The New Zealand Coal Industry

PROMOTING ENTERPRISE EDUCATION IN PARTNERSHIP WITH NEW ZEALAND BUSINESSES

Source: CRANZ

The New Zealand Coal Industry

A resource for senior students and teachers

by Lyn Morris
Enterprise New Zealand Trust

Enterprise New Zealand Trust
66-70 Bloomfield Terrace
PO Box 31-545
Lower Hutt

Coal Research Association of New Zealand Inc.
68 Gracefield Road
PO Box 31-244
Lower Hutt

Foreword

Industry Studies Project

Our industry studies series is designed to help senior students, teachers and tutors. Each study reflects the way the industry operates. Users of our booklets, who may question the structure and operation of an industry, will find the information relevant and useful to any debate.

Each industry study has been prepared by the Enterprise New Zealand Trust in conjunction with the particular industry featured.

Kathie Willis, the Trust's Manager of Educational Programmes since 1991, has developed the series. Lyn Morris, the author of this study, recently joined the Trust as a Programme Director. Lyn has had 21 years' teaching experience. Her last teaching position was in 1995 as Head of Commerce at Chilton Saint James School in Lower Hutt.

The studies provide practical background material for students and teachers who are looking for New Zealand industries to research and study. Further information on the industry can be sourced from surveys of retailers, producers, newspapers and industry publications.

The studies are useful because they:

- contain relevant and up-to-date information
- are founded on thorough research
- provide a basis for exercises and project work
- include graphics and statistics.

The industries studies project is one example of the school-industry links being developed by the Enterprise New Zealand Trust to promote a better understanding of business and the economy in schools. Industry funding has enabled each study to be prepared. We hope that these studies will establish closer links between schools and some of New Zealand's major industries.

The full series to date includes:

- The New Zealand wool industry (March 1992)
- The New Zealand meat industry (June 1992)
- The New Zealand dairy industry (October 1992)
- The New Zealand apple and pear industry (June 1993)
- The New Zealand poultry meat industry (July 1994)
- The New Zealand kiwifruit industry (October 1994)
- Manufacturing in New Zealand (May 1995)
- Local Government in New Zealand (1997)
- The New Zealand coal industry (1997)

Reproduction of any part from this material must be acknowledged.

Ken Baker
Executive Director
Enterprise New Zealand Trust
May 1997

Published by Enterprise New Zealand Trust, PO Box 31-545, Lower Hutt

ISBN 0-9583259-2-8

Contents

- **GLOSSARY** 4
- *Chapter One* - **IMPORTANCE AND STRUCTURE** 6
- *Chapter Two* - **NATURE AND USES OF COAL** 9
- *Chapter Three* - **DEVELOPMENT OF THE COAL INDUSTRY** 11
- *Chapter Four* - **DEMAND, PRICES AND COMPETITION** 13
- *Chapter Five* - **PRODUCERS, DISTRIBUTION AND SUPPORT CHAINS** 19
- *Chapter Six* - **ENVIRONMENTAL ISSUES** 25
- *Chapter Seven* - **FUTURE DEVELOPMENTS** 29

Enterprise New Zealand Trust is pleased to acknowledge editing and financial assistance from Coal Research Association of New Zealand. The assistance of individual coal producers and the staff of CRL - Energy Research and Testing with data and information relating to the coal industry is also acknowledged. Special thanks to the Librarian at BP Oil, for documentation and data provision.

Glossary

agglomeration	formation of larger coal or ash particles by smaller particles sticking together
anthracite	a hard, black, shiny coal very high in fixed carbon and low in volatile matter, hydrogen and oxygen
biogas	energy produced from the anaerobic digestion of sewage and industrial waste
bituminous coal	a relatively soft dark brown to black coal, lower in fixed carbon than anthracite, but higher in volatile matter, hydrogen and oxygen
char	the solid carbonaceous residue that results from incomplete combustion of organic material
coal rank	the classification of coal in terms of its chemical and physical properties
co-generation	the simultaneous or sequential production of two or more forms of useful energy from a single primary energy source
coking coal	coal with a quality that allows the production of a coke suitable to support a blast furnace charge
cover:coal ratio	the proportion of overburden to coal prior to mining
CV	calorific value, energy content measured as the heat released on complete combustion in air or oxygen
depression	a phase of the business cycle characterised by widespread unemployment, under-utilisation of industrial capacity and little investment or consumer optimism
elasticity	the responsiveness of demand (in this case energy) to other variables, primarily (energy) prices and income
externalities	the side effects of an action which influence parties other than those directly involved in the action
fossil fuels	coal, natural gas, LPG and fuels derived from crude oil (including petrol and diesel). They have been formed over long periods of time from ancient organic matter.
GATT	General Agreement on Tariffs and Trade. An international agreement made in 1947 to reduce trade restrictions. It attempts to negotiate tariff reductions, prevent discriminatory trade practices and eliminate import quotas.
GJ	Gigajoules. 10^9 joules. A generic unit of energy
GDP	Gross Domestic Product. A measure of the value of goods and services produced in a year
greenhouse gases	gases that increase the temperature of the earth's surface. They include water vapour, tropospheric ozone, chlorofluorocarbons, carbon dioxide, carbon monoxide, methane and nitrous oxide.
hard coal	coal with a high proportion of carbon to oxygen
IEA	International Energy Agency
integration	the process whereby firms combine or merge to form larger units
ITO	Industry Training Organisation
joint venture	an undertaking of a risk with another party
lignite	a brownish-black, woody-structured coal, lower in fixed carbon than either anthracite or bituminous coal, but higher in volatile matter and oxygen
marginal cost	the increase in total costs of production that results from the production of one extra unit of a good
marginal revenue	the change in total revenue resulting from one unit change in the quantity sold
marginal social benefit	the sum of the private benefit and the spillover benefit of consuming an extra unit
marginal social cost	the sum of the private cost and the spillover cost of producing an extra unit
metallurgical coal	coal suitable for steel production
mine roof	the layer of rock or coal over an underground mine working
monopsony	a market in which there is only one buyer of a resource
natural gas	consists mainly of methane occurring naturally in underground deposits. It may be associated or free gas.
NZMIA	New Zealand Minerals Industry Association

