

COAL



FORMATION a



Coal

- Coal is a flammable rock that is mostly carbon, hydrogen and oxygen, with lesser amounts of nitrogen, sulphur and traces of other elements.
- Coal deposits are formed over millions of years by the decay of accumulated plant life. Over time, the organic matter buried beneath other sediments is transformed into a compact solid, which ultimately forms carbon rich coal.
- Interlayered with other sedimentary rocks, coal is formed into beds ranging from less than a millimetre to many metres thick. Such a bed, or several beds separated by thin layers of shale, siltstone or sandstone make up a coal seam. It takes 30 metres of vegetation to form a 1 metre bed of black coal.
- Coal's carbon content and properties are highly variable and they depend on the type of plant life, the depth of burial, the effects of pressure, temperature, percolating groundwaters and the length of time that the organic matter is buried.

MINING

- Once exploration has revealed a viable coalfield, the site is pegged, an environmental assessment completed and, if approved, a mine is established.
- Either open cut or underground methods are used to mine coal. Although a large number of deposits are mined underground in Queensland and New South Wales, the last Western Australian underground coal mine closed at Collie in June 1994. All coal produced in the State is now from open cut mines.
- To begin open cut mining, the topsoil and overburden must be removed. The topsoil is spread directly on contoured rehabilitation areas or stockpiled for later use. The operation is performed using bulldozers, excavators, front-end-loaders and dump-trucks. The caprock (laterite) beneath is up to 2 metres thick and is 'ripped' by bulldozers or blasted and recovered for use as road building material.
- The remainder of the overburden is drilled with rotary 'blast hole' drill rigs and charged with bulk explosive. It is then loaded by the hydraulic excavator and draglines (a dragline is a large excavator which picks up the ore by dragging a large toothed bucket) onto dump trucks and placed in overburden dumps. The overburden can be used to create new hills or it can be back filled into disused pits as part of the rehabilitation process.
- With the removal of the overburden from the coal seam, the top of the seam, known as the roof, is scraped clean using bulldozers. The coal seam is then drilled, blasted and mined in strips. Bulldozers clean down to the floor of the seam which can be over 200 metres deep as at the Muja open cut mine. Front-end-loaders and draglines load coal onto trucks to be transported to either the crusher or Western Power Corporation's coal receipt point for the Muja power station.
- Underground methods are used to mine coal seams at depths between 150 and 500 metres. The coal seam is reached by vertical shafts or sloping tunnels (declines). The coal is extracted using either the 'board and pillar' or 'longwall' methods. The board and pillar method uses machines called 'continuous miners' which cut out blocks of coal leaving behind pillars to support the roof. These may be extracted in a second stage of mining. Longwall mining uses hydraulic rams to support the roof while a cutting head removes the coal from the length of the wall. The mine roof is then allowed to collapse behind the working face. Generally, longwall techniques result in higher productivity and higher recovery of coal than does the board and pillar method.
- When an open cut mine is depleted, the pit is sometimes filled with waste rock, covered with topsoil and replanted. Alternatively, the pit may be allowed to fill with ground water to create an artificial lake. Underground mines are sometimes simply filled with waste rock and sealed. Overburden dumps are smoothed and recontoured and revegetated with either pasture or native timber.



4000 BC

First use of coal found in funeral pyres in ancient Wales, U.K.



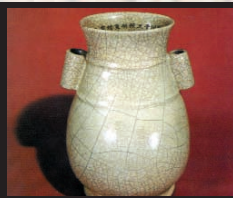
3000 BC

Coal and its by-products such as bitumen first used by Phoenicians.



300 AD

Romans used coal for heating and metalworking in ancient Britain.



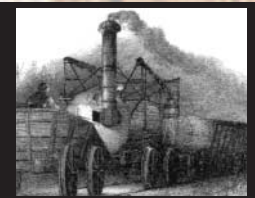
1200 AD

Coal in widespread use for heating, ceramics and metallurgy in China.



1400 AD

Hopi Indians in North America employ coal industrially for making pottery.



1782

Although Thomas Newcomen invented the steam engine in 1710, James Watt made fundamental improvements to the design that led to wide-scale use in industry. The age of steam (and coal) was born.

and LOCATION

- The coal found in Western Australia varies from 40 to 280 million years in age. The coal at Collie, 200km south of Perth, is located in sediments deposited during the Permian Period, between 255 and 280 million years ago, when the first dinosaurs began roaming the Earth's surface.
- At Collie, coal is found in an isolated Permian Basin, preserved within the granitic Archean Basement rocks of the Yilgarn Block. The basin is divided into two sub-basins, Cardiff and Premier and cover an area of over 350km². Tertiary sands and clays of the Nakina formation cover the coal deposits. The seams of the Muja Pit 12km south of Collie are within a structure 4km long and 1.2km wide.
- The Collie field has been mined continuously since 1898 and is Western Australia's only producing coalfield with 55 potentially economic seams. Known coal reserves are sufficient for Western Australia's energy needs for at least 100 years at the current rate of production.



