FACT SHEET 12

COAL

Introduction

For centuries people have recognised coal as a mineral that burns.

Up until the late 17th century it was regarded in Britain as a poor person's fuel, with most preferring to use charcoal or wood for heating.

In fact, during the reign of Edward I in the 13th century, coal was considered an obnoxious type of fuel and the death penalty was imposed on anyone found guilty of burning it.

It wasn't until the Industrial Revolution in Britain early last century that coal began to emerge as a strategic fuel.

Today it is an important source of energy, especially as a power station fuel, and is also used to smelt iron and for the production of numerous chemicals.

Coal is one of Australia's most significant natural resources. It accounted for 24% of total mineral exports, worth $7 166 million, during 1993/94.

Composition and uses of coal

Coal is a black or brown combustible substance formed from the decay of plant life. Over many millions of years this accumulated organic matter — trees, grasses etc — is buried beneath other sediments and transformed into a compact solid, which, in its ultimate stage, approaches pure carbon.

Just as today's plants vary in many aspects including chemical and physical properties, so too does coal. The type of plant life, the depth of burial, the effects of pressure, temperature, percolating groundwaters and time all determine how much a particular deposit has been transformed and thus what properties the coal will have.

Coal is classified according to rank, a measure of how far the coal has been transformed from plant material towards carbon.

Temperature, pressure and the length of burial are the main factors determining the degree to which "coalification" of plant material can proceed. The progressive stages in this process are peat, lignite (brown coal), sub-bituminous coal, bituminous coal and anthracite. The latter three are known as black coal.

Peat is a loosely-compacted spongy substance usually found in low-lying swampy ground. Formed from partly-decomposed plant remains (it is often possible to identify pieces

Δ *Griffin's open-cut coal mine near the Muja power station in the background.*

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of bark, leaves and wood within the peat), it contains up to 90% water and needs to be dried out before being burned.

Lignite or brown coal is the next stage in the development of peat. It has a high "in situ" moisture content (up to 60%) and a high oxygen content. It is highly susceptible to spontaneous combustion.

Despite being more compact than peat, it crumbles when exposed to air. Brown coal's relatively low heat content makes it uneconomical to transport over long distances. Therefore the fuel is typically burned in power stations located on or close by coalfields. Brown coal is also used for the manufacture of heating briquettes and conversion to liquid or gaseous fuels.

Black coal (either sub-bituminous, bituminous or anthracite) is a solid rock formed after greater heat and pressure has been applied to brown coal.

Sub-bituminous coal is usually dull, black and waxy in appearance. Its carbon content is higher than brown coal (71%-77%), while its moisture content is about 10%. It is a valuable fuel for power generation and can be converted to liquid and gaseous fuels.

Bituminous coal is dense , black and solid. It frequently contains bright bands. Its carbon content ranges from 78% to 91% with a water content from 1.5% to 7%, and it burns with a luminous flame. There are many varieties of bituminous coal which are used for gas making, steam raising and coke making.

Anthracite is a very hard, black coal with a brilliant lustre. It has a carbon content of more than 92% and a very low moisture content. It is often found in mountainous regions, where it has been formed under the extreme pressures resulting from the folding of Earth's surface into mountain ranges. Used as a fuel for domestic heating and cooking in many countries, anthracite can also be blended with bituminous coal for use in the iron and steel industries.

Other uses

The uses for coal are continually changing.

Fifty years ago coal was in greatest demand for home heating, as a fuel for trains and ships, and to produce synthetic gas for heating and lighting.

Apart from heating, coke making for the production of iron and steel and as a fuel for the generation of electricity, coal is also used to make plastics and a range of chemicals.

In Western Australia, most of the coal produced on the State's only coalfield at Collie is used at the nearby Muja power station. The balance of the coal is sold for cement manufacture, brick making, mineral sands processing and other industrial applications.