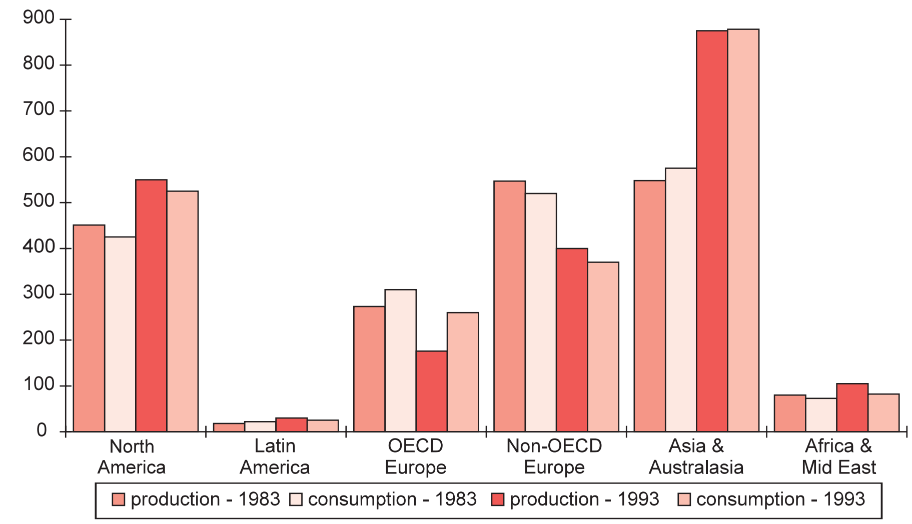
opencast	mining by removal of the surface layers, working from above, not from shafts
overburden	rock etc. that must be removed prior to mining the mineral deposit beneath it
pit-head	the top of a mine shaft
PJ	Petajoules. 10^{15} joules. A generic unit of energy
primary energy supply	calculated as indigenous production + imports - exports - stock change - international transport
reducing agent	a substance that brings about a conversion to metal by oxidation and losing electrons
RMA	Resource Management Act
SOE	State owned enterprise. A government department that was really a trading enterprise and has been established as a business operation and is governed by SOE regulations.
splint coal	hard dull coal which occurs in bands in coal seams. It does not burn readily
spot market	the market pertaining to a here and now point in time
steaming coal	see thermal coal
sub-bituminous	a glossy-black, non-agglomerating coal lower than bituminous coal in fixed carbon and with more volatile matter and oxygen than the latter
thermal coal	coal used for steam raising and space heating purposes, including all anthracite coals and bituminous coals not included under coking coal
try pot	a pot for extracting oil from fat by heating
turnkey	providing for a supply of equipment in a state ready for operation
vertical integration	the joining of firms responsible for different production stages of a particular product so that more of the entire process is under a single control

Chapter One

Importance and Structure

Coal is one of the most significant natural resources in the world, with extensive coal reserves occurring in almost 100 countries. It is second only to oil as a source of energy and, at current levels of proven reserves and consumption, global coal reserves will last more than twice as long as the combined known reserves of oil and gas. Coal is most widely used in electricity generation and as a "reducing agent" in steelmaking. It is the most available and likely energy source to meet the rapidly growing energy demand in developing countries in the medium term.

FIGURE 1
Production and Consumption 1983 and 1993
(million tonnes of oil equvilent)



(Source: BP Statistical Review June 1994)

The world's major hard coal producers are China, North America, India, South Africa, Australia, the Russian Federation, Poland, Kazakhstan and the Ukraine. Coal is mostly consumed in the region where it is produced, but about 12 percent is traded between countries. Australia is the leading coal exporting country followed by North America, South Africa and Indonesia. Major net importers are OECD Europe, Japan, South Korea and Taiwan. The largest growth in both consumption and production over the past decade has been in Asia and Australasia. Figure 1, Production and consumption 1983 and 1993, illustrates recent patterns of growth.

Coal has played a significant part in the development of New Zealand and will continue to contribute to the New Zealand economy in the future. Coal occurs widely throughout the country, and reserves greatly outweigh the country's known deposits of oil and gas. New Zealand's total in-ground resource amounts to 15 billion tonnes, of which 8.6 billion tonnes (74 percent of New Zealand's energy resource) are judged to be recoverable.

The major coal producing areas are Waikato, Westland and Southland, with smaller fields in Taranaki, Nelson and Otago. Total coal production for the year ended December 1995 was approximately 3.5 million tonnes and by March 1996, about 47 percent of production was being exported. In 1995 there were 53 mines in operation, of which 42 were opencast and 11 were underground mines. They were responsible for approximately 81 percent and 19 percent respectively of total coal production. Five mines produced over 200,000 tonnes of coal each and 26 operators had an output of under 10,000 tonnes.

Coal currently supplies almost 10 percent of New Zealand's energy needs. Its main competitors are natural gas in the North Island and

Table 1, New Zealand coal production figures 1995, outlines recent production figures, which indicate the increasing use of opencast mining methods and the concentration of production in the following districts.

TABLE 1
New Zealand coal production figures 1995 (in tonnes)

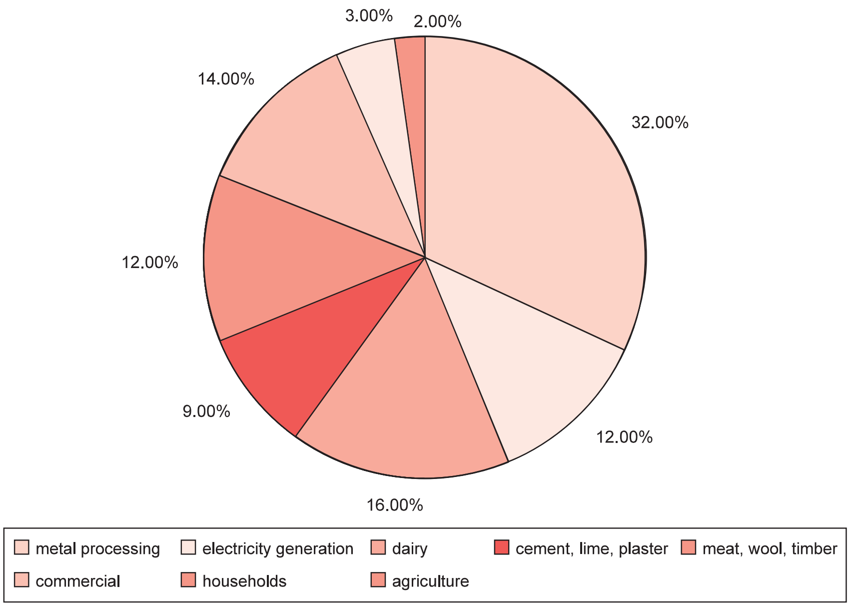
Region	Opencast	Underground	Total
Waikato	1,148,033	275,081	1,423,114
West Coast	1,345,994	305,166	1,651,160
Canterbury	1,879	0	1,879
Otago	41,517	0	41,517
Southland	198,291	129,077	327,368
New Zealand total	**2,735,714**	**709,324**	**3,445,038**

(Source: New Zealand Annual Mining Review 1995) hydro-electricity, especially in the South Island.

