand.
- The new policy promises simpler rules, tax breaks, pricing and marketing freedom and is part of a government strategy to **double oil and gas output by 2022-23.**
- **What are the Drawbacks of the New Exploration Licensing Policy (NELP)?**
- There are **separate policies for oil and gas, coal-bed methane and shale oil and gas.**
- **Multiple policies caused inefficiencies** in exploiting natural resources. For example, while exploring for one type of hydrocarbon, if a different one is found, it will need separate licensing, adding to cost.
- The issue of the **pricing of gas witnessed considerable litigation.** Earlier there was possibility of gold plating the investment and cheating the government by '**manipulating profit**'.
- **What are the Functions of HELP?**
- **Uniform Licensing:**
  - HELP was approved by government in March 2016 replacing New Exploration Licensing Policy (NELP).
  - HELP provides for a uniform licensing system that will cover all hydrocarbons such as [oil](#), [gas](#), and coal bed methane.
  - Under NELP separate licenses were issued for exploring different type of hydrocarbons. This leads to additional costs, as **a separate license is required if a different type of hydrocarbon is found** while exploring a certain type.

## Revenue Sharing Model:

- HELP provides for revenue sharing model, the government will receive a share of the gross revenue from the sale of oil and gas, etc. and will not be concerned with the cost incurred.
- The NELP was profit sharing model, where profits are shared between the government and the contractor after recovery of cost. It became necessary for the Government to scrutinize cost details of private participants and this led to many delays and disputes.

## Pricing:

- HELP has **marketing and pricing freedom**. Before HELP, contracts were based on production sharing with possibility of gold plating (incorporation of costly and unnecessary features) the investment and causing loss to government by ‘manipulating profit’. To reduce the complexity of handling contracts, it was changed to revenue sharing.
- Under the new system, a **graded system of royalty** rates will be introduced. Under this system the **royalty rates will decrease from shallow water to deep water to ultra-deep water areas**.
- While fixing royalties, the present system does not distinguish between shallow water fields (where cost of exploration and risks are lower) and deep water fields (where cost and risks are higher).

- Under HELP, oil companies **can select blocks of their choice** under this **Open Area Licensing (OAL)** regime. Earlier it was the government that selected the blocks where oil exploration can be carried out. It will enable a faster coverage of the available geographical area.
- Under NELP exploration of hydrocarbons was limited only to the blocks which have been put on tender by the government.
- **National Data Repository**
- National Data Repository (NDR) is an integrated data repository of Exploration & Production data of the Indian sedimentary basins.
- NDR will provide an important data resource In line with the [Digital India initiative](#).
- A bidder (an Indian or a foreign company) after studying the data through NDR can propose an **Expression of Interest (EOI)**, throughout the calendar year in two windows without waiting for announcement of bids.
- **What are the Advantages?**
- HELP provides for **marketing freedom** for [crude oil](#) and natural gas produced from these blocks. This is in tune with the Government's policy of ["Minimum Government –Maximum Governance"](#).
- Under the earlier profit-sharing methodology (NELP), it became necessary for the Government to scrutinize cost details of private participants, and this led to many delays and disputes. HELP is in tune with the Government's efforts to promote ['Ease of Doing Business'](#).
- The policy is also **aimed at enhancing transparency and reducing administrative discretion**.
- HELP marks the biggest transition from an era of government control to government support for upstream E&P in India. [Open Acreage Licensing Programme \(OLAP\)](#) removes restrictions on exploration by giving companies both the data and the discretion to explore areas of their choice.