History of coal

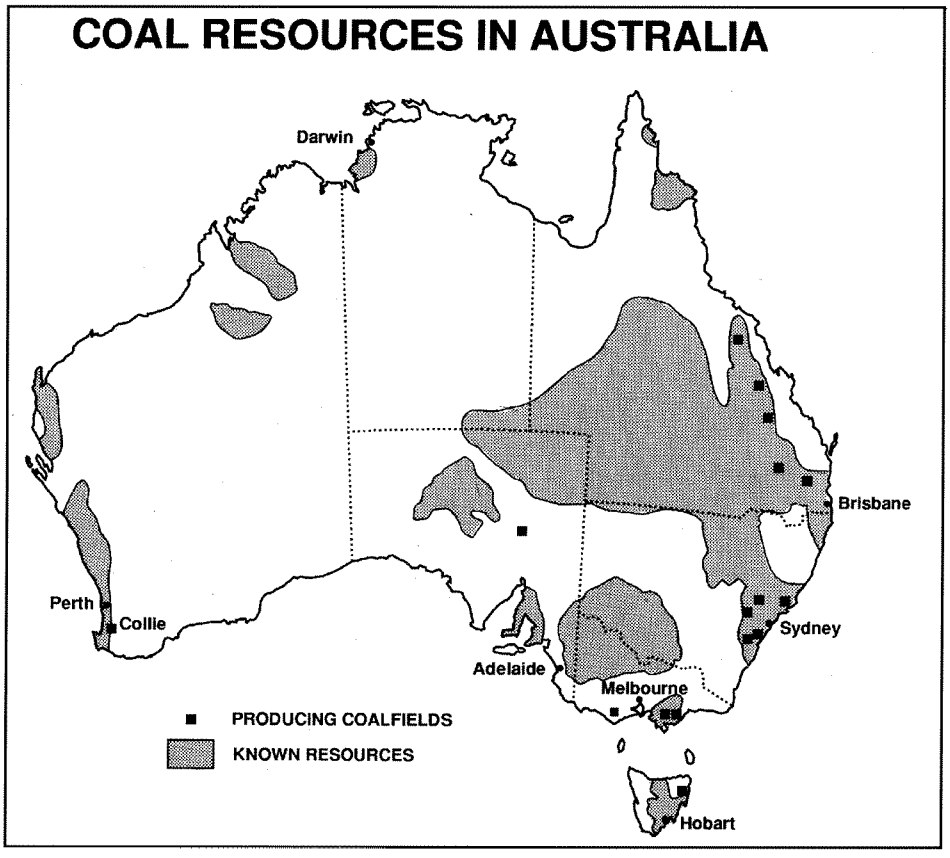
Coal has been used as a fuel since the beginning of civilisation. The writings of the ancient Greek philosopher Theophrastus mention a black stone that blacksmiths burned instead of charcoal, and the Chinese are said to have used coal for fuel about 100 BC. Although a European coal industry is known to have existed about AD 1200, the use of coal was discouraged because open burning produced objectionable fumes.

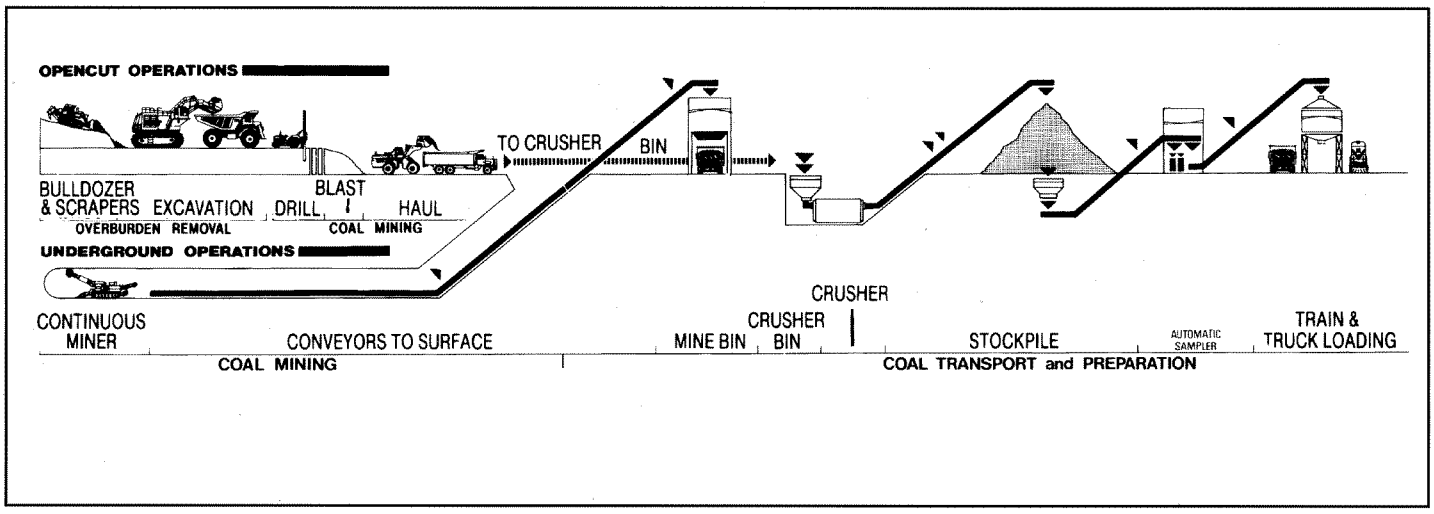
Small coal mining operations began in Europe in the 15th century and grew as coal-fired brick kilns came into use. Nevertheless, wood from the abundant forests remained the primary fuel for heat and energy. As the population of European countries grew rapidly in the 1600s, the forests became depleted, and coal began to replace wood as a domestic fuel.

A new market for coal arose with the discovery that coal could be made into coke and used to smelt iron. Beginning in the 1700s and throughout the Industrial Revolution, metallurgical and engineering advances produced an insatiable demand for coal.

Coal history in Australia

Coal was first discovered in Australia near Newcastle in 1791, by escaped convicts. Over the next few years, coal was reported in many localities to the north and south of Sydney.