The major, local end users of coal are basic metal manufacturing (principally steel), which in the year to December 1995 accounted for 33 percent of total coal used in New Zealand, and other manufacturing (primarily the cement, lime and plaster, meat, dairy products, wool and timber industries) 32.9 percent. Electricity generation (including co-generation) took 15 percent and commercial heating 14.6 percent. Household use accounts for only 2.6 per cent, agriculture 2 per cent and 0.1 per cent for transport, as illustrated in Figure 2, Major end users of coal in New Zealand.

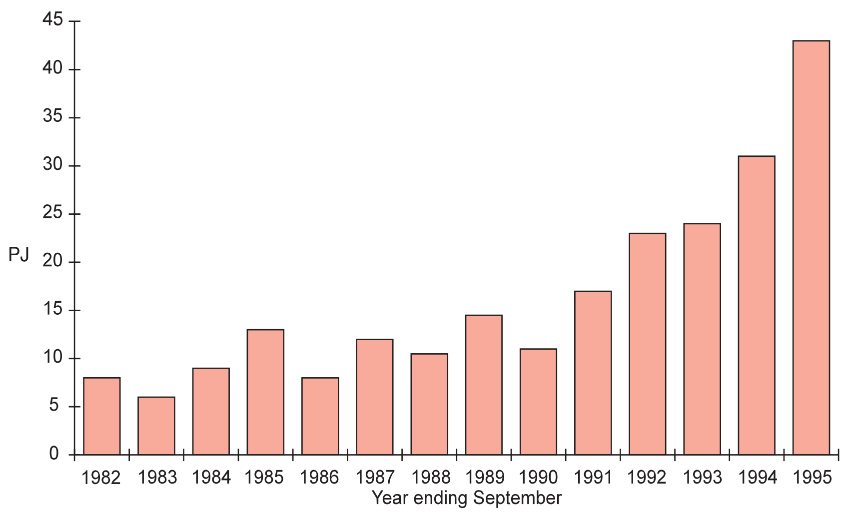
Dwindling gas supplies, a lack of investment in oil and gas exploration and increased environmental constraints on new hydro schemes mean that coal will very probably be an important component in electricity generation, in coming decades. Environmental policies will be a critical factor in coal use.

FIGURE 2
Major end users of coal in New Zealand



(Source: CRANZ Inc.)

FIGURE 3
New Zealand coal exports



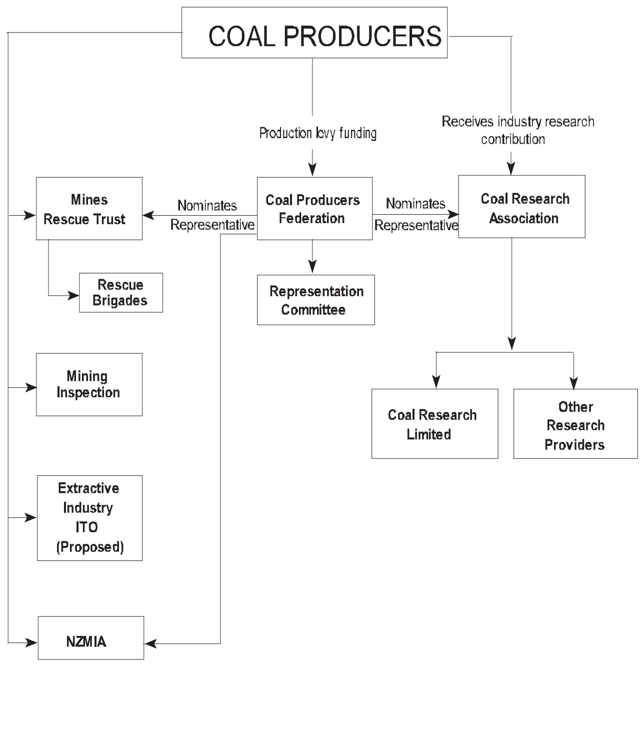
(Source: Ministry of Commerce)

New Zealand has taken advantage of growing Asian demand to expand coal exports. Intensive marketing of New Zealand's premium coals in recent years has dramatically increased the proportion of coal it exports. Between 1962 and 1974 coal exports were fewer than 50 tonnes a year. From 1975, export tonnage rose steadily until, after trial shipments of West Coast coal began in the late 1970s, coal exports leapt to 93,000 tonnes in 1980. By June 1996, they had reached 1.4 million tonnes. The removal of subsidies on the production of coal, and the move to establish competitiveness in the coal industry, provided the incentives to search for alternative markets. Figure 3 indicates the rise in coal exports (using the heat measure, petajoules) since 1982.

Coal producer support agencies

The coal producers are supported by a variety of agencies which are outlined in figure 4.

FIGURE 4
Coal producers support agencies



(Source: CRANZ)

Industry participants

Table 2 lists the participants in the primary, secondary and tertiary sectors of the coal industry.

TABLE 2

Sectors	Participants
Primary *(extraction)*	Prospecting geologists Miners Electrical and mechanical tradesworkers Machine operators Mining technicians Mine maintenance staff Ventilation and mining engineers Mine inspectors Heavy machinery drivers Mine planners Quarrymen and explosive technicians Miscellaneous support staff (e.g. finance)
Secondary *(further processing)*	Preparation and screening staff Blending and bagging plant staff
Tertiary *(services)*	Transporters -rail workers -deep water port employees -shippers Storage handlers Healthy/safety staff Mines rescue personnel Environmental monitoring staff Coal research personnel, consultants -chemists -geologists -analytical services -support staff Coal merchants Marketers

Chapter Two

Nature and Uses of Coal

Coal formation and classification

New Zealand's economically important coals range in age from 25 - 70 million years. Coal classification depends on the nature of the original vegetation, its biochemical experience and the length of the coalification process. Deposits of coal are formed from plant material which has been buried and altered by heat and pressure over a long period of time. When plant life partially decays under anaerobic conditions, it forms peat. After peat accumulates, it may then be compressed under other sediments. This change reduces the quantity of water and oxygen present, while at the same time increasing the proportion of carbon, to form coal. The proportion of hydrogen, oxygen and carbon is what decides how a coal will be classified or 'ranked'. The greater amount of carbon, the higher the rank of the coal.