● Major coal mining in W.A.

PROCESSING

- The sub-bituminous black coal mined at Collie has such a low ash and sulphur content that it needs little processing before use. The coal is crushed and screened to reduce the rock to a usable and consistent size.
- Coal is sometimes washed to remove pieces of rock or other minerals that may be present. This reduces ash content and improves overall quality. Washing involves immersing the crushed coal in a liquid of high specific gravity in which coal floats and can be recovered while the heavier rock and minerals sink and are discarded.
- Differing grades of coal are often blended to ensure a consistent quality of coal to the user. This is done with a travelling stacker that blends the product whilst moving along the stockpiles.



1780's - 1914

With cheap usable power, the Industrial Revolution that began in Britain swept the world, driven by coal.



1846

A.C. Gregory found the first coal deposit in Western Australia at Irwin River, 300 km north of Perth. The deposit remains uneconomic.



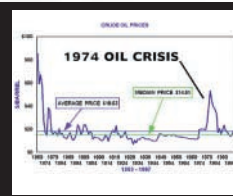
1883

George Marsh discovered the more significant Collie field, which is still in production.



1920 - 1966

Discovery of potentially economic coal deposits at Wilga, Boyup Brook, Hill River, and Vasse River in the Collie area and Perth Basin.



1974

Oil crisis resulted in a worldwide resurgence of interest in coal as an energy source because of its relative abundance.



1995 - 1998

The new Premier Mine in Collie was developed for dedicated supply to the new 300 megawatt power station.

COAL STATISTICS

Total Quantity of Coal Produced in Western Australia

2003 – 6,026,581 tonnes (\$266,405,945)
2002 – 6,262,538 tonnes (\$266,402,673)

Royalty Receipts

2003 – \$13,677,342
2002 – \$16,154,724

Employment

In 2003 the coal industry in Western Australia directly employed 641 people. Many hundreds more are employed in power generation supply industries.

Primary Coal Producers in WA

THE GRIFFIN COAL MINING COMPANY PTY LTD
Collie.

WESFARMERS PREMIER COAL LTD
Collie.

Current statistics are available from the Statistics Digest on the Department of Industry and Resources website at www.doir.wa.gov.au



COAL FACTS

Coal is a combustible rock of **organic origin** composed mainly of carbon (50-98%), hydrogen (2-13%) and oxygen, with lesser amounts of nitrogen, sulphur and other elements such as chlorine. Some water is always present, as are grains of inorganic matter that form an incombustible ash.

Straight from the ground, **Collie coal** typically contains 41% fixed carbon, 27% moisture, 26% volatiles (such as methane), 6% ash and <1% sulphur. This produces 20.1 megajoules of **energy** per kilogram.

Coal is also used in the **production** of gas and liquid fuel, cement manufacturing and brick-making.

Worldwide, over 85% of coal, both black and brown, is used to **generate electricity**.

Coal is an important **reducing agent** used in mineral processing in Western Australia for the production of ilmenite and nickel.

Many **organic chemicals**, including tars and basic ingredients for making various plastics, can be prepared from the by-products of coke (upgraded coal) and gas production.

Coal is classified by **volatile content**, **calorific value** (heat produced when burned), **caking** and **coking** properties. These are controlled by the extent the organic matter has been transformed into carbon. Greater transformation due to increased temperature and pressure results in lower water content and a higher carbon content and calorific value.

Coal types fall into three main groups. **Peat**, a loosely compacted fossil fuel that is 90% water and must be dried out before burning. **Lignite** or **Brown coal**, has a high moisture content and is relatively soft with a quarter of the heating value of black coal. **Black coal** is a grey to black, solid rock with moderate to low water content, and is further divided into sub-bituminous, bituminous or anthracite.

Collie coal is sub-bituminous, with low caking, low ash, and low sulphur, making it ideal for power generation.

MORE INFORMATION

- **Stedman, C.** *100 Years of Collie Coal*, 1st Edition, (1988), Curtin University Printing Services, Perth, WA.
- **Griffin Coal** *Collie Based Operations*, (brochure), (1996), Perth, WA.
- **Minerals Council of Australia** *Coal Fact Sheet*, (brochure), (1995), Canberra, ACT.
- **Skinner, Brian J.** *Earth Resources*, 3rd edition, (1985), Prentice-Hall Inc., New Jersey, USA.
- **Selinger, Ben** *Chemistry in the Marketplace*, 4th edition (1988), Harcourt Brace Jovanovich Group (Australia) Pty Ltd, NSW.

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