

Oil & Gas - Teacher Background

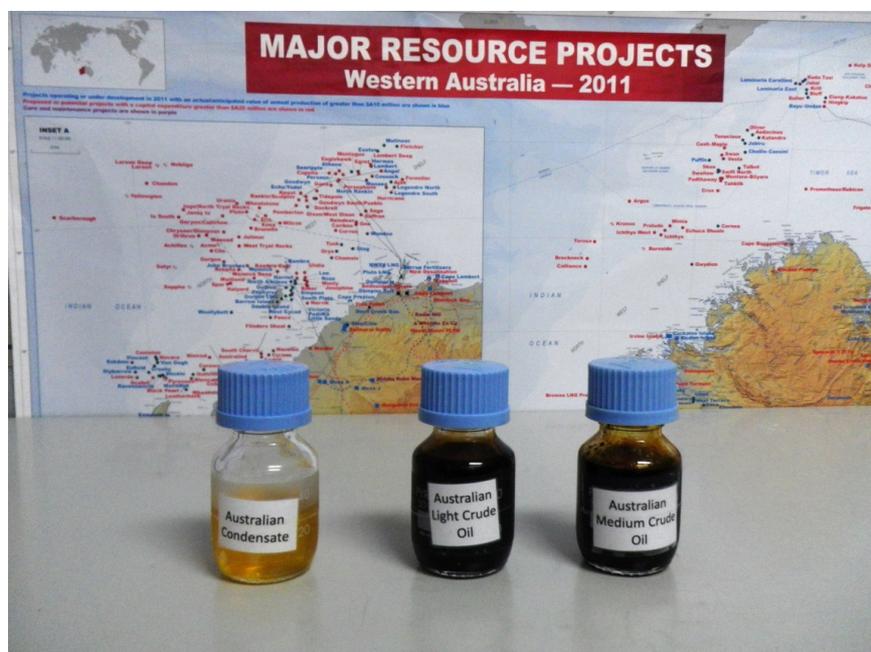
We are using “the dwindling deposits of the last hours of ancient sunlight”.
Robert Newman, The History Of Oil.
The Stone Age didn't end because we ran out of stone – we just got clever!
Engineers' dictum

Oil and gas are **hydrocarbons**, molecules of combined hydrogen and carbon produced from the breakdown of organic (living) materials. Indirectly they are fossilised energy supplies from ancient sunlight, converted by photosynthesis to plant and then sometimes animal materials and then finally are buried and chemically changed by the Earth. Millions of years of Sun energy and great masses of organic material are turned into smaller but more concentrated energy sources. They start out as tiny isolated specks but migrate to areas where they are trapped and become more concentrated. These are the oil and gas fields we drill for our energy needs.

Surface hydrocarbon seeps have been utilised since Palaeolithic times. Bitumen was found on Neanderthal tools, was used to seal baskets in early cities of the Middle East and was employed in the construction of towers in Babylon where asphalt was used later to seal streets. Chinese people first drilled for oil as a fuel about 347AD using over 180m of bamboo poles. The oil was used to heat brine to make salt for preserving food.

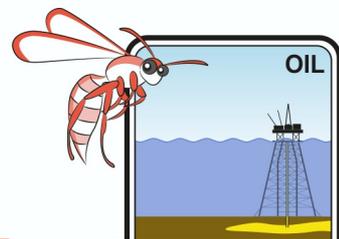
Our modern life depends on using hydrocarbons as fuel for heat, for transport, for light and for a source of chemicals to produce plastics, paints and pharmaceuticals, among other things. Although new supplies of oil and gas are continuously produced the conditions that permit them to be concentrated into economic reserves are indeed rare.

As a resource, the timescale for their replenishment is vastly greater than their present depletion rate. As such, they may be regarded as non-renewable.



In the financial year 2011 – 2012, condensate, crude oil, LNG, LPG, and domestic natural gas to the value of \$23.8 billion dollars or \$754 per second were produced in Western Australia. The petroleum industry contributed to 18% of royalty receipts. Our petroleum products were exported to Japan (44%), China (16%), South Korea (8%), Singapore (8%) and others. We produce 77% of Australia's crude oil and condensate and 63% of our Natural gas production. Source “Western Australian Petroleum statistics 2001-2012” www.dmp.wa.gov.au

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Fascinating fact *The Gorgon gas field in the seas north west of our Pilbara coast contains 25% of Australia's known gas reserves.*

Tight gas & light oil

In a bid to balance the increasing demand for oil and gas with decreasing supply, exploration companies are now looking for methyl hydrates, commonly called “unconventional gas”, in offshore sediments in river basins, around the continental coasts in river delta systems and under the Arctic permafrost. Referred to also as “bridge oil”, this is mostly methane, has a lower energy rating but produces half the amount of carbon dioxide as coal. “Light” oil or condensate is also released as a by-product. The terms unconventional gas and tight gas broadly refer to resources that need special techniques and technology to enable oil and gas flow from shales and other tightly packed host rocks. “Fracking” or the hydraulic fracturing of rock is one of these techniques. Until recently the USA was traditionally a net importer of gas. As a result of an unexpected surge in shale gas production it will soon be competing with Australia, Malaysia, Algeria and Nigeria in the export of LNG (Liquefied Natural Gas).