Variations within coal, apart from those factors relating to its age and rank, may be a result of the nature of the original plant life. They may also depend on the mud content of the original peat, or the waterborne trace chemicals washing through the decaying plant matter. Coal can be further analysed by its proportion of moisture, sulphur, volatile matter, fixed carbon, ash and physical properties.

New Zealand coals, in descending order of rank and with percentage of available reserves in brackets, are bituminous (8 per cent), sub-bituminous (22 per cent) and lignite (70 per cent). Bituminous coal is black with a bright shining lustre. Sub-bituminous coal is black with a faint brown tinge and a dull shine. Lignite is a dull, brown coal. Coal regions, types and markets are summarised in table 3.

Coal properties determine usage

Different types of equipment and processes require different types of coal. Desirable features include low sulphur content, low residual ash and a sufficient heating value for the particular use. The ability of some coal to swell during heating is an important property for some industries, notably steel works.

With end uses in mind, coal is often described as either *coking* or *thermal.*

- *Coking coal* is medium-to-high rank bituminous coal which swells, fusing to form hard coke when heated in coke ovens. Coke is coal minus the moisture and volatile material. It is produced by heating coal quickly in the absence of air. Coke is used for steel production in blast furnaces. Sub-bituminous coals form char under similar conditions.
- *Thermal coal*, also called *steaming coal,* is used for heat generation. Thermal power stations, cement and lime producers need thermal coal to feed their boilers. Steel making in New Zealand uses a non-swelling thermal coal from the Waikato coalfield.

Each category of coal has its own market, in which prices rise and fall, according to market demand and availability.

Changing uses

Initially, coal was:

- used for heating in open fires and cooking in coal ranges
- converted into gas (at gas works) and used for gas lighting
- converted into steam in boilers and then used to drive steam engines in factories, ships and trains.

Technological improvements in machinery meant the coal could be burnt using new methods. This was particularly important to the steel industry. As a consequence of its properties as a reducing agent (ability to convert iron compounds to another form), coal is used as a raw material in steel production.

TABLE 3

Coal producing regions, types and markets

Coal producing region	Coal type	Markets
Waikato (North Island)	Sub-bituminous	Domestic steel, electricity, industrial heating and household
West Coast (South Island)	Bituminous plus minor sub-bituminous	Export coking, export thermal, domestic industrial
Southland (South Island)	Sub-bituminous and lignite	Domestic meat, dairy, hospitals, schools etc.

(Source: Coal 1995, Australian Coal Report)

Table 4, Changing uses of New Zealand coal, shows the main uses of coal over the last fifty years, over four periods. It reflects the development of alternative fuels, technological change and the growth of new industries.

TABLE 4

Changing uses of New Zealand coal
(annual averages, tonnes per year)

Coal uses	1946 - 50	1971 - 73	1981 - 83	1991 - 93
Export	0	0	220,000	800,000
Steel mill	0	140,000	150,000	750,000
Factories	685,000	600,000	595,000	510,000
Households	600,000	280,000	261,000	240,000
Cement making	110,000	250,000	220,000	220,000
Other uses	380,000	310,000	288,000	200,000
Electricity	70,000	600,000	500,000	100,000
Gas making	315,000	100,000	21,000	0
Railways	565,000	219,000	0	0
Shipping	75,000	0	0	0
Total	**2,800,000**	**2,499,000**	**2,255,000**	**2,820,000**

(Source: Solid Energy)

Chapter Three

Development of the Coal Industry

Early settler discoveries

The first recorded use of coal in New Zealand by Europeans dates back to the 1830s. Sailors broke off lumps of coal from beach outcrops at Shag Point (Otago) for fuelling their try pots, used for rendering whale blubber down to oil, and for heating and cooking. Maori in the Waikato area showed European settlers coal outcrops in 1842.

Brunner and Heaphy discovered coal near Charleston on the South Island West Coast and in the Grey River area in 1848. The first recorded coal mine opened in 1849 at Saddle Hill, near Dunedin. In 1859, coal was discovered by Rochfort in the Buller field.

During the 1860s, discoveries were made in Northland by gum diggers and in the Waikato, coal was used to fuel the river steamers. By the 1870s, mining had begun in Ngakawau, Huntly and Denniston. During the following decade, the coal mining industry became well established. By 1899, coal miners were extracting one million tonnes per year.

Employment

Coal mining was an important industry in nineteenth century economic development of New Zealand. In the developing colony, early industries, the distribution networks of rail and shipping and households, all relied on coal as their energy source.

Entire communities grew up dependent on coal as their economic base and some localised populations became virtual monopsonies for the employment of labour. The South Island West Coast boomed, attracting migrant labour with mining skills. The township of Huntly grew up around the original pit-head of the Taupiri Coal Mining Company, which was established in 1874. The social fabric of these communities has often been subjected to the economic cycles associated with the industry.

The variations in output and associated numbers of people employed in coal mining since 1936 are shown in table 5. Over the last fifty years, the mechanisation of extraction and the shift to opencast mining have reduced the demand for labour in coal mining. In 1936, it took 4,257 workers to produce 2.2 million tonnes of coal; in 1995, it was possible to produce 3.5 million tonnes with only 740 workers. The reduction in employment improved industry productivity and competitiveness but deeply affected traditional mining communities. Studies in the United States in 1995 indicate that for every coal miner employed, eleven jobs are created elsewhere in the community. Today, the areas of Waikato, Westland and Southland are the most vulnerable to the changing patterns of coal use and cyclic economic activity. They will also reap the most benefit if the country turns to coal to help meet the energy needs of the next few decades.