Δ *An artist's diagram of an open-cut coal mining operation.*

The coal industry began in New South Wales in 1798 when ship owners gathered coal from the surface at Newcastle and brought it to Sydney for sale. The export of Newcastle coal began in 1799 with a shipment to India.

Coal is now found in every Australian State.

Coal history in Western Australia

Coal was first discovered in Western Australia in the banks of the Irwin River in 1846 by Assistant Surveyor General, A.C. Gregory and his two brothers.

Stockman George Marsh is credited with finding the State's first commercial coalfield, at Collie.

According to legend, young George was minding sheep along the banks of the Collie River in October 1883. While preparing to cook his evening meal he picked up some dark coloured stones and placed them beside his fire to support some cooking utensils. To his surprise, the stones caught fire.

Exploration and development of the Collie coalfield received enthusiastic support from the Government because railways and other consumers at the time depended entirely on imported coal and local wood for steam raising.

Commercial mining began in the Collie area with the establishment of the Wallsend Colliery in December 1898.

Δ *Coal hawlage at a Western Collieries' open pit mine near Collie.*

WA coal resources

Collie is the State's only producing coalfield. Two companies — Griffin Coal Mining Company and Western Collieries Ltd — mine coal at Collie. There are currently six mining operations in the Collie Basin — all open-cut. Griffin has Muja and Chicken Creek and Western Collieries has WO5 and W5H.

Collie coal is sub-bituminous, with a specific energy of 20 megajoules per kilogram (MJ/kg). The coal is non-coking and has a low ash, medium volatility and high moisture content.

There are several other coal deposits in Western Australia, but currently are not being worked. They include:

- The Hill River coalfield, located between Jurien and Eneabba. Resources of 600 million tonnes (Mt) of sub-bituminous coal, with an energy content of 18-20 MJ/kg, have been identified. The coal is a non-coking type with a moderate ash content.

- The Vasse River coalfield, located near Dunsborough in the South-West of the State. The resource is estimated to contain 800 Mt of export-quality steaming coal. Though at underground mining depths, it has similar characteristics to the coal now being mined at Collie.

- The Wilga and Boyup coalfields, located 30km and 45km south of Collie, contain sub-bituminous coal similar to that mined at Collie. Resources are

estimated at 260 Mt for Wilga and 60 Mt for Boyup.

There are also two substantial deposits of brown coal at Scadden and Balladonia in the south-east portion of the State. With combined estimated resources of 1 660 Mt, the coal has a high salt and ash content, and is unlikely to be exploited in the foreseeable future.

Other known coal occurrences in WA are at Irwin River, Eradu (east of Geraldton), Bookara (south of Geraldton), in the south-east portion of the Carnarvon Basin, and in the Canning Basin, south-west of Derby.

Reserves and production

Australia has recoverable reserves of 49 500 Mt of black coal and 42 000 Mt of brown coal, which represents about 4% of the world's coal reserves.

Australia produces 4% of the world's black coal annually, and is ranked sixth (well behind China, the United States and the former Soviet Union) as an international producer.

Australia is ranked tenth as a producer of brown coal.

About 16% of the world's brown coal reserves are located in Victoria's Latrobe Valley.

Most of Australia's black coal resources are concentrated in the Sydney Basin in NSW, the Bowen Basin in central Queensland and the Surat Basin in south-east Queensland.

In Western Australia, total coal resources are estimated at 6 840 Mt. WA's only producing coalfield at Collie has total resources of about 1 330 Mt.

About 5.4 Mt are mined annually in WA, most of which is used for power generation.

Mining methods

There are two main methods of mining coal— surface and underground.

Δ *A "Continuous Miner" gnaws away at a coal seam near Collie.*

Surface mining, sometimes called open-cut, opencast or strip mining, is used where the coal seam lies close to the surface (usually up to 120 metres).

Most of Australia's coal is extracted from open-cut mines. Open-cut mines are cheaper to operate than underground operations. A greater proportion of the coal seam can be extracted, there are fewer accidents and there is also less exposure to dust for miners.

Overburden (soil and rock) is first broken up by explosives, and removed by front-end loaders and trucks or big mechanical excavators, called walking draglines.

Once the coal seam is exposed it is drilled, exploded and systematically mined in strips.

After the coal has been removed, the site is reshaped to conform with the surroundings: covered with topsoil, fertilised and revegetated.

Underground coal mines in Australia generally operate at depths between 150 metres and 500 metres. The coal seam is reached either by a vertical shaft or sloping tunnels called drifts.

Coal is extracted by mechanical methods using continuous miners or longwall equipment.

Continuous miners use the "bord and pillar" method of extraction where blocks of coal are cut out leaving sections, or pillars, behind to support the roof. In certain circumstances, these pillars are later removed and the roof subsequently collapses.

In longwall mining, hydraulic rams support the roof as a cutting head moves across the coal face along the length of the longwall unit.

After the coal is removed, the complete unit is moved forward and the process is repeated. The roof collapses behind as the unit is advanced. The longwall method is a more efficient way of extracting coal, but only under certain geological conditions.

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