Interesting Fact *The US Energy Agency estimates Western Australia to have the world's fifth largest resource of shale gas (unconventional gas).*

The four on-shore areas currently under exploration for tight gas in shales in Western Australia are the Canning Basin, Carnarvon Basin and Perth Basin (both Mid West and South West).

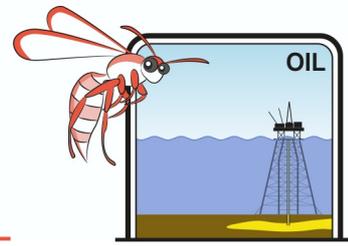
NOTE Fracking is also used to release coal seam gas from shallow formations in Queensland, Victoria and Queensland. When these shallow coal formations are fractured extreme care must be taken as poor well completion practise in the past has released highly toxic materials into the environment. In particular, care must be taken to case or seal the sides of the holes when they penetrate aquifers. In 2012 the Department of Mines & Petroleum Western Australia released more stringent guidelines for fracking shales. (More information at www.dmp.wa.gov.au/onshoregas)

Many oil-producing countries such as the USA had started to exhaust their reserves and were judged past “Peak oil” production. Since the 1980s the USA and UK became net importers depending on external suppliers to fill the gap between supply and demand. However the use of tight gas to fuel industry traditionally powered by oil has freed up more oil for petrochemical production.

Control over energy sources and energy access has changed geopolitical thinking in our world. Data below is from <http://truecostblog.com/2012/01/21/countries-by-peak-oil-date-2011-data-update/>

Country	Year peak oil achieved	Peak not yet achieved.
Iran, Libya, Venezuela	1970	
Kuwait	1972	
Indonesia	1977	
Iraq	1979	
UK and Europe	1983	
Uzbekistan	2002	
Australia	2000	
Canada		X
Brazil		X
Azerbaijan		X
Kazakhstan		X
Qatar		X

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Although the data may be debatable in specifics, it is clear that production in most major traditional oil producing countries is declining. At the 2012 GSWA Oil and Gas conference, it was estimated that oil production in the World would be down to 30%. Energy security has become important across the globe. Politicians need to ensure reliable, safe and secure energy to maintain living standards.

In 2012, the Western Australian Minister for Mines Norman Moore stated, "Development of unconventional gas in the Perth Basin will double present available gas reserves". In the same year Western Australia produced 70% of the World's LNG (Liquefied Natural Gas). This future dependency on unconventional gas prompted the International Energy Agency to produce "The Golden Rules for the golden age of gas" at the G8 conference in 2012.

http://www.iea.org/media/WEO_GoldenRules_ForA_GoldenAgeOfGas_Flyer.pdf

Natural gas emits half as much greenhouse gas as coal when burnt and therefore contributes only half as much towards global warming. There is concern that a sustained gas glut might undermine new investment in other energy production systems such as wind, solar and tidal systems, which produce, almost, zero emissions and maintain our addiction to burning fossil fuels.

To date (2012) Australia has not published a resource management plan to control development and to conserve future supplies of hydrocarbons for national use.

Teachers may find Newman's "History of Oil" witty, quirky, and confronting and that the opinions stated are clearly polarised. www.youtube.com/watch?v=Qu47flklsY8&feature=related

PowerPoint on oil and gas. <http://vimeo.com/8567803> Gives a good overall view of this subject for Natural Gas.

Interesting fact **60-70% of domestic gas in Perth comes from the Karratha gas plant. It takes seven days to travel to Perth along the pipelines.**

Oil and gas are the result of a fortuitous set of circumstances involving the deposition and maturing of a rich resource rock, the timely migration of oil and gas into porous reservoir rock and their containment in these reservoir structures beneath impermeable seals

UK Offshore Operators Assoc. And Natural History Museum Britain's offshore oil and gas

To create an economic deposit of hydrocarbons, three factors are necessary:

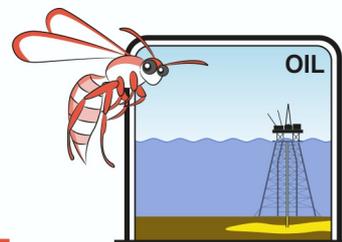
1. A source rock which contains hydrocarbons (e.g. oil shale or coal)
2. Migration of hydrocarbons from source through pores into a reservoir rock
3. The reservoir rock must be capped or sealed by an impermeable layer or structure to stop the oil escaping

Trapping in reservoir (economic)

Migration through permeable rock

Formation of a source

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Important Note It can be dangerous to use petroleum and methane in school laboratories with students of any age. In the following activities water has been used as a safe substitute.

Possible sequence of activities:

- 1. Formation Of A Source Rock**
 - De-watering Of Sediments – Student Activity
 - It's A Gas! – Student Activity

- 2. Migration To A Reservoir**
 - Pressure & Depth of Burial – Student Activity
 - Porosity & Permeability – Student Activity
 - Permeability – Student Activity (Optional)
 - Migration Rate – Student Activity

- 3. Formation Of A Reservoir**
 - Structural Seal – Teacher Demonstration

- 4. Recovery Of Oil & Gas**
 - Pressure Lift – Student Activity
 - Viscosity & Raising Raisins – Student Activity
 - LNG Gas & Oil Treatment - Flow Plan

- 5. Safety In The Oil & Gas Industry**
 - Safety In The Oil & Gas Industry – Student Activity