TABLE 5

Output and employees 1936-1995

Year	Output (tonnes)	Employees
1936	2,174,460	4,257
1941	2,681,739	4,991
1946	2,838,572	5,557
1951	2,474,473	5,062
1956	2,669,759	4,548
1961	2,971,521	4,044
1966	2,636,163	3,359
1971	2,124,240	2,297
1976	2,486,904	1,528
1981	2,196,894	1,580
1986	2,518,000	1,670
1993	3,101,100	676
1995	3,446,000	740

(Sources. Mines Statements 1946 and 1963, Ministry of Energy 1983, Ministry of Commerce, January 1996, NZ Mining Update for Schools 4)

Safety and health

Technological and legislative advances have greatly improved safety and working conditions. Mining conditions are often difficult and can be dangerous. Mining practices have changed to take account of these conditions and worker safety is of prime importance to the industry. The Mines Rescue Trust is based at Huntly and Westport. It is a system of core paid staff and a number of volunteer staff who will be mobilised in the case of disaster.

The politicising of the workforce

A crusading mission to humanise mine work sprang up and spread to a desire to transform society. The West Coast's town of Blackball became a centre of discontent and resistance to the dangerous conditions and the brutally hard work. In 1908, the miners went on strike, demanding an eight hour work day and a doubling of the fifteen minute lunch break.

The New Zealand organised labour movement and the NZ Labour Party both have their origins in the Blackball Coal Miners' Strike. For a short time, the New Zealand Communist Party was also headquartered at Blackball and the country's first miners' union was located at Runanga, north of Greymouth.

Mine ownership issues

Until the end of the nineteenth century New Zealand coal mines were all privately owned and operated. State Coal Mines was established in 1901 under the Coal Mines Act and opened the first government owned mine at Seddonville in the Buller region in 1903. But private mining continued to dominate the industry, which suffered setbacks in the depression of the 1930s and experienced a brief resurgence during World War II. After the war, production stabilised and became less profitable. One after another, private mines were abandoned.

The State took over many mines, even those deemed unprofitable, in order to ensure a cheap coal supply for post-war recovery and employment, and to preserve mining skills in the mining regions. Government continued to support the coal industry by making coal-fired heating compulsory in public buildings. By 1950, State Coal Mines was the country's largest mining operation. In 1952, State Coal Mines was absorbed into the Mines Department and did not regain separate trading status until 1983.

By 1966, Government policy was to shut down uneconomic mines. Between 1961 and 1973, more than 3,000 people left mining settlements, as a result of a second decline due to the introduction of cheap electricity and fuel oils.

The 1970s oil crises spurred the Government to reassess New Zealand's energy resources. The New Zealand Coal Resources Survey was carried out in the late 1970s and early 1980s. State Coal Mines began production in 1978 at Huntly East and West underground mines, servicing NZ Steels Mill and the Huntly Power Station. With the subsequent sale of Maui gas rights by the Government, gas became the preferred fuel and coal a back-up fuel at Huntly.

State Coal in decline

Despite increased sales, State Coal Mines made losses. In 1986, over $100 million was spent on capital development of mines and prospecting areas. A trading loss of $76 million was incurred and total debt amounted to $600 million. It was estimated that it cost $160,000 a year to keep each State Coal miner employed. The fourth Labour Government decided to add State Coal to its list of state-owned enterprises. Until 1987, the government had set State Coal's prices at a politically acceptable level and kept mines in operation for social and political reasons.

The State Owned Enterprises model

State Coal Mines was corporatised in 1987 and was called the Coal Corporation of NZ Ltd (CoalCorp). Wholly owned by the government, the State Owned Enterprise (SOE) has two shareholders — the Minister of State Owned Enterprises and the Minister of Finance. The SOE's board of directors comprises people with business expertise.

The objective of the new organisation was to operate as a commercial business. Whereas State Coal Mines previously had centralised energy planning, regional development and employment objectives, CoalCorp was motivated by economic efficiency and required to focus on profit. As a State Owned Enterprise, it set about turning around twenty years of losses. As the State Coal Mines had already done much of the prospecting and overburden stripping and incurred related costs, CoalCorp inherited several advantages. Productivity improved. An expanded export strategy was put in place and new markets were found. In the first year of operation, CoalCorp turned a loss of $76 million to a profit and continues to trade successfully.

In 1997, Coal Corporation of New Zealand was renamed Solid Energy New Zealand Ltd and the export operation became Solid Energy International.

Solid Energy is the dominant producer in the coal industry. It produces two-thirds of New Zealand's coal from ten mines. There are also three medium-sized private sector coal companies, and about twenty-three small coal mines are still privately operated.

Chapter Four

Demand, Prices and Competition

International trends

Over the last ten years, world demand for coal has moved within a constant band. Table 6, World primary energy consumption by fuel, shows the trends for usage over two decades. The demand for coal is growing in the Asia/ Australia region, where economic growth is consistently higher than the world average. Until alternative technologies are put in place, or other energy resources become more available in this area, coal is a viable, cost efficient energy source for these fast developing regions.

New Zealand energy demand and consumption

Although New Zealand energy consumption has risen steadily since 1984, coal consumption has remained relatively static in recent years. In the calendar year of 1994, coal provided just over 10 percent of the primary energy demanded. Consumer energy demanded by fuel for 1993-94 is illustrated in table 7, Total consumer energy by fuel (percent).

Coal consumption levels are largely determined by industrial requirements, which, in turn, are related to Gross Domestic Product (GDP) growth rates. Based on real GDP forecast growth rates shown in table 8, total consumer energy by fuel is forecast to increase by 45 percent from 1995 to 2020, with coal demand expected to rise by 24 percent. Table 9 shows total consumer energy by fuel 1995-2020.

If the expected decline in gas reserves occurs around 2005, coal is increasingly likely to be used as the energy source for electricity generation. The anticipated growth in coal demand over the next twenty-five years puts considerable pressure on the industry. It is possible that estimated growth in North Island demand may have to be met by imports from the South Island, Australia or Indonesia. Table 10 shows coal demand for 1995-2020, assuming that much of the current gas fuelled electricity generation switches to coal and new coal-fired plant is installed near the end of 2020.

Changes in derived demand influence coal production

Demand for coal is dependent on the demand for the final product that coal helps to produce. Demand for coal as such is a derived demand as it is an input resource for industrial use.

Changes in demand for steel, forestry, dairy, cement and lime products would all impact significantly on the coal industry.

