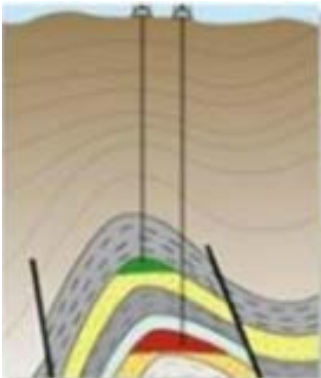


Oil & Gas Industry: Trends, Technology and Career

By

Dr. David Agiddi

5th April 2016



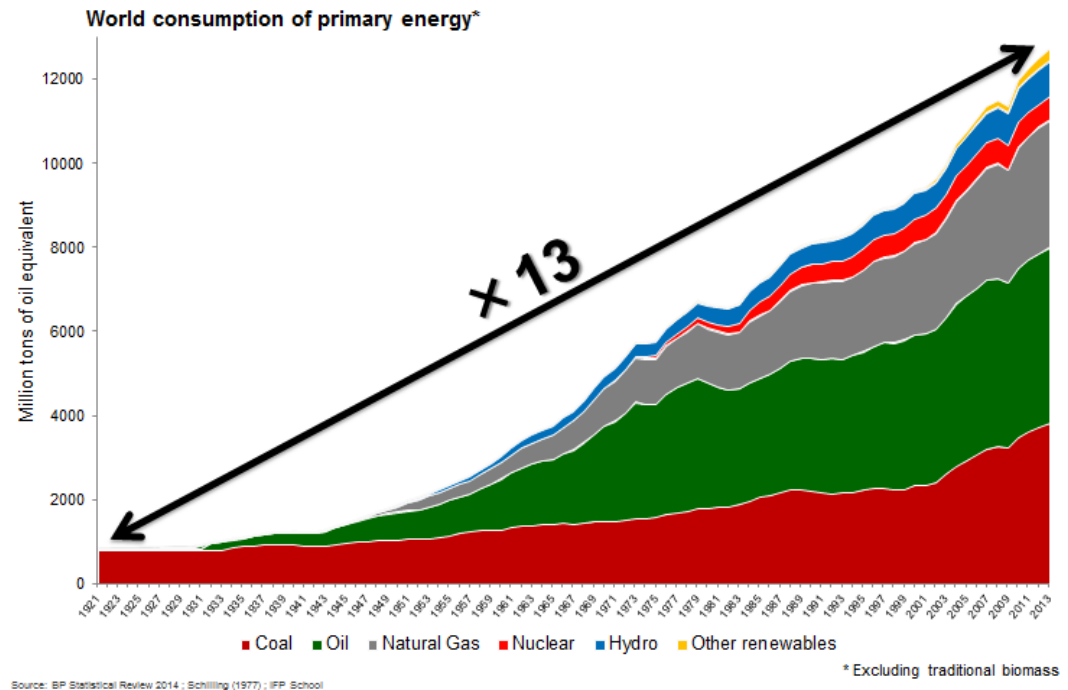
Outline

- Global Energy Consumption & Growth
- Energy Mix and Trend
- The E&P Chain & Challenges – From Exploration Drilling to Field Development
- Technology and Trend that impacts E&P
- Oil Field Career



Global Energy Consumption & Growth

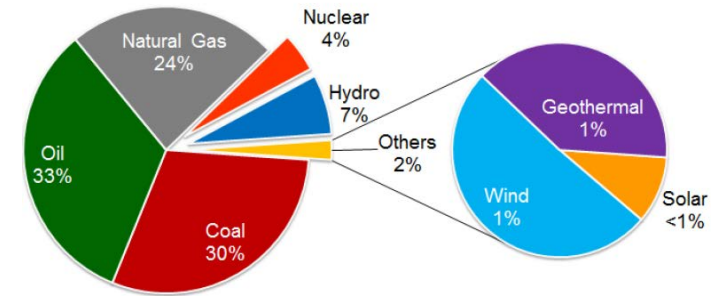
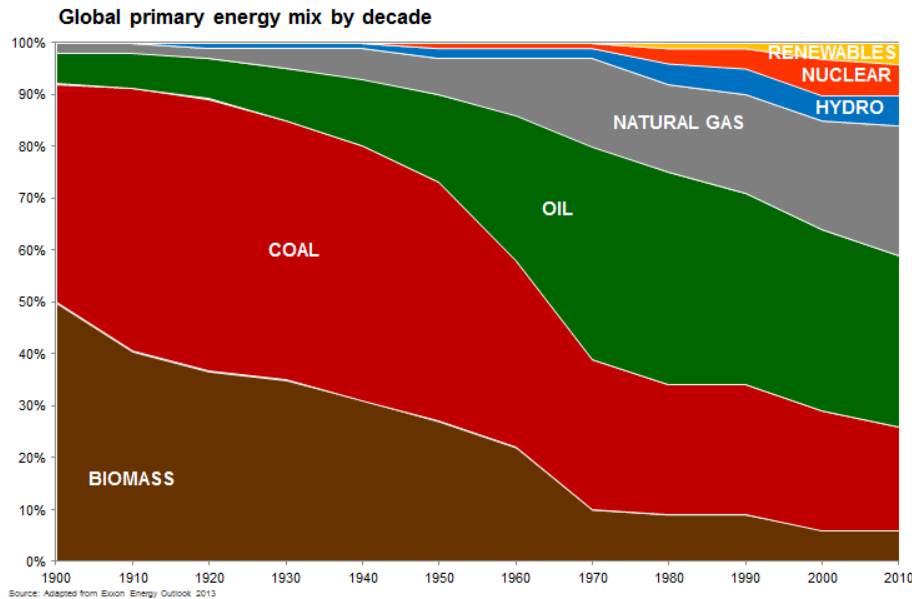
- Global oil and gas industry is a primary source of energy
- Global population was 1.6 billion in **1900**, 2.5 billion by **1950** and > 7 billion today
- **GDP** multiplied by **40** over the period
- **Energy consumption** impacts growth and has increased by **13** over the period.



- World energy mix is a trade-off between multiple sources: Coal, Fossil, Hydro, Nuclear and renewables e.g. wind, geothermal, and Solar etc.

Human development is closely linked to energy consumption or revolution.

Global Energy Mix



- Fossil resources is an economic and efficient energy sources. Oil can be transported by such means as barges, oil pipelines, trains or trucks as adequate. Natural gas may require compression to boost its entry pressure. LNG makes transportation of gas more flexible.
- Energy is required for heating, about half of global demand, transportation – about 1/3 of global demand, and about 15% demand is for electricity.

Oil and natural gas energies are dominant in the global energy mix today

The Energy Trend

- Over 50 years of fossil resources to meet demand based on current consumption and proven oil resources
- North America's unconventional resources (aka. shale oil plays) is a game changer
- Venezuela and Canada lead in heavy oil resources with proven oil reserves that rank 1st and 3rd globally.
- Middle East holds about half of the world 's proven oil reserves and 43% of the global natural gas reserves
- Sub-Saharan Africa remains prolific in the deep waters with almost 30% of the global oil & gas discoveries during the last 5 years,
- Recent hydrocarbon discoveries have been made in frontier basins, East and Southern Africa and Brazil with discovery of ultra-deep offshore pre-salt reservoirs,
- Production not reserves drives world economy (US with 2.6% of the world's reserves)
As the oil price goes up, more resources become profitable to extract from the ground and are added to the global proven reserves.



The E&P Chain

- The global oil and gas industry comprises of three major sectors: upstream, midstream and downstream.
- Upstream: the exploration & production of natural resources,
- Midstream: the treatment, transportation and distribution of energy molecules
- Downstream: the transformation of extracted natural resources into petroleum products and their distribution to the final consumers.



Upstream

Midstream

Downstream

- The upstream has two main actors: the Operating and Service companies
- Major operators are EXXON MOBIL, SHELL, CHEVRON, TOTAL, ENI and BP
- Major Service vendors are Schlumberger, Halliburton, Weatherford. Transocean, Saipem and Baker Hughes etc.

Challenges in the Upstream Oil Industry

- Significant increase of E&P investment made in the last decade
- High focus on quality, safety and processes to improve efficiencies, optimization & delivery
- Consequently E&P cost had risen by over 60% in last 5 years
- Companies adopt technology based on how they are structured to take advantage of challenges in the ever-changing competitive environment



COST OPTIMIZATION



EQUIPMENT & PROCESSES
STANDARDIZATION



The goal of E&P companies is to maximize the oil rent, which is the difference between crude oil price and the exploitation cost

Exploration Challenges

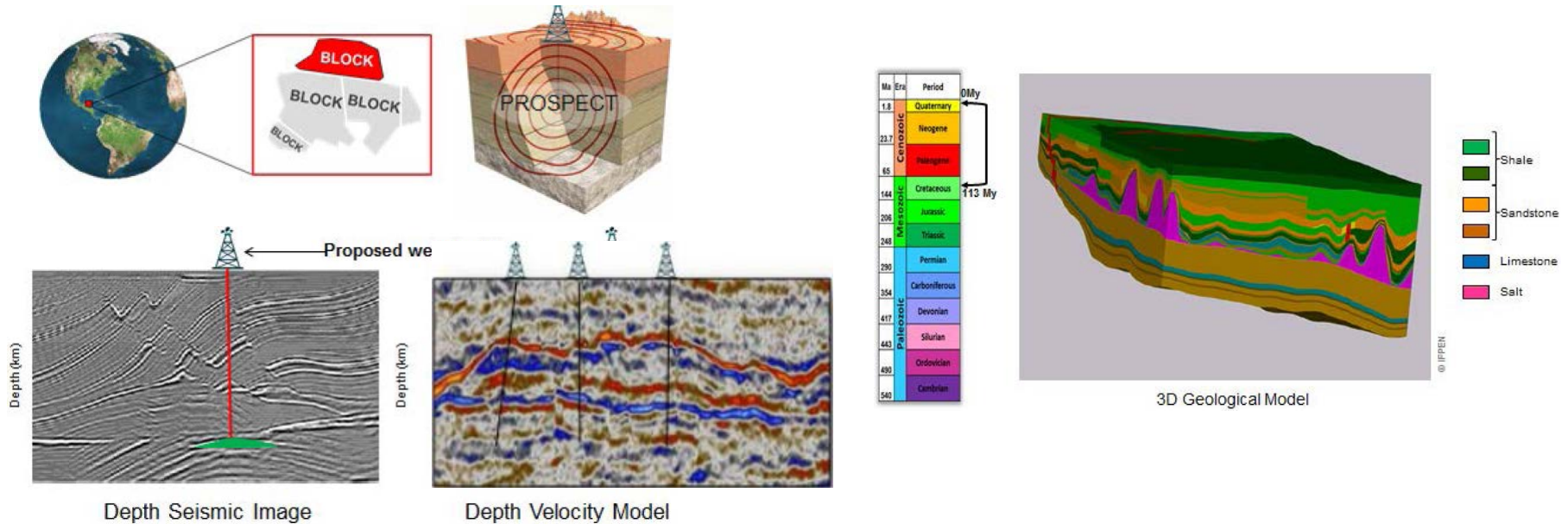
- Geologists are looking for a petroleum system that includes all the parameters required for hydrocarbon accumulations to exist
- These are a source rock (such as thin sediments or shales), a reservoir rock (such as carbonates or sandstones) and a seal rock (such as salt or shales) and are characterized by dynamic processes due to fluid movement.
- Gulf of Mexico and the Atlantic margins like Offshore Brazil and West Africa are the most prolific deep offshore areas (1 – 3 km water depth) .
- Frontier basins such as the Arctic and ultra deep water are recent areas for exploration and require innovative techniques because of the difficulties of accessibility and climatic conditions. Deep water has high drilling risks and associated costs

Regional Evaluation



Probability of success - 60% (mature basins), about 10% (Frontier basins) between 20 – 30% (Existing deep offshore margins)

Seismic Imaging

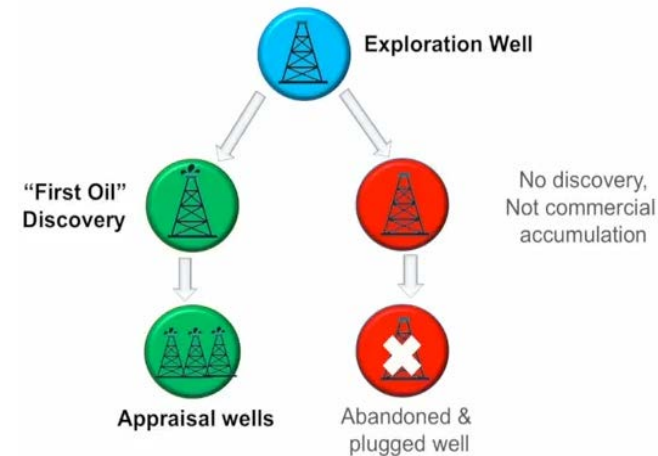
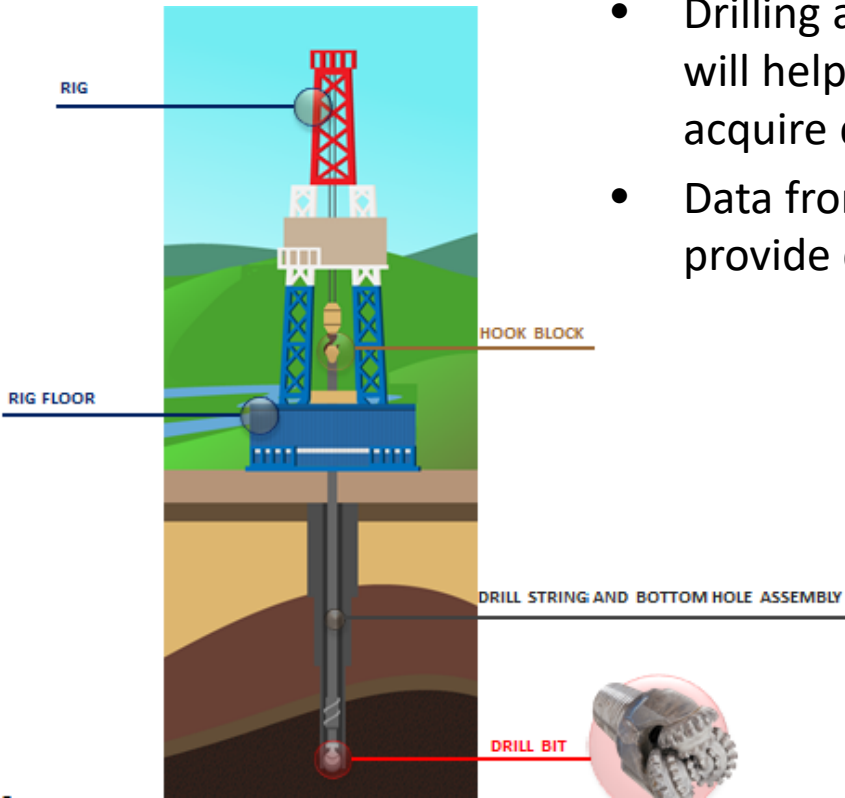


- Potential reservoirs are called prospect until properly and more accurately investigated and checked by the geologist for the presence of hydrocarbons using seismic imaging and well drilling.
- Geophysicist perform seismic acquisition, processing and interpretation workflow to enhance the petroleum exploration studies.

The goal of seismic exploration are to obtain an image of the subsurface, locate the prospects and propose well locations based on a geologic model.

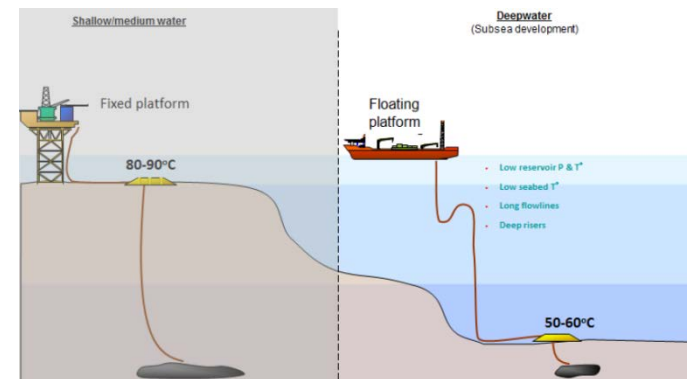
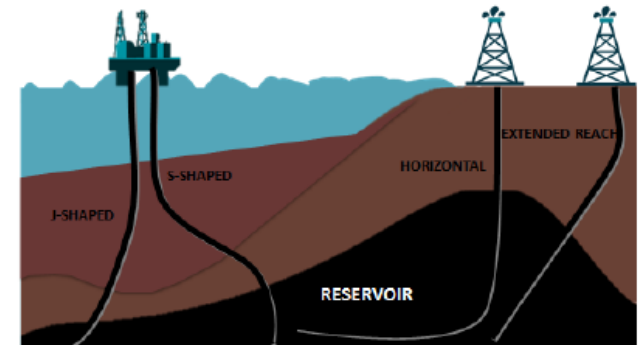
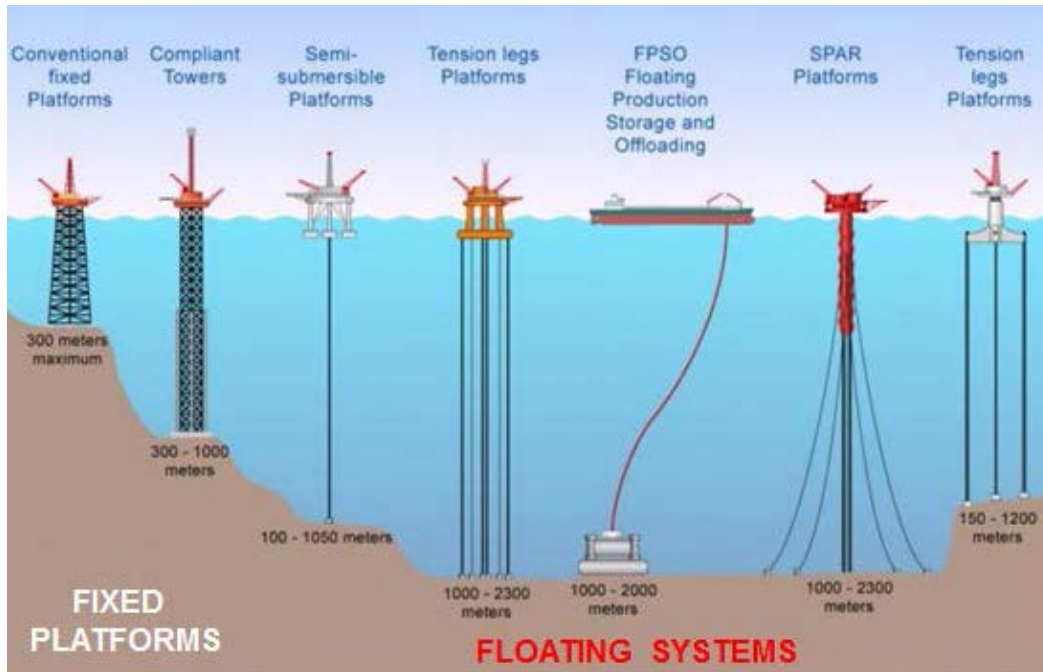
Well Drilling

- Drilling an exploration well to reach the potential reservoir will help ascertain that hydrocarbons are present and acquire data, valuable in underexplored basins.
- Data from well logs, cores, cuttings, samples and pressures provide details about fluid and reservoir rock properties



Exploration well could be a success, if hydrocarbon reservoir is discovered that can be exploited commercially. Several appraisal wells may be required to acquire further data

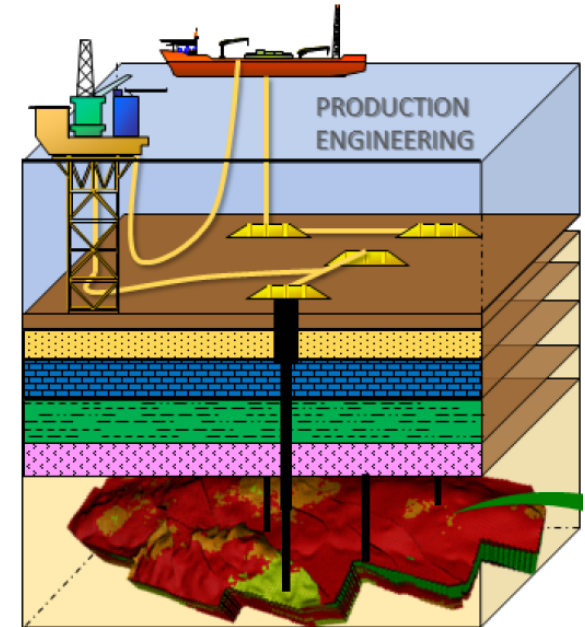
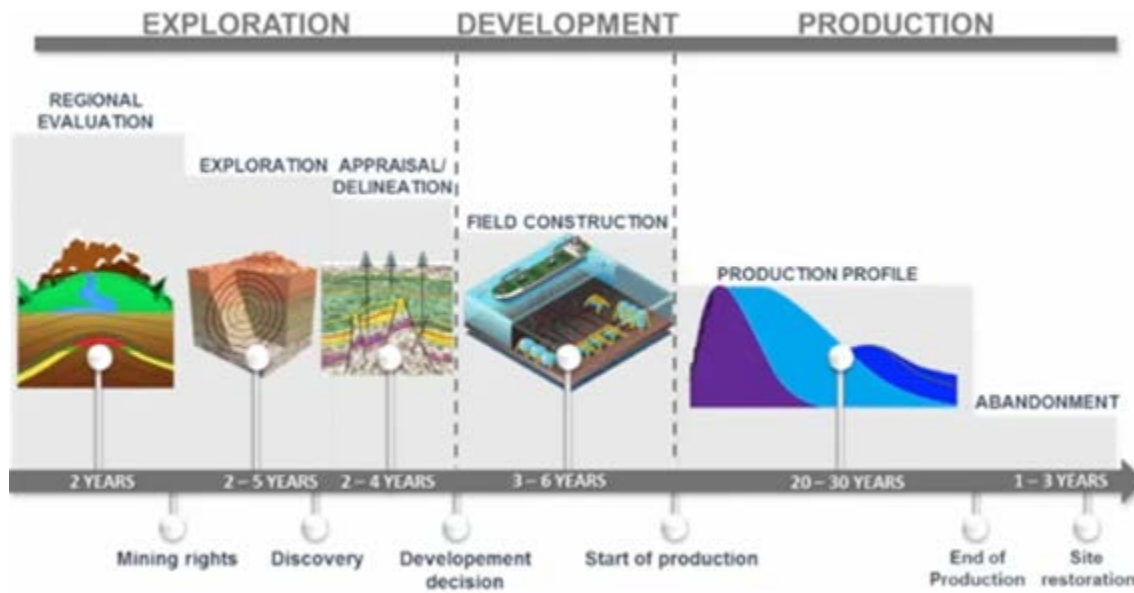
Field Developments



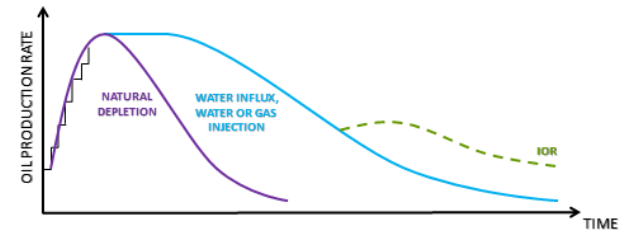
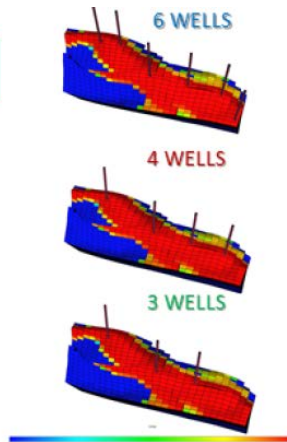
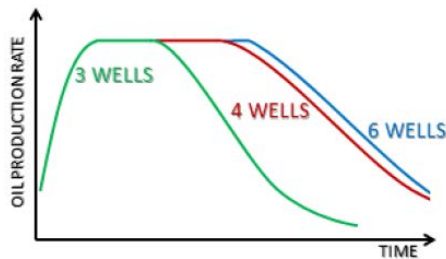
- How will the wells be drilled, vertical or horizontal?
- Will the wells be subsea or surface wells? What will be the wells' trajectories?
- Fixed or floating platforms? And how many of them will be needed for the development of the field? Manning levels ?
- How many development phases will be needed? Will the production be stored and exported?
- What is the reservoir depletion strategy? Is pressure maintenance or lift required? How ?

Field architecture is critical to economically and safely developing an oilfield

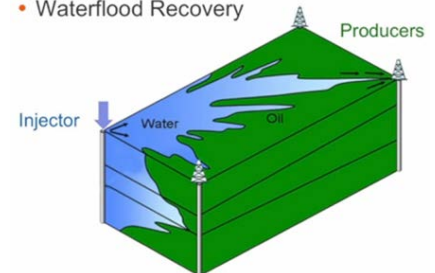
Life Cycle of an Oilfield



$$\text{Number of wells} = \frac{\text{Field plateau rate}}{\text{Production rate per well}}$$



• Waterflood Recovery



Oilfield Technologies

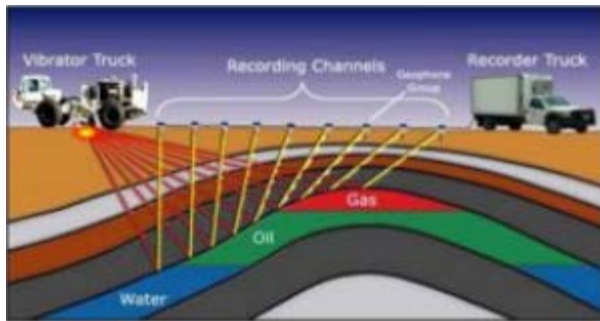
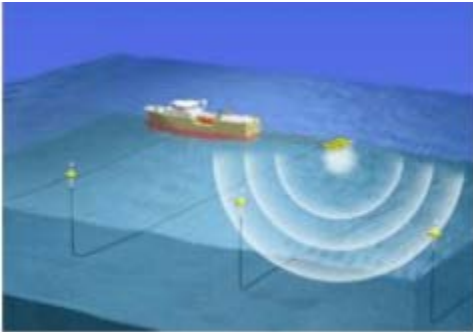
- The oilfield operation philosophy would impact the unit cost of exploration and exploitation
- Unit cost is the ratio of annual cost performance to the annual total production
- Reduction of the unit cost will increase profitability assuming a fixed price of oil and environmental risk
- Information Technology for data acquisition, analysis and data management such as used to integrate production data with supply chain.

Fit for purpose technology adoption will help reduce the unit cost of exploration and exploitation.

Some game changing technology

- Directional drilling
- Multistage hydraulic fracturing
- Seismic imaging 3D and 4D
- Fiber optic sensing
- LWD and MWD
- Rig and bits
- Drilling and completion fluids
- Expandable sand screens
- Subsea and FPSOs
- Digital oilfield
- Artificial Lift
- LNG and FLNG

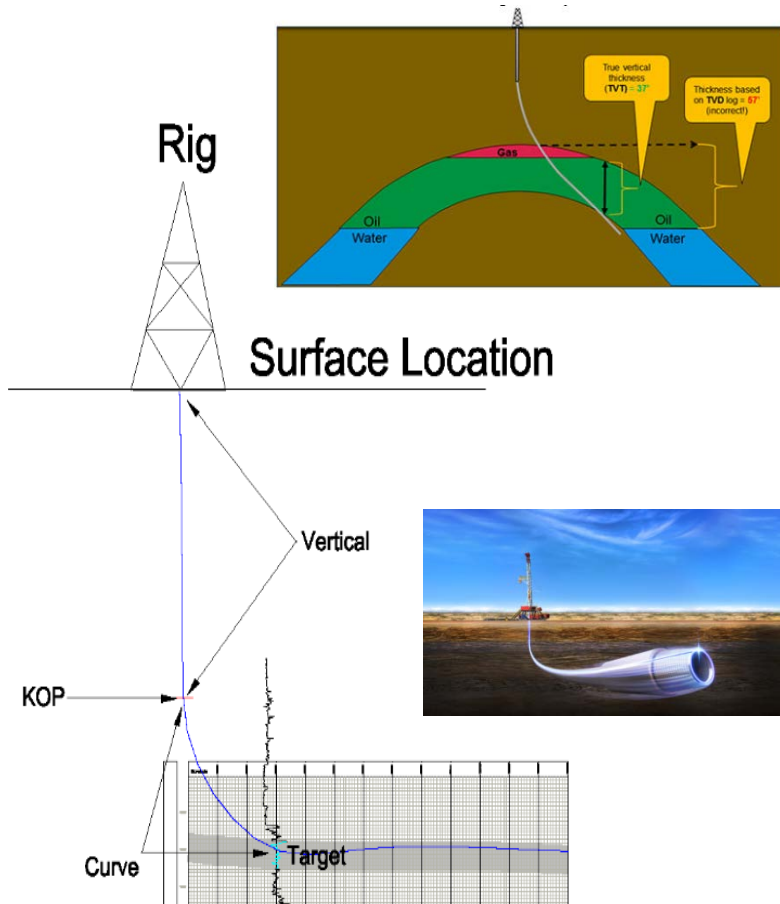
Offshore and Onshore Seismic, Drilling Rigs & Production Systems



Trend that impacts E&P

- Demand for energy and consequently energy prices is impacted by the political and world economic landscape, movement in US dollar as the dominant currency and the application of innovative technologies in the oil industry
- Technology – a key factor that has enabled the economical exploitation of shale oil and gas. U.S. is experiencing growth in hydrocarbon production – thanks to multi-stage hydraulic fracturing and horizontal drilling technologies - and today has begun exporting oil in commercial quantities.
- Renewables & Energy Efficiency - Technology advancement has led to the development of “game changers” like electric and solar powered devices / transportations (e.g. energy saving light bulbs and smart cars) that will in turn reduce future demand for hydrocarbon.

Geosteering the Well Construction



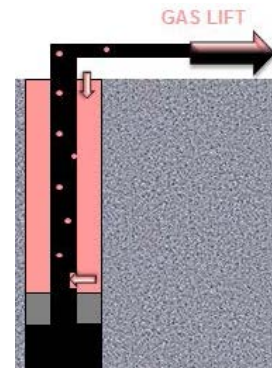
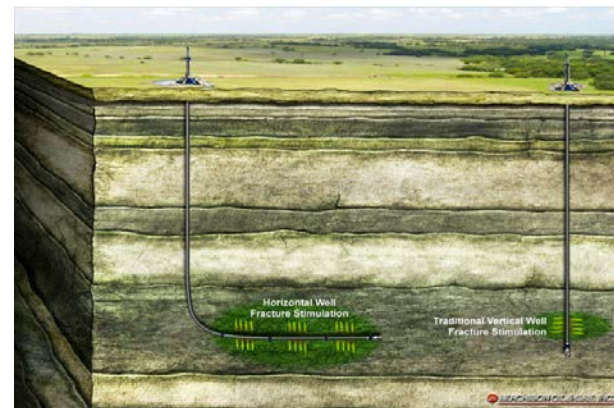
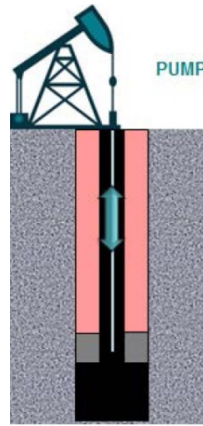
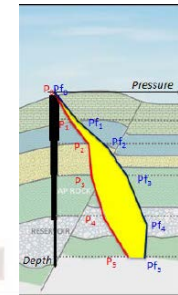
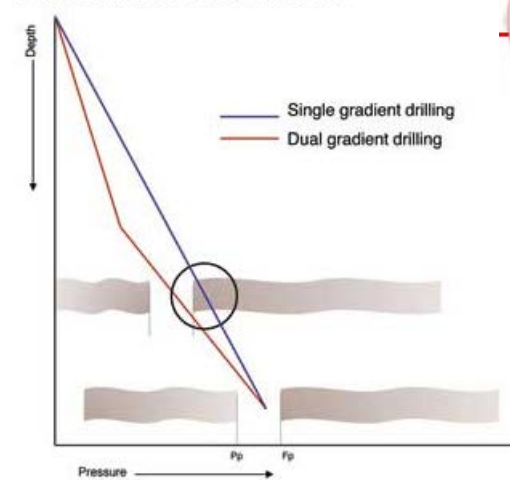
- Azimuthal gamma and resistivity, or regular LWD/MWD tools (basic gamma) are used in proactive geosteering.
- Without geosteering there is the risk that the drill bit exits the reservoir's productive zone. This leads to high angles, out of zone time, and more significantly, more oil/gas left in the ground.
- Proactive geosteering involves anticipating the bit exiting the zone and correcting course before any out-of-zone footage is logged.
- Requires an experienced geosteering geologist and a directional driller.

Geosteering enables the drilling to stay in the target reservoir leading to maximum hydrocarbon recovery.

Benefit of Technologies

- PDC cutter increased bit durability by revolving 360 resulting in reduced frequency of wellbore trips saving \$0.3 million, increased performance by 50% and led to 280% increase in production above the average.
- Dual gradient drilling technique led to savings of 11% in cost of a GOM well drilled to 22,500 ft in 2500 ft water depth and savings of 30% in a well drilled to 18,000 ft in 7000 ft water depth.
- Installed wellbore lifts and multi-stage hydraulic fracturing have led to increases in field production by several folds.

