

# What is Coal?



Coal is one of the most significant natural resources in the world, with extensive reserves in almost 100 countries.



Left: Drill Samples from the Stockton Plateau, Buller, Top right: Rotowaro Opencast Mine, Bottom right: Stockton Coal Handling Processing Plant.

Coal is the altered remains of prehistoric vegetation that originally accumulated as plant material in peat mines. The accumulation of silt and other sediments, together with tectonic movements in the earth's crusts buried these biochemical deposits often to great depth.

This subjected the plant material to elevated temperatures and pressures causing physical and chemical changes in the peat, transforming it into coal. Initially it was converted into **lignite** or **brown coal**.

Over many more millions of years, the increased temperature and pressure produced more changes in the lignite, progressively increasing its maturity and transforming it into **sub-bituminous** coals. As further chemical and physical changes occurred these coals became harder and more mature, to be classified as **bituminous** or hard coals. Under the right conditions, the progressive increase in the organic maturity continued, ultimately to form **anthracite**.

Coal classification depends on the nature of the original vegetation, the length of the coalification process and most importantly the depth and temperature it was subjected to. The proportion of hydrogen, oxygen and carbon also decides how a coal will be classified or ranked. Coal can be further analysed by its proportion of moisture, sulphur, volatile matter, fixed carbon, ash and physical properties.

Low-rank coals, such as lignite and sub-bituminous coals, have a dull, earthy appearance. They have high moisture levels, a low carbon content and therefore a low energy content. Higher-rank coals typically have a black vitreous lustre. Increasing rank is accompanied by a rise in the carbon and energy contents and a decrease in the moisture content of the coal.

Large coal deposits only started to be formed after the evolution of land plants in the Devonian period, some 400 million years ago. Significant accumulation of coal occurred since the Carboniferous/Permian period (350-225 million years ago) in the Northern and Southern Hemisphere and, more recently, the late Cretaceous period to early Tertiary era (approximately 100 - 15 million years ago) in areas as diverse as the USA, South America, Indonesia, India, Australia and New Zealand.

Coal Type	Depth of Burial	Maximum temperature during burial	Moisture Content	Fixed Carbon Content
Peat	0-0.2km	0-25°C	75%	10-20%
Lignite	0.2-1.5km	25-45°C	30-75%	20-35%
Sub-bituminous	1.5-2.5km	45-75°C	10-30%	35-45%
Bituminous	2.5-6km	75-180°C	1-10%	45-80%
Anthracite	>6km	>180°C	<5%	80-96%



Left: New Vale Opencast Mine, Middle left: Spring Creek Underground Mine portal, Middle right: Peacock coal, Right: Rotowaro Opencast Mine.

## World Coal Reserves

Coal is one of the most significant natural resources in the world. It has been estimated that there are over 984 billion tonnes (Bt) of proven coal reserves worldwide. This means that there is enough coal to last us almost 200 years. Coal is located worldwide – it can be found on every continent in over 70 countries, with the biggest reserves in the USA, Russia, China and Australia.

While it is estimated that there is enough coal to last almost 200 years, this could extend still further through the discovery of new reserves from ongoing and improved exploration activities and advances in mining techniques, which will allow previously inaccessible resources to be reached.

Over 4 Bt of coal is currently produced worldwide each year – a 38% increase over the past 20 years. Global coal production is expected to reach 7 Bt in 2030 – with China accounting for around half the increase over this period.

## New Zealand Coal

Coal occurs widely throughout New Zealand and our economically important coals range in age from 25 to 70 million years. New Zealand's total in-ground resource amounts to some 15 Bt, with 80% of this made up of Southland lignites.

The major coal producing areas are Waikato, the West Coast and Southland, with smaller fields in Taranaki, Nelson and Otago. In geological terms New Zealand

is very young compared with continents, but its tectonic history has been active. Because of the land's mobility, the thickness of sediment cover over many peat deposits increased rapidly at a high geothermal gradient and as a result some of our coal contains as much energy potential as many much older overseas coals.

Less than 10% of New Zealand's available reserves are bituminous, while 22% are sub-bituminous and 70% lignite.

**South Island coals:** The South Island's West Coast is one of New Zealand's most geologically active regions. Buller and Greymouth coalfields have been buried deeply and uplifted fairly rapidly. As a result they contain bituminous coal, much of it well above sea level. The Ohai field in Southland has seen less burial so its coals have not quite reached bituminous rank. The lignites of East Southland have only seen shallow burial, followed by slight tilting and uplift.

**North Island coals:** The coal areas of the North Island have all had fairly similar geological histories and mineable coal is only of sub-bituminous rank. The bituminous coals in the North Island are buried thousands of metres below Taranaki and offshore from Northland to north-west Nelson. The volatile material driven from them produced natural gas, condensate and crude oil (now produced from Maui and other smaller gas fields).

## Solid Energy

Solid Energy has opencast and underground mines around Huntly in Waikato, Greymouth, Westport and Reefton on the West Coast and in Southland, employing more than 1400 people directly and 200 more through contractors working mainly at the opencast mines.

The company produces about 4 million tonnes (Mt) of coal a year, of which about half is exported. While New Zealand's share of the world trade is small, our coal is valued internationally for its special qualities, particularly its low ash and phosphorus content, and high vitrinite making it suitable for steel making.

Forecast demand within New Zealand and internationally is driving the planning and development of new mines. While Solid Energy has more than 2 Bt of coal and lignite in our licence and exploration areas, not all is accessible at prices that are economically viable today. Our current reserves total about 49 Mt. We estimate that our production over the next 20 years will total about 100 Mt, requiring ongoing major investment in the development and expansion of new and existing mines.

### For further information visit:

- World Coal Association at: <http://www.worldcoal.org/>
- Solid Energy New Zealand Ltd at: [www.coalnz.com](http://www.coalnz.com)
- Straterra at: [www.straterra.co.nz](http://www.straterra.co.nz)

### Sources:

"The New Zealand Coal Industry" Lyn Morris, Enterprise New Zealand Trust, 1997  
 "Coal: Power for Progress," World Coal Institute, 2000  
 "The Coal Resource," World Coal Institute, 2005