TABLE 6

World primary energy consumption by fuel
(million tonnes of oil equivalent)

Year	Oil	Gas	Coal	Hydro	Nuclear
1973	2798.0	1066.1	1581.1	112.5	52.3
1975	2724.8	1079.4	1615.8	124.5	94.0
1977	2985.9	1161.9	1729.9	128.7	138.1
1979	3125.0	1273.4	1839.9	145.4	164.9
1981	2902.8	1320.7	1831.9	151.2	215.6
1983	2801.4	1325.5	1920.8	165.4	265.7
1985	2802.5	1490.5	2099.9	174.2	382.2
1987	2948.2	1580.9	2198.4	179.9	447.9
1989	3087.0	1734.5	2268.8	183.7	502.3
1991	3133.1	1798.7	2193.3	194.8	541.3
1993	3131.5	1830.0	2165.7	205.2	564.5
1995	3226.9	1883.6	2210.7	218.5	596.4

(Source: BP Energy Data File)

TABLE 7

New Zealand total consumer energy by fuel (%)

Year	Coal	Oil	Gas	Geothermal direct use	Electricity	Other renewables	Total
1993	11.2	40.8	9.6	3.3	25	10.1	100
1994	10.3	42.9	9.5	3.0	24.4	9.9	100

Other renewables include wind, landfill gas, biogas, biomass and animal products, industrial and municipal waste and wood.
(Source: Ministry of Commerce)

TABLE 8

Real GDP growth rates: historic and forecast (1964 - 2020)

March years	Growth rates (% pa)
1964 - 1994	2.4
1984 - 1994	1.6
1994 - 1995	3.6
1996 - 2020	3.0

(Source: Ministry of Commerce)

TABLE 9

Total consumer energy by fuel 1995-2020 (PJ per annum)

March years	Coal	Oil	Gas	Electricity	Total
1995	46.5	197.0	66.2	106.5	416.2
2000	51.6	221.7	70.3	119.2	462.8
2010	56.6	267.2	52.6	142.5	518.9
2020	57.6	322.7	57.8	166.0	604.1

(Source: Ministry of Commerce)

TABLE 10

Coal demand (PJ) 1995-2020

March years	Residential	Metals manufacturing	Other industrial and commercial	Electricity generation	Total
1995	1.3	15.0	30.2	5.2	51.7
2000	0.5	18.8	32.3	5.2	56.8
2010	0.0	20.0	36.5	62.3	118.9
2020	0.0	20.0	37.6	85.1	142.7

(Source: Ministry of Commerce)

Steel and cement, in particular, are both sensitive to the prevailing economic climate, especially the building sector. Dairy farming, in recent years, has been increasing in the South Island, as a result of comparatively advantageous land prices and coal has a strong cost advantage over other energy sources in the South Island. It is important to the dairy industry, where it is used to provide heat for drying milk and for co-generation. The largest dairy company, the New Zealand Dairy Group, maker of the Anchor brand of products, owns its own coal mines (Glencoal Energy) and is an example of vertical integration. Demand from hospitals has declined, due to hospital closures, cost reductions and energy efficiency programmes.

The steel industry

Expansion of the Glenbrook steel mill has increased the coal used for steel making by 500 percent in the last twenty years. Actual and anticipated energy requirements for the iron and steel industries are set out in table 11.

Forestry

The forestry industry is a high energy user, accounting for 12 percent of total energy demand in 1990. The expected energy demand increase from this high growth sector is likely to be over 80 percent, from its 1990 level of 45PJ to 81PJ per annum in 2020. The use of coal is expected to rise by 50 percent from 2.1PJ to 3.2PJ over the same time frame as a result.

Electricity

In New Zealand, electricity is generated mostly by hydro, with lesser contributions from gas, geothermal, and coal and other more minor contributors, such as wind and solar power. Current projections indicate that a growth in demand for electricity and the prospect of no new discoveries of gas would mean construction of a possible new coal-fired plant would move forward, to come on stream in 2015.

TABLE 11

Iron and steel energy demand (PJ)

March years	Electricity	Gas	Coal	Total
1990	3.8	2.4	13.0	19.2
1995	3.1	1.9	15.7	20.7
2000	2.0	2.0	17.4	21.4
2005	2.1	2.2	18.6	22.9
2010	2.4	2.2	19.1	23.7
2015	2.1	2.2	19.0	23.3
2020	2.0	2.2	18.8	23.0

(Source: Ministry of Commerce. NZ Steel and Pacific Steel provided the 1990 data and assisted with projections.)

Coal prices and competition from substitutes

By international comparison, New Zealand enjoys low coal and electricity costs. Comparative energy prices are indicated in table 12.

In all but one of the countries listed, coal is the cheapest source of industrial energy. New Zealand coal prices are the second to lowest among the countries mentioned and coal is overall the country's least expensive energy source.

In table 13, industrial energy prices for New Zealand are outlined for a three year period.

Energy elasticities

Elasticity of demand indicates the responsiveness of the quantity demanded to a change in another factor, such as price or income. Price elasticity of demand refers to the degree of responsiveness of quantity demanded of a good or service to changes in its price. If the response to a price change is a more than proportionate change in quantity demanded, that is, the co-efficient is greater than one, the good is said to be elastic (i.e Ed > 1). If the response to a price change is a less than proportionate change in quantity demanded, that is, the co-efficient is less than one, the good is said to be inelastic (i.e. Ed <1). Income elasticity of demand refers to the degree of responsiveness of quantity demanded to

TABLE 12

International industrial energy price comparisons Second quarter 1995* (NZ$/GJ)

Country	Coal	Natural gas	Heavy fuel oil	Electricity
New Zealand	3.00	7.40	7.44	17.50
U.S.A.	2.34	3.71	4.23	21.25
Japan	3.19	18.81 (1994)	7.49	81.27 (1994)
Germany	14.99	7.47 (1994)	5.97	44.58
U.K.	3.21	4.00 (Q1 1995)	5.38	25.57(Q1 1995)
Australia	n.a.	5.37 (1993)	n.a.	21.67 (1993)
Canada	n.a.	2.84 (Q1 1995)	4.49	16.15(Q1 1995)
Taiwan	5.75	10.74	8.37	31.30

(Source: Ministry of Commerce, Energy Data File January 1996)

Note 1: NZ Coal price is without delivery costs which can add up to 10 - 100% to the total costs.

Note 2: In addition to the coal prices, there are costs associated with handling, stockpiling and ash disposal.

