RESERVES AND RECOVERY OF HYDROCARBONS

RESOURCES AND RESERVES

- **A natural resource** is any natural material that is useful and valuable.
- **A reserve** is the amount of a resource that can be extracted at a profit using existing technology.

Reserves can be:

A. **Proven:** there is certainty on their existence.
B. **Probable:** there is only some certainty that the reserve is there.
C. **Possible:** reserves which may become economic in the future provided conditions are favourable.

Oil and natural gas reserves can go up if:
Exploration discovers more.
Technology improves so that more can be extracted from existing reserves, deeper water or from unconventional sources.
Smaller oilfields become economic when prices rise.
Oil and natural gas reserves can go down if:
They are being extracted from the earth (depleted)
Calculations or reserves were incorrect
Smaller oilfields become uneconomic when oil prices fall.

Reserve calculations are made on the basis of **incomplete geological data, volatile market prices** and must be correct if oil companies are to **make a profit and meet demands**. **Complex mathematical models** are required for reserve estimates. While it is possible for mistakes to be made, companies can **deliberately overestimate** reserved to boost their **share price**.

Reserves are calculated **following exploration.**

PRIMARY RECOVERY

- **Primary recovery** is where oil initially gushes to the surface under natural pressure and is then pumped out.
- **Blowout:** when oil gushes uncontrolled to the surface

In order to begin extraction, the **reservoir rock is drilled into** and a **production well is established**. The well required to be **quickly capped off** to prevent **blowouts and oil spills.** Directional drilling is used so that a number of wells form one wellhead can tap into the reservoir rock over a large area.

In the case of Wytch Farm, Dorset, the reach wells go 10.7km horizontally over the wellhead.

Initially oil will rise to the surface under natural pressure because:

A. **Gases come out of solution**
B. **Expansion of the gas above**
C. The **hydrostatic pressure** of the water in the **pore space beneath** the oil.

Once the **natural pressure has ceased**, the oil must be pumped up to the surface using s**ubmersible pumps or beam pumps** called '**nodding donkeys'**. Typically only **20%-30%** of oil can be recovered **using primary recovery**.

EASE OF EXTRACTION

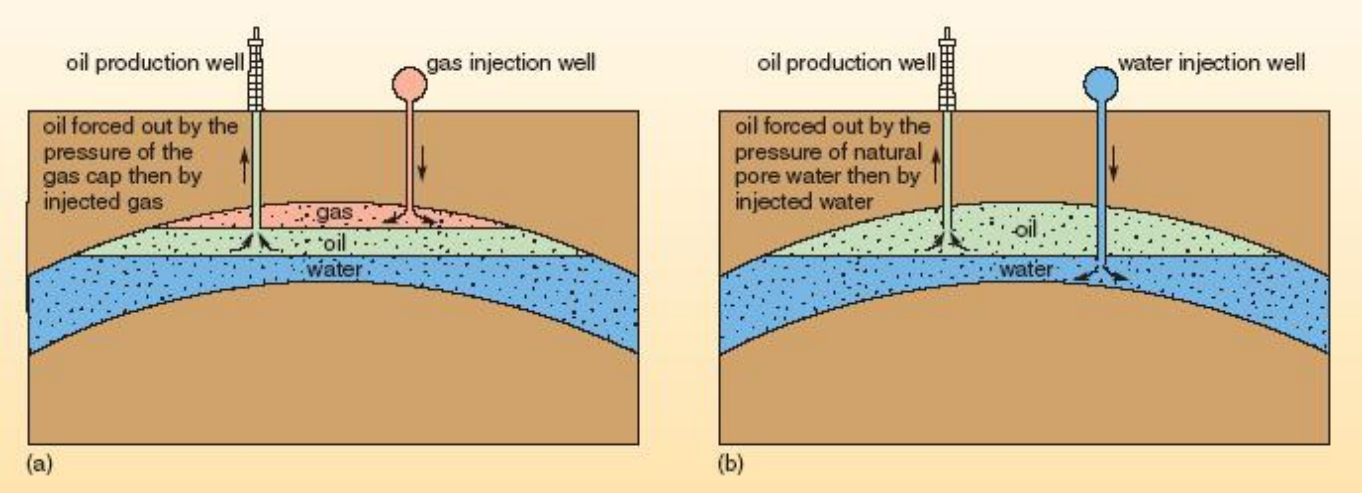
The reservoir rocks will determine the percentage of oil that can be recovered. **Porosity and permeability** play vital roles, determined by **grain size, roundness and sorting**. the amount of **matrix or cement** will also be factors, as will the presence of structures like **joints and faults**. the amount of **diagenesis and compaction** (so **depth**) will affect the **pore space** too. Oil is **highly viscous** with a **large surface tension** so **sticks to grains** but at higher temperatures, deeper in the Earth's crust, oil **becomes less viscous** but **porosity decreases** due to the overburden **weight causing compaction**.

SECONDARY RECOVERY

- **Secondary recovery** is where water is injected below, or natural gas is injected above, the oil to maintain the pressure.

Such techniques are used to further increase the yield of oil from a reservoir rock.

- **Water flood drive** – Water is **injected beneath** the oil to maintain a **high hydrostatic pressure** so oil continues to rise or at least assist with the ease of pumping.
- **Gas cap drive** – **Natural gas, carbon dioxide or nitrogen** (inert) are **injected above the oil** within a reservoir to maintain a high pressure. Some gases **dissolve** into the oil and so lower its viscosity.
- **Steam injection** and other **thermal methods** help **lower the viscosity** of oil by increasing its **temperatur**e.
- **Detergents** may be **pumped down** into the reservoir to **reduce surface tension** and **loosen oil** from its grains.
- **Bacteriological methods** – these are also being developed to **digest and break down large hydrocarbon** molecules to decrease their **viscosity.**



CASE STUDY: ROYAL DUTCH SHELL PLC

Royal Dutch Shell plc is one of the largest multinational oil companies in the world. In 2004, Shell faced a barrage of criticism since it overestimated its reserves by 20% in order to increase their share price. This back fired as their share price plummeted by 6% and the Chief Executive Officer was dismissed when the company was accused of violating accounting rules and guidelines.

Shell is expected to pay out **$700 million** in fines but the company still announced a **profit of $26 billion** in 2006, one of the most profitable British companies ever.

CASE STUDY: EDWIN DRAKE PENNSYLVANIA

The first commercial oil well to be dug was by Edwin Drake in Pennsylvania, USA. Drilling for oil was very hazardous and the first sign that you hit oil, in the early days, was when it gushed uncontrollably to the surface. These 'gushers' or **blowouts** as they are now called, could **damage equipment, burst ear drums** and k**ill oil worker**s. They also posed a **major fire hazard.**

Only in 1924, were blowouts prevented using a **valve that fixed to the wellhead** and could be closed in the event of **high pressure fluid backflow**.