OIL & GAS TECHNOLOGY

Chapter 6 : Unconventional & Conventional Resources & Environmental Effect

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Chapter Description

- Aims
  - The aim of this chapter is to understand the concept of unconventional & conventional resources and also to discuss the various emission and environmental effects in oil and gas industry.

- Expected Outcomes
  - Explain various type of unconventional & conventional resources
  - Discuss various emission and environmental effects in oil and gas industry
  - Evaluate the current issues in oil and gas industry

- References
  - Håvard Devold, 2013, Oil and gas production handbook: An introduction to oil and gas production, transport, refining and petrochemical industry, ABB ATPA Oil and Gas.

Content

6.1 Introduction

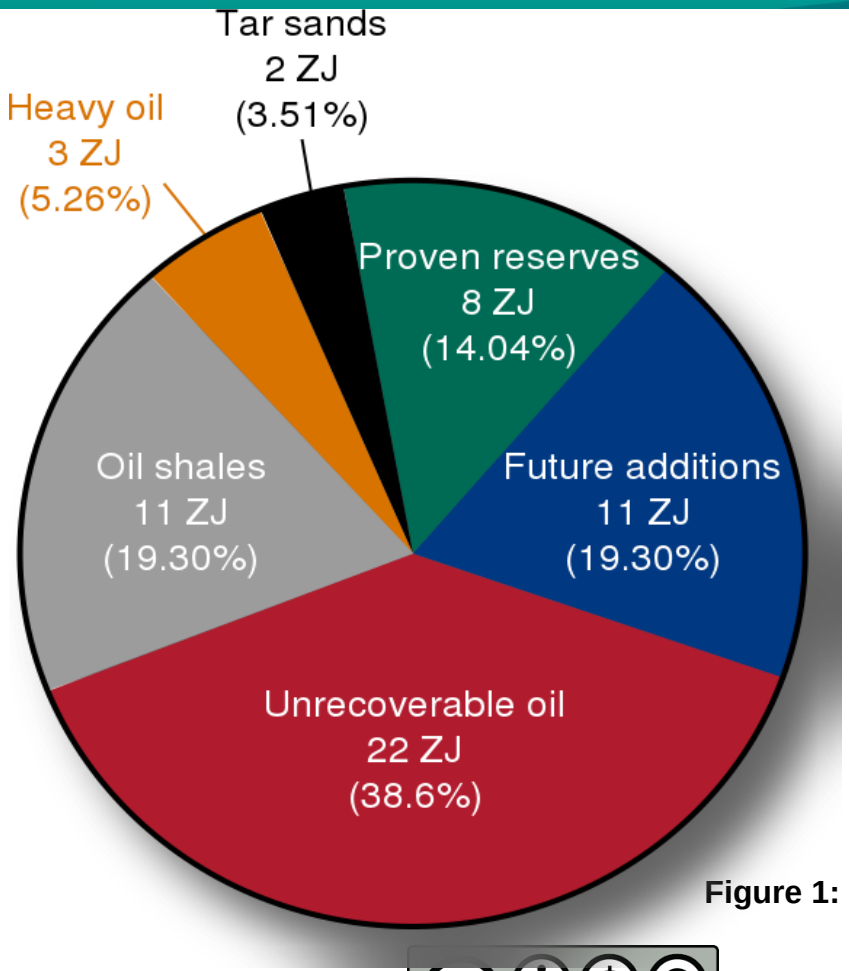
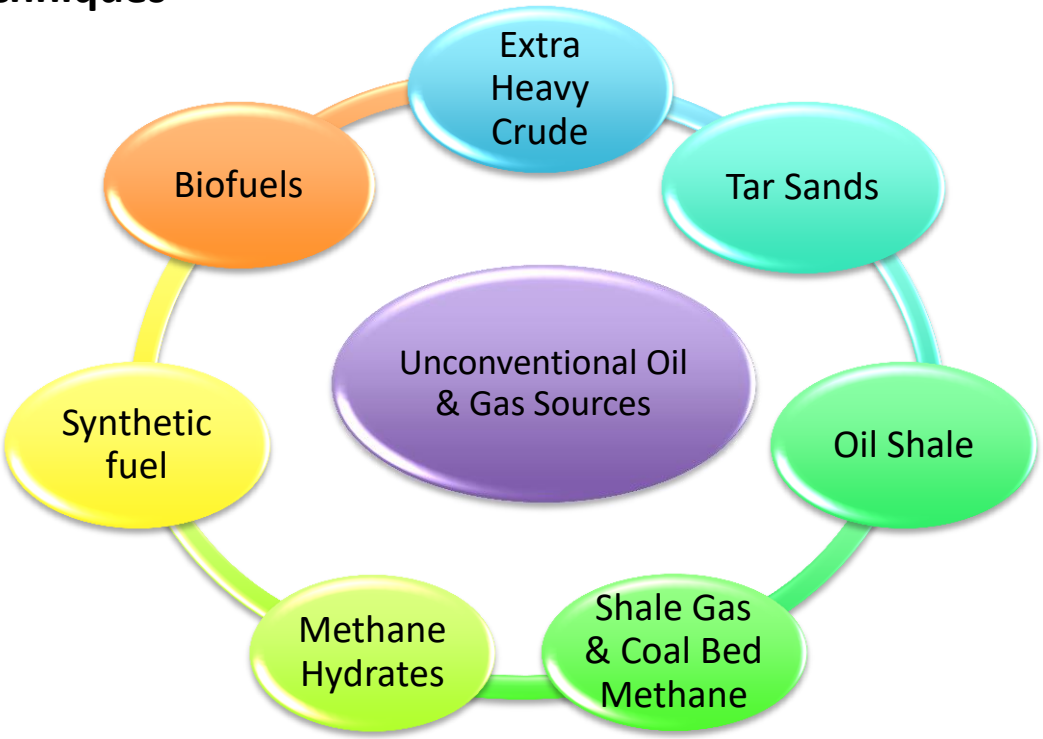