All NZ prices exclude GST

*Unless otherwise stated, e.g. Q1 1995 = First Quarter 1995

TABLE 13

New Zealand industrial energy prices July 1992 - July 1995 (NZ$/GJ)

	Coal	Electricity	Natural gas	Heavy fuel oil
July '92	3.60 (1990)	15.19	7.53	8.30
Jan. '93	3.00	15.64	7.29	8.80
July '93	3.00	15.19	7.30	9.31
Jan. '94	3.00	15.47	7.30	9.30
July '94	3.00	17.09	7.17	5.61
Jan. '95	3.00	17.20	7.28	8.71
July '95	3.00	17.44	7.17	8.88

(Source: Ministry of Commerce, Energy Data File)
All prices are GST exclusive
Coal prices do not include delivery

TABLE 14

NZIER energy elasticity co-efficients

	Price elasticity		Income elasticity	
	Short run	Long run	Short run	Long run
Residential	0.08	0.27	0.13	0.51
Industrial	0.06	0.11	0.72	1.26

(Source: Ministry of Commerce)

changes in income. Elasticity co-efficients have implications for pricing decisions, and resulting total and marginal revenues.

Short and long run elasticities

Time frames for the long and short run vary from industry to industry. In general, the long run is the time the industry takes to change its stock of fixed assets. In the short run, demand for energy is price inelastic, as the elasticities are all less than one, but in the long run, demand is slightly more price elastic. This indicates that as users are able to adjust their capital stock of appliances and equipment in the long run, they are more likely to switch to a substitute form of energy. It is difficult for an industry geared for gas usage to suddenly switch to coal if the price of gas rises. However, there is more likelihood of substitutes being used if the situation persists. Residential and industrial energy elasticities are shown in table 14.

Competition from substitutes

Energy sources available in New Zealand include oil (imported and indigenous), natural gas, hydro and geothermal generation, and other renewable forms such as wind, landfill gas, biogas, biomass, as well as coal. They are not equally substitutable and there are other considerations besides price. Appliance or plant conversion may be expensive. There may be energy efficiency losses involved. Convenience and access are important, especially for the residential sector. Despite the low cost of coal and its guaranteed reserves, it may not be the preferred choice of an industry, for reasons such as environmental constraints or availability of alternative fuels.

The coal industry considers factors such as these, when planning for its future, to ensure its long term success. Table 15 shows own-price and cross-price elasticities of energy substitutes in the residential sector. It shows the percentage change in quantity demanded of the substitute if there is a 10 percent rise in the price of the energy source noted. If there was a 10 percent real rise in electricity prices, for example, in the long term this would lead to a 6.7 percent increase in the demand for coal. The Ed co-efficient in this example would be 0.67.

User perceptions

Usage in parts of Asia and Eastern Europe contribute to a perception of coal more suited to the Industrial Revolution. The picture of heavy industry's black, dirty, smoke belching factories is out-of-date in the twentieth century elsewhere. This perception relates to old technology and use of poor quality coal with high sulphur, ash and moisture contents. Such a viewpoint is more prevalent in the general community than with the actual users of coal.

For many industrial users coal is a cost-effective, long-term energy source. The benefits of guaranteed supply, relatively high combustion efficiencies and low price outweigh disadvantages relating to storage, by-products and high capital equipment costs.

TABLE 15

Own-price and cross-price elasticities in the residential sector

A 10% real price rise in...	..leads to the following long term percentage changes in quantity demanded				
	Electricity	Oil	Gas	Coal	Total
Electricity	-2.6%	29.0%	4.7%	6.7%	-2.1%
Oil	0.0%	-20.0%	0.0%	0.0%	0.0%
Gas	0.3%	2.5%	-6.6%	1.4%	0.1%
Coal	0.0%	1.0%	0.2%	-9.0%	-0.1%

(Source: Ministry of Commerce)

TABLE 16

Industrial users viewpoints of coal as an energy source

Characteristics	Perceptions
Low price	Very cost effective, particularly well-suited to bulk heat applications
Energy efficient	Comparative high energy efficiency (80% efficiency in industrial boilers)
Reliable energy source	Abundant in supply, stable in price
Large reserves available	Long term supply possible No shortages envisaged compared to electricity and gas
Ash created from usage	Disposal can be a problem Ash by-products can be used for roading and artificial aggregates
Essential raw material in some industries	Use of alternative products not feasible in the steel making industry
Air emission problems	Efficient usage necessary to gain maximum energy from the minimum amount of coal to reduce air pollution
Storage and distribution	Takes up storage space Dust and spontaneous combustion control essential Mechanical distribution transport systems required

Marketing: creating demand

Marketing — meeting customer needs

The industrial customers' needs are identified as part of a marketing operation. Industries for which coal is an appropriate fuel have certain features in common. These are:

- a large heat requirement
- a low cost requirement
- constraints getting other energy forms to the required destination
- availability of other energy forms somewhat limited
- distance from the mines is not great.

Marketplace positioning

Coal faces a number of issues:

- it is a commodity type product
- there are handling difficulties
- cleanliness.

One way of repositioning in the marketplace is to focus on the energy needs of existing and potential clients and provide a "turnkey" package, where the supply of equipment is in a state ready for operation. Both energy and advice on managing the capital equipment, with financial assistance and operations advice as part of the package, are supplied. Supplying a quality product and technical back-up are increasingly important marketing points. The focal point is now on turnkey operations, delivering the end product (hot water/steam). For example, Solid Energy may own the generating plant and deliver the steam to hospitals or it may finance the user into ownership or upgrades of the plant. As the capital cost of the equipment is high, if a user needs to spend money for conversion to coal, Solid Energy provides the finance.

There are some natural variations to these strategies for other reasons. South Island industries do not have the same access to natural gas as those in the North Island. The cost of getting coal to some North Island destinations may outweigh coal's low cost.

Export demand

The export focus is recent and New Zealand initiated. The table 17, Coal industry exports, illustrates the growing emphasis on exporting in comparison with the domestic focus for the two decades after World War Two. Exports for the year to March 1996 are 47 percent and domestic consumption is 53 percent.

New Zealand coal is exported to countries which are mostly located around the edge of the Pacific Basin, with Japan, Chile, India, Australia and China being the most important markets, as outlined in Figure 5, New Zealand coal export by countries.