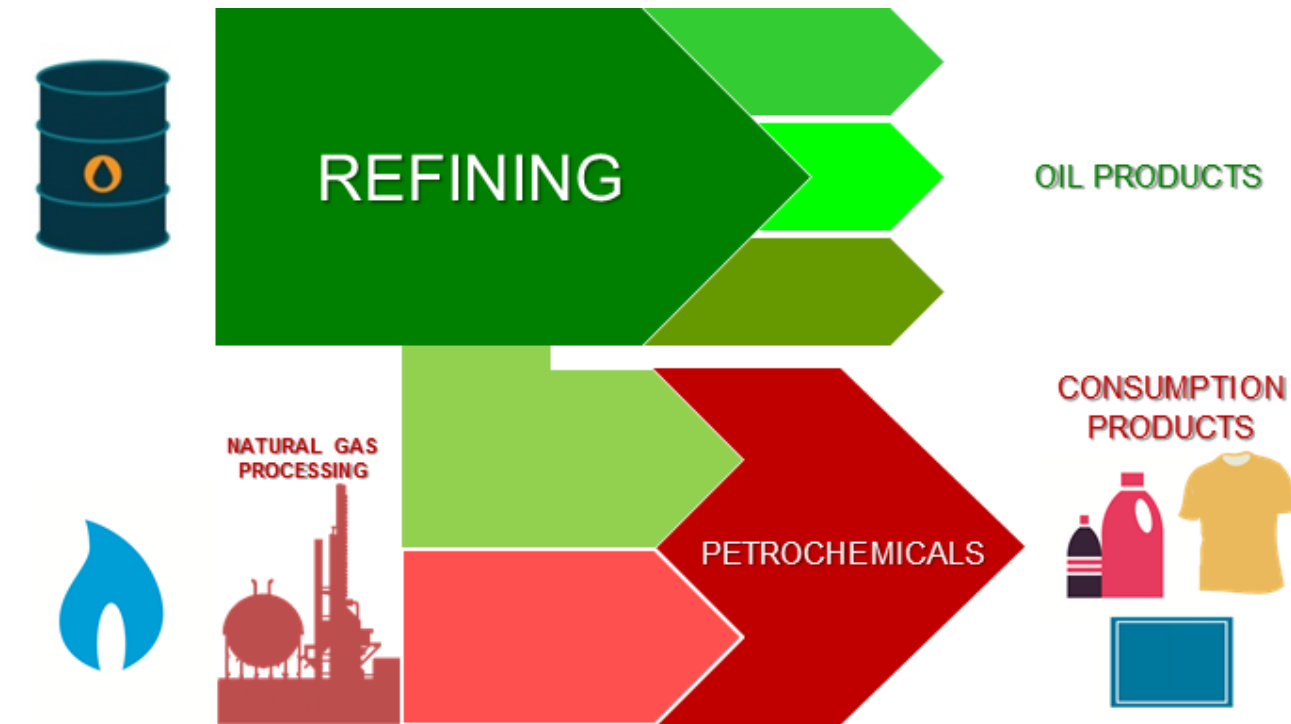
Dual Gradient Variation MPD



Technology adoption will help reduce the unit cost of exploration and exploitation.

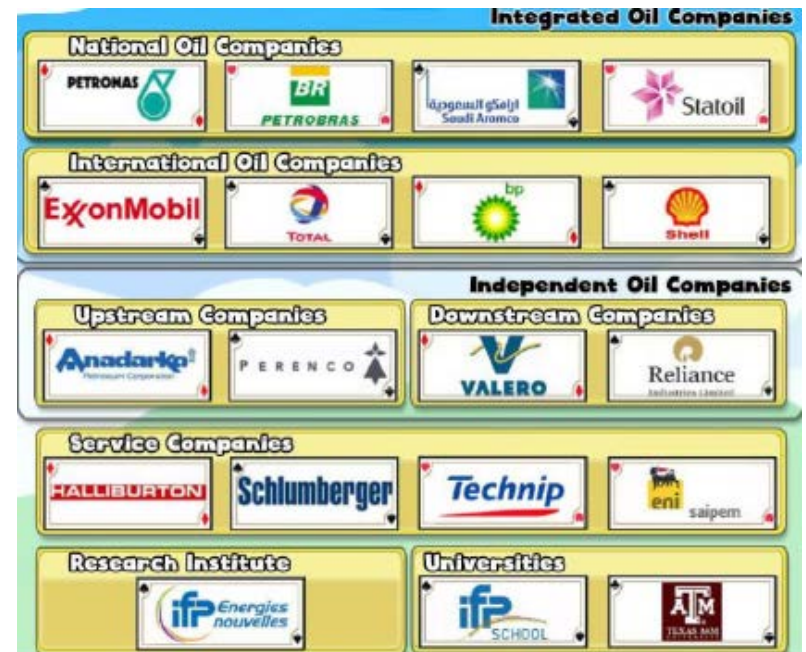
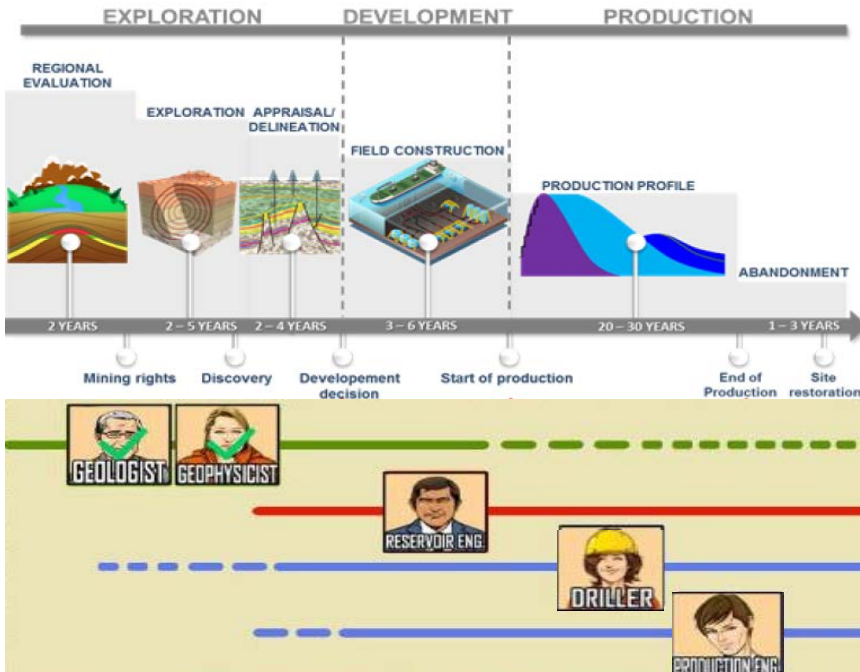
Challenges in the Downstream Oil Industry

Downstream is focused on margins which is the difference between the value of the outgoing product and the cost of the ingoing feedstock.



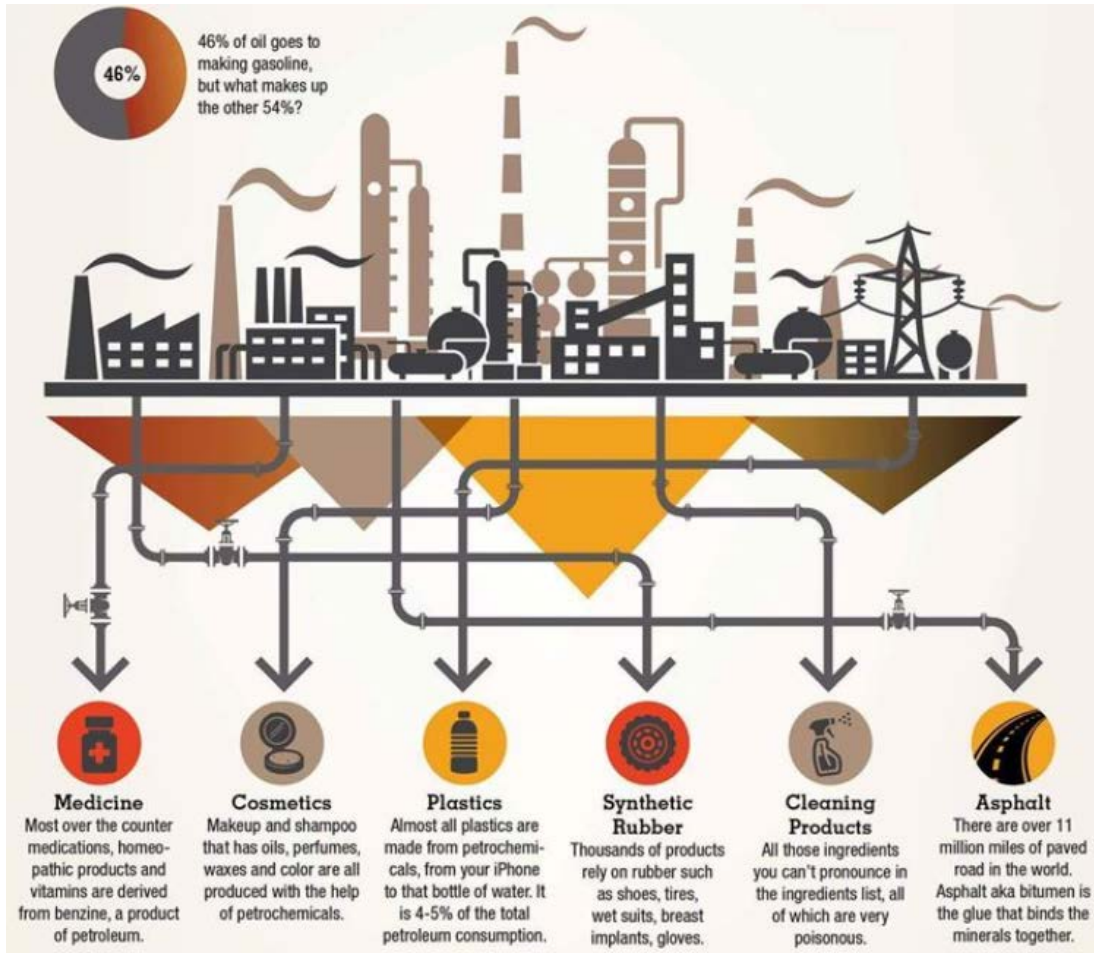
REFINING MARGINS	GROSS MARGIN = VALUE OF EX-REFINERY PRODUCTS – COST OF CRUDE OIL
	NET MARGIN = GROSS MARGIN – VARIABLE COSTS OF PRODUCTION

Oilfield Career



- Start with the right education – take courses in geology, formation evaluation , drilling etc.
- Enter a world of choices and challenges – go places, work in multidisciplinary teams, develop models, enjoy personal and financial rewards
- Develop talents – within a multinational corporation and independent operator or a service provider

Life Without Oil



A few other products made with Oil

Insecticides, Ink, Floor Wax, Pens, Upholstery, Clothing, Boats, Sports Car Bodies, Nail Polish, Fishing Lures, Bags, Perfumes, Cassettes, Dishwasher Parts, Tool Boxes, Shoe Polish, Helmets, Caulking, Petroleum Jelly, Tape, Washers, Antiseptics, Curtains, Food Preservatives, Basketballs, Soap, Antihistamines, Purses, Dashboards, Cortisone, Deodorant, Footballs, Putty, Dyes, Panty Hose, Refrigerant, Percolorators, Life Jackets, Rubbing Alcohol, Linings, Skis, TV Cabinets, Shag Rugs, Electrician's Tape, Tool Racks, Car Battery Cases, Epoxy, Paint, Mops, Stacks, Insect Repellent, Oil Filters, Umbrellas, Yarn, Fertilizers, Hair Coloring, Roofing, Toilet Seats, Fishing Rods, Lipstick, Denture Adhesive, Linoleum, Speakers, Plastic Wood, Electric Blankets, Glycerin, Tennis Rackets, Rubber Cement, Dice, Nylon Rope, Candles, Trash Bags, Paint, Water Pipes, Hand Lotion, Roller Skates, Surf Boards, Shampoo, Wheels, Paint Rollers, Shower Curtains, Guitar Strings, Luggage, Safety Glasses, Antifreeze, Airings, Elongation, PVC Pipes, Ice Chests, Corned Beef, DVD's, Brushes, Detergents, Vaporizers, Balloons, Sun Glasses, Tents, Heart Valves, Crayons, Parachutes, Telephones, Enamel, Pillows, Dishes, Cameras, Aesthetics, Artificial Turt, Artificial Limbs, Bandages, Dentures, Model Cars, Folding Doors, Hair Curlers, Cold Cream, Movie Film, Soft Contact Lenses, Drinking Cups, Fan Belts, Car Enamel, Shaving Cream, Ammonia, Refrigerators, Golf Balls, Toothpaste, and of course Solvents, Diesel Fuel, Motor Oil, Bearing Grease etc. etc. etc.

Maybe it isn't as simple as we thought?

Energy, Technology and Career in E&P -
 Dr. Sidd

**“The Stone Age did not end for lack of stone,
and the oil age will end long before the world
runs out of oil”**

Sheikh Ahmed Zaki Yamani, former Oil Minister of Saudi Arabia

Thank you for your attention

Acknowledgements

- IFP school – MOOC 2015
- BP Statistical Review