Figure 1: Potential of unrecoverable oil

Source :
https://en.wikipedia.org/wiki/World_energy_resources

6.1 Unconventional sources

The term "unconventional oil" is synonymous with oil that cannot be produced, transported, or refined using traditional techniques



Unconv. and Conv. Resources by Siti Noraishah

(a) Extra Heavy Crude

- API grade is 15 or below.
- Will mix with diluents (often LPGs) once arrived at surface to help it flow in pipelines. It will be upgraded and converted to SynCrude in a processing plant
- The diluents are recycled by separating them out and piping them back to the wellhead site.
- Several stages of hydrocracking and coking for crude oil to form lighter hydrocarbons. Coke and sour crude (rich with sulfur) will be removed

(b) Tar Sands

Consists of sand grains with a water envelope. Has bitumen film that covered it and possibly contain 70% oil.

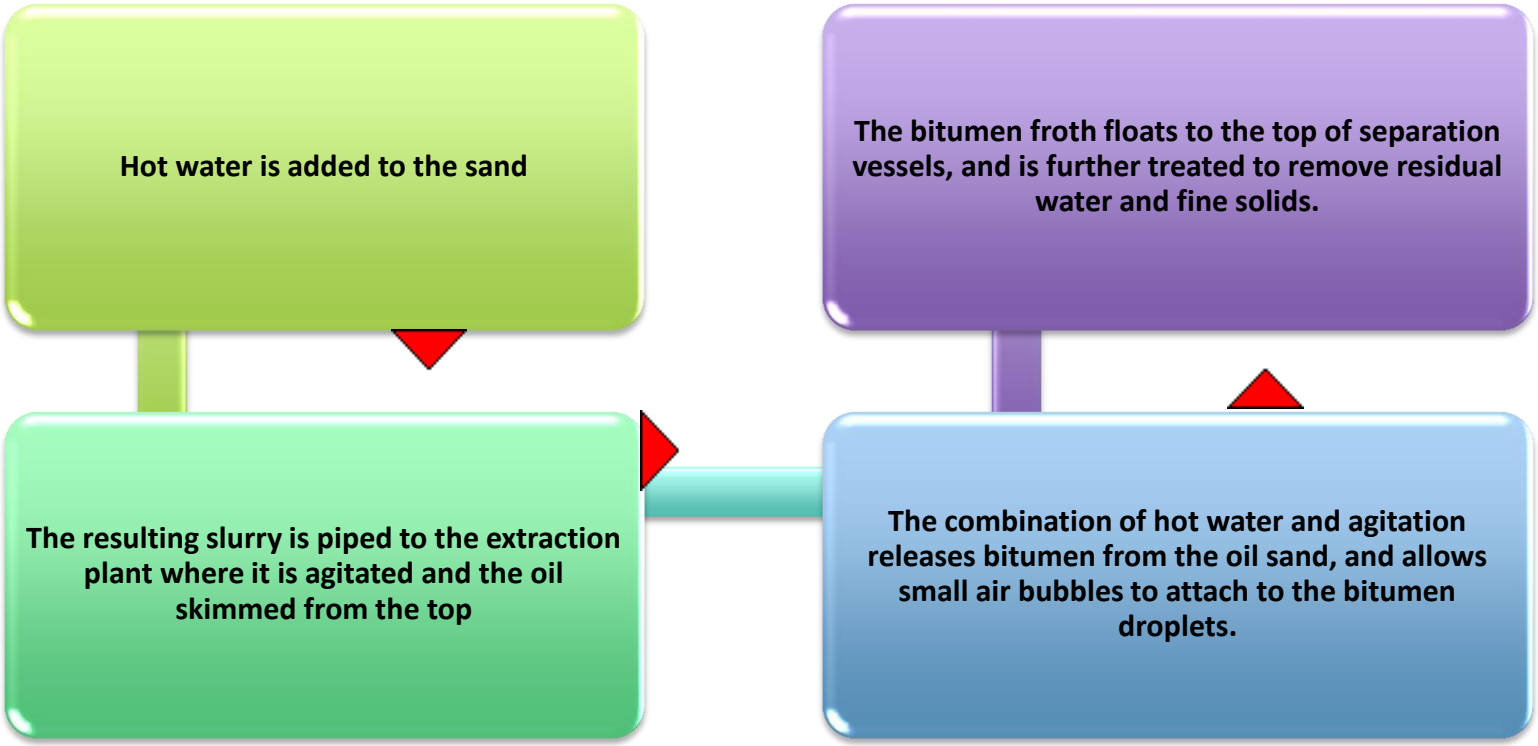
Bitumen and water will consists of fine particles

Can be processed using water extraction.

Injection of steam is required into a deposit to obtain it. Before arriving the surface, liquefaction process can be occurred.

Source
https://commons.wikimedia.org/wiki/File:Aurora_-_tar_sands.png

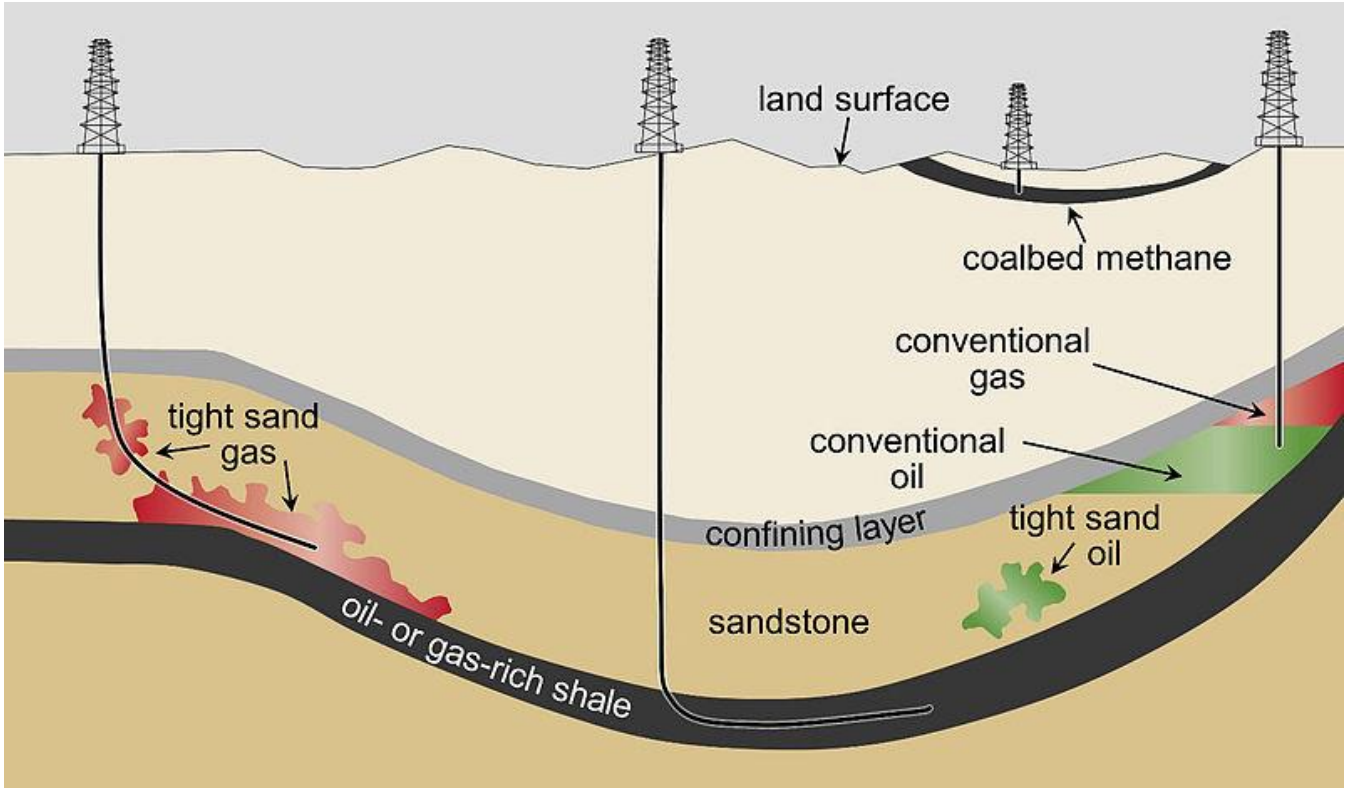
(b) Tar Sands



(c) Oil Shale

- Fine-grained sedimentary rocks containing relatively large amounts of organic matter, from which significant amounts of shale oil and combustible gas can be extracted by destructive distillation.
- Higher content of sedimentary rock compared to coal.
- Algae and sediment deposit in lakes, lagoons and swamps and forming oil shale at an anaerobic environment . This environment avoids the breakdown of organic matter and allows it to accumulate and form thick layers.
- The overlying rocks will cover these layers and will be heated at high P and T. At this case, the heat and pressure is less compared to oil and gas reservoirs.

(d) Shale Gas & Coal Bed Methane



Source :https://commons.wikimedia.org/wiki/File:Schematic_cross-section_of_general_types_of_oil_and_gas_resources_and_the_orientations_of_production_wells_used_in_hydraulic_fracturing.jpg

(e) Coal, Gas to Liquids and Synthetic Fuel

Synthetic diesel is used water gas (synthestis gas) to create coal. Coal will pass through steam over red hot coke

$C + H2O \rightarrow H2 + CO$

Water gas shift will produce more hydrogen

$rCO + H2O \rightarrow H2 + CO2$

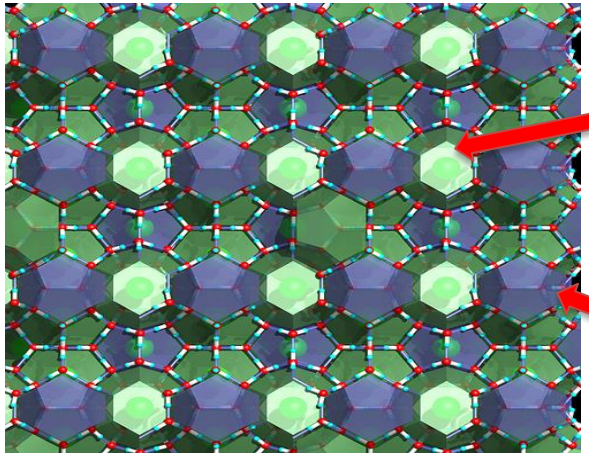
These synthesis gases are then used in the *Fischer–Tropsch process*:

$(2n+1)H2 + nCO \rightarrow CnH(2n+2) + nH2O$

Stages	Temp, T	Pressure, P	Catalyst
Stage 1: high temperature shift (HTS)	350 °C	2-4 MPa	catalyst iron oxide promoted with chromium oxide
Stage 2: low temperature shift (LTS)	190–210 °C	2-4 MPa	catalyst copper + zinc oxide + aluminum oxide

LTS: The composition of alkanes is 10-15 carbon number and average carbon number of 12.

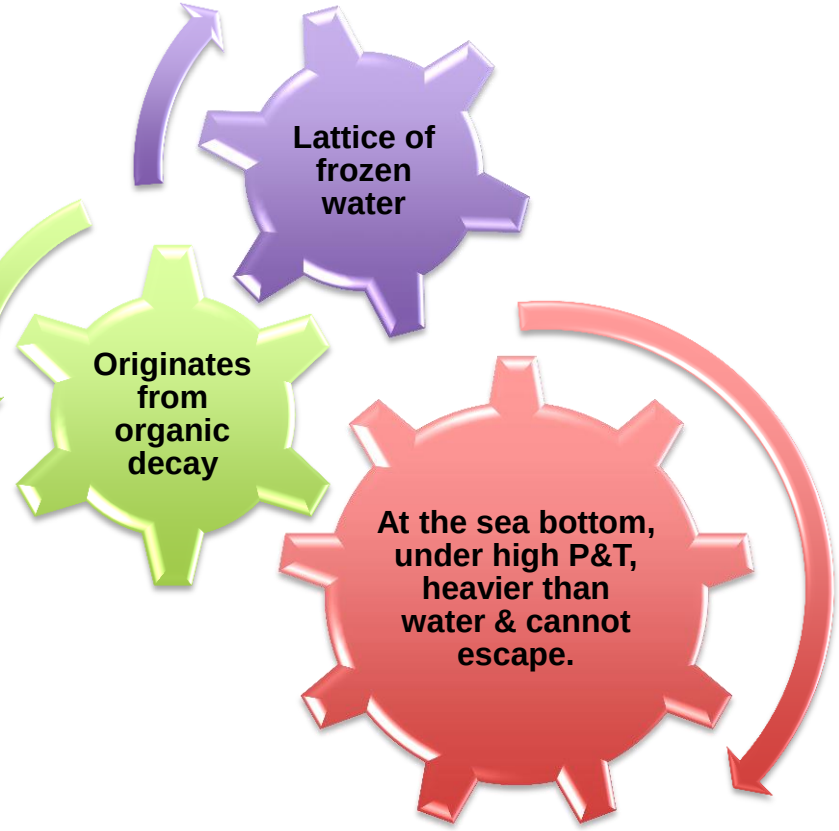
(f) Methane Hydrates



Gas molecules

Water molecules

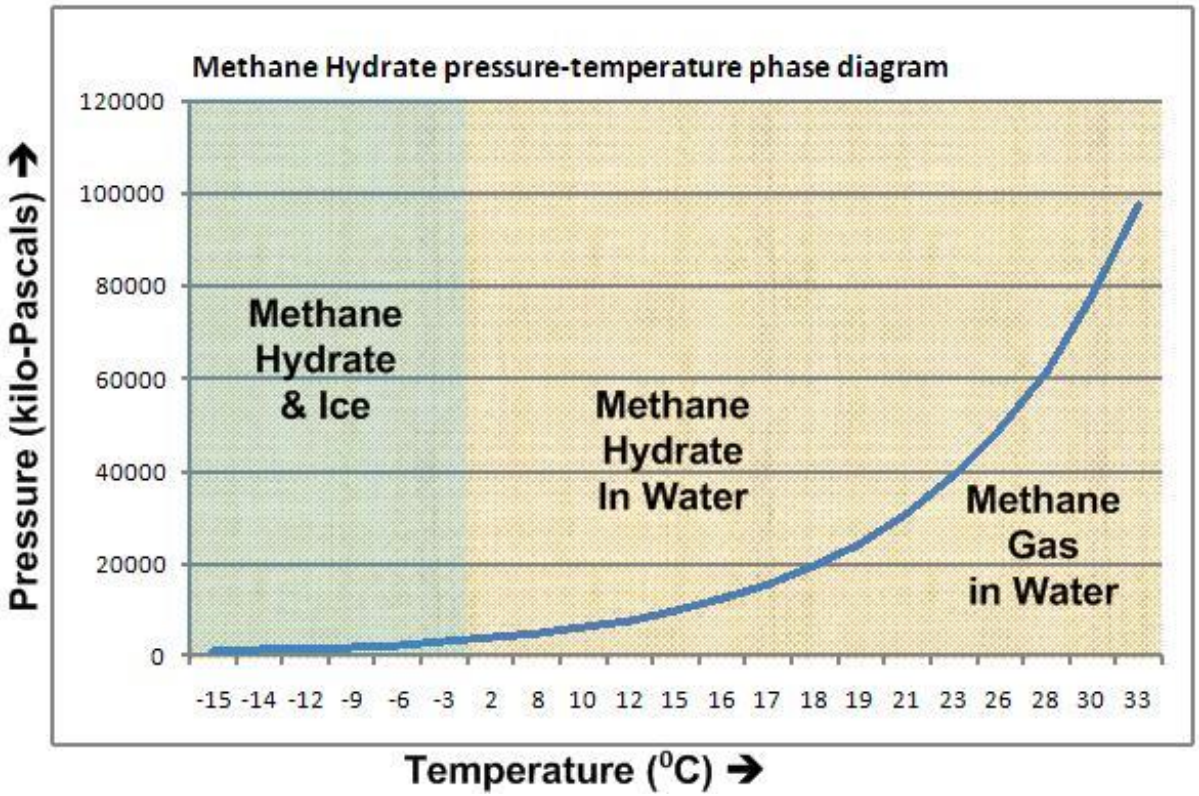
Source: https://www.flickr.com/photos/vitroids/4309946964



The US Geological Survey reported the methane hydrates contain more organic carbon compare to world's coal, oil, and conventional natural gas – combined.

Source: *Methane Hydrates: Office of Fossil Energy.*

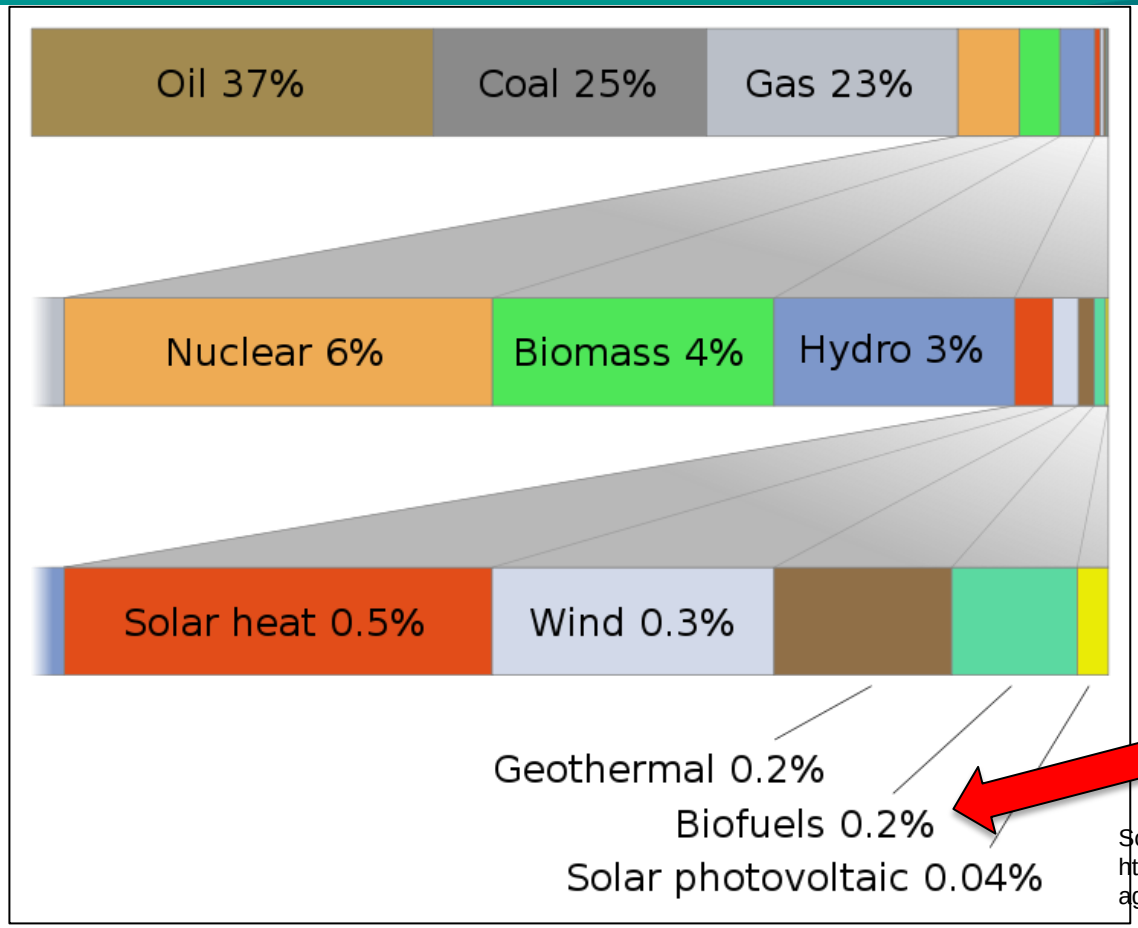
(f) Methane Hydrates



Source: https://commons.wikimedia.org/wiki/File:Methane_Hydrate_phase_diagram.jpg

Source: https://commons.wikimedia.org/wiki/File:Gashydrat_mit_Struktur.jpg

(g) Biofuels- World energy usage

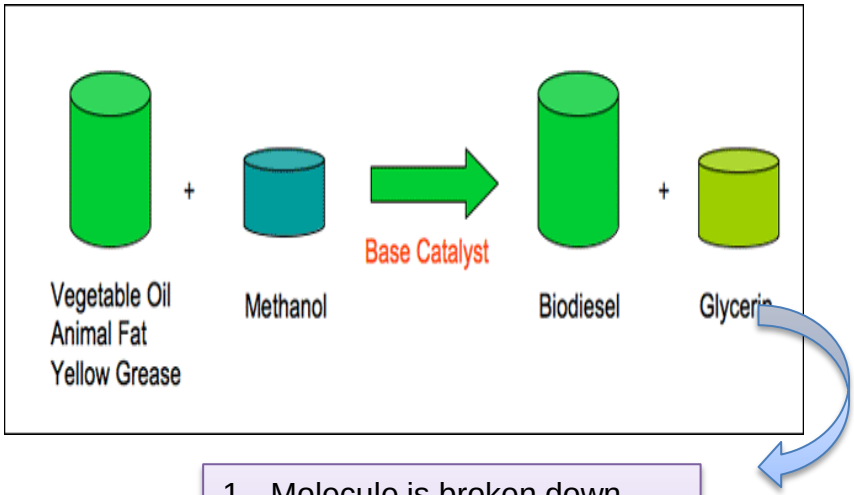


Source;
https://commons.wikimedia.org/wiki/File:World_energy_usage_width_chart.svg

(g) Biofuels

Also called **carbon neutral** produced from plants such as oilseeds, organic waste

Biodiesel
Recycling vegetable (lipid) oil or cooking grease.



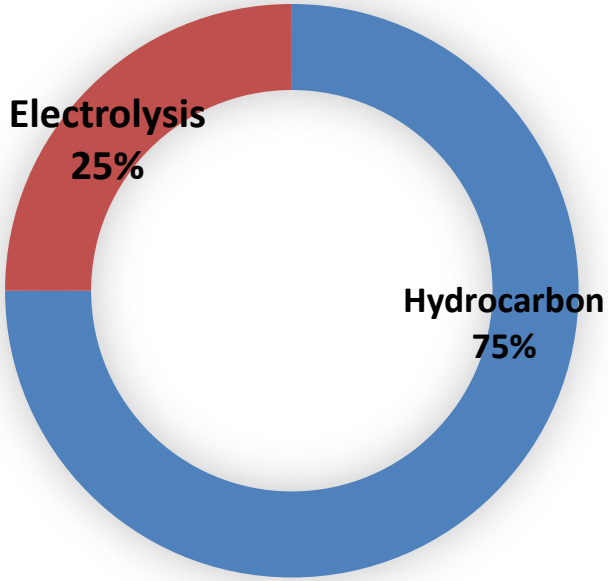
1. Molecule is broken down through ***transesterification.***
2. *MeOH is added and is heated.*
3. *NaOH and KOH catalyst.*
4. *Methyl esters and glycerine as byproduct.*

Ethanol Alcohol
Distilled from fermented sugar or starch
Burned with gasoline combination

(h) Hydrogen

- A clean burning and complement to traditional hydrocarbon based fuel.
- Conventional engine or fuel cell only release water vapour as emission.

Produce from water by
Electrolysis
at normal condition.
50%
(High Temperature & pressure)

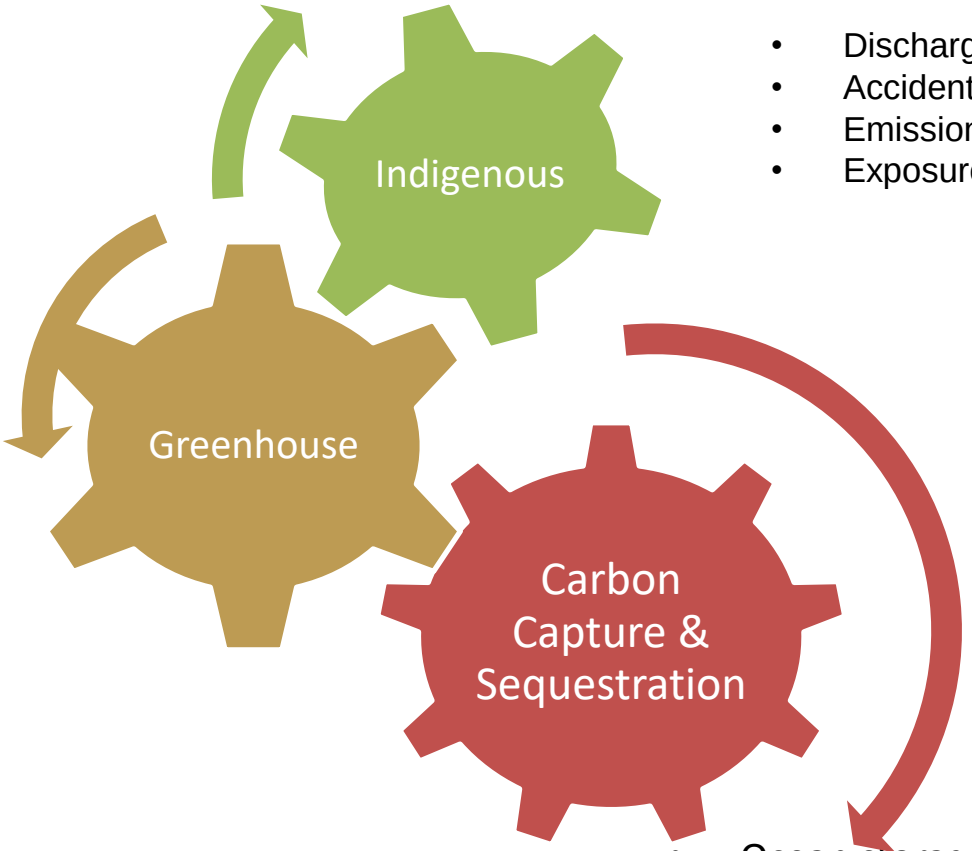


Produce from water by
Hydrocarbons
Up to **80%** efficiency via syngas.

1. **Energy carrier** replacing batteries
2. Clean
3. Renewable energy source

CO_2 can be removed and handle at central location provide cleaner energy carrier.

6.3 Emission & Environmental effects



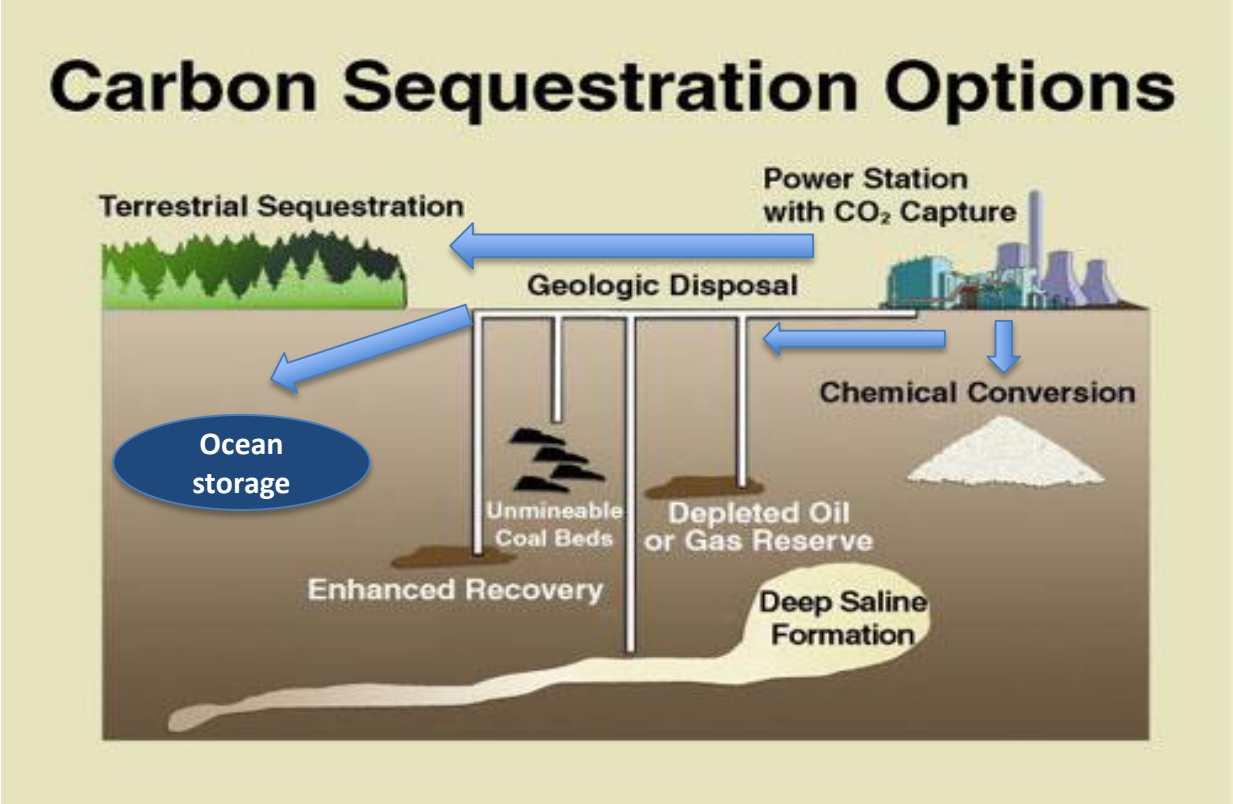
- Discharge
- Accidental Spills
- Emissions
- Exposure

Greenhouse gases are a group of compounds that are able to trap heat, keeping the Earth's surface warmer

- Ocean storage can cause water to be more acidic
- CO_2 leakage may occur

Source: *Oil & Gas Production Handbook*, Devold (2013)

Carbon Capture & Sequestration



Source: http://photos.state.gov/libraries/usinfo-photo/39/week_3_0407/

6.5 Conclusion

- Exploration of unconventional resources are still limited due to technology constraints.

- Emission & Environmental effects, mostly emissions of carbon and methane are the major concern to be considered.

- For indigenous emissions, national and international laws should be tightly controlled. For example, energy-efficient products such as electrical based products or vehicle can be used instead of depending on fuels.

Authors Information

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