These countries buy New Zealand coal because of its special quality. Some West Coast coals have desirable qualities such as:

- less than 1 percent ash level

TABLE 17

Coal industry exports, 1956-1995

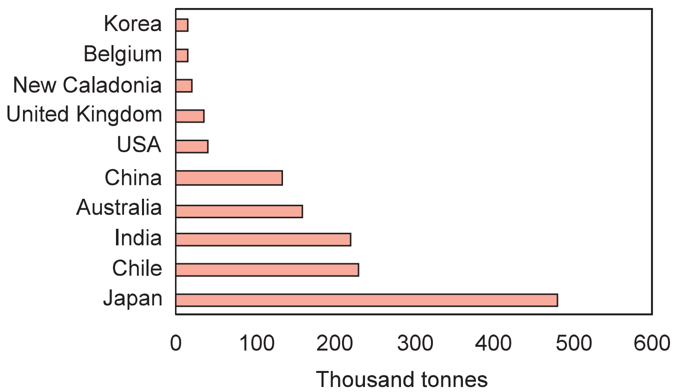
Year (March end)	Coal exported (tonnes)	% of output exported
1956*	670	< 0.1
1966	10	< 0.1
1976	10,394	0.4
1986	281,700	11
1994#	952,222	29
1995#	1,213,758	38

*December year
June year
(Sources: Mines Statements 1967 and 1983, Ministry of Commerce 1996, Solid Energy 1996)

- low sulphur content
- high heating values
- strong suitability to steel-making.

International concern about acid rain problems has created export interest in the low-sulphur coals located in the West Coast, Waikato and Southland.

FIGURE 5
New Zealand coal export by countries
September year 1995



(Source: Ministry of Commerce)

The GATT Uruguay Round negotiations have enabled 52 percent of current New Zealand coal exports to enjoy duty-free treatment and tariff reductions. This has caused coal prices to fall on the international market. In 1992, Coal Corporation set itself a target to treble annual exports from almost one million tonnes to three million tonnes by the year 2001.

Uses for export coal

New Zealand export coals are used

in the manufacture of :

- specialised high grade steels
- coke and briquettes
- carbon for batteries
- activated carbon for special water and chemical filters.

as energy sources in the production of:

- electricity
- cement
- chemicals.

New Zealand's proportion of the export market is tiny by world standards. Transportation costs are an inhibiting factor, but potential for expansion is high. The increase in exports is generating an increase in overall production and employment opportunities in New Zealand. The demand is now for skilled rather than unskilled labour.

Coal adds value to other products

The true value of exports is not confined to the value of actual tonnage sold. Value is added by the coal resource, for instance, through its use as a reducing agent in the manufacture of steel in the North Island — much of which is exported. Coal energy is a large component of the value added in the processing of other exports, particularly dairy products.

Coal expertise earns export receipts

Downstream export opportunities also arise from the development of technological expertise in the coal industry. Joint ventures and service activities, such as training and consulting, earn New Zealand companies export receipts in countries like Indonesia where the coal resource is being developed.

Chapter Five

Producers, Distribution and Support Chains

The coal mines and extraction

The West Coast and Waikato regions are the most important coal mining areas today. Total annual New Zealand coal production exceeded one million tonnes in 1900 and two million tonnes in 1910. A peak level of production of just over three million tonnes was achieved in 1960 before subsequently declining. It was 1993 before the 1960 production level was again reached. Table 18 shows New Zealand coal production between 1980 and 1995. The 1995 peak has been sustained and output is still rising.

Mining methods

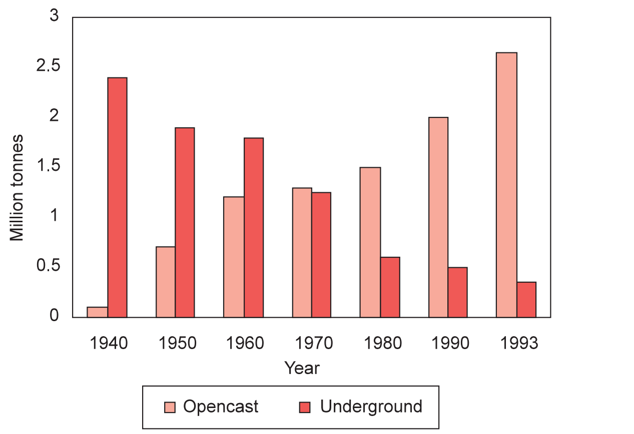
Two methods are practised — underground and opencast. The trend has been a shift to opencast mining, as seen in figure 6. Underground mining is now a small proportion of mining activity, but new underground mines on the West Coast will reverse this trend. Opencast and underground mining are compared in table 19.

TABLE 18
New Zealand coal production
1980 - 1995 (calendar years)

Year	Output (tonnes)
1980	2,162,600
1982	2,244,400
1984	2,579,600
1986	2,518,000
1988	2,438,100
1990	2,587,600
1991	2,684,200
1992	2,948,600
1993	3,101,100
1994	2,997,600
1995	3,446,000

(Source: Ministry of Commerce 1996)

FIGURE 6
New Zealand coal mining methods



(Source: Ministry of Commerce)

Productivity

Cost reductions and productivity gains in mining have been significant. Improved technology and mining methods, especially the switch to opencast mining, and the drive to increase efficiency have resulted in industry increasing its tonnes sold per employee as well as a fall in the cost of coal mining. Opencast mining decreases the use of labour in proportion to capital, increasing labour productivity. Solid Energy's increased profitability and international competitiveness results from the focus on productivity gains. Labour productivity gains over a forty-four year period are shown in figure 7. Up to 1980, the figures are industry-wide. The 1988 figures relate to Solid Energy only and do

TABLE 19

Opencast	Underground
• chosen if cover:coal seam thickness ratio < 12:1	• chosen if cover:coal seam thickness ratio > 12:1
• large opencast mining at Stockton and Rotowaro	• large underground mines at Huntly East, Greymouth and Ohai
• machinery removes overburden	• two methods of removal used are:
• excavators, hydraulic back-hoes or face shovels dig out and load the coal	-continuous mining, where machines remove coal with rotating cutter blades,
• heavy duty trucks, conveyor belts transport the coal away	-monitor mining, where water jets remove coal directly off the face
• surface rehabilitation necessary	• shuttle cars, conveyors or water transport remove coal to surface, excess dirt removed above ground
	• potential subsidence problems

TABLE 20

Industry investment in new capital

- Computer-controlled coal screening plant
- Earth-moving machinery
- Bagging plant and warehouses
- Development of new West Coast mines
- Coal handling plant
- Automated weigh bridges
- Telemetry systems and electronic capture and transmission of data
- Computers for water treatment facilities

not necessarily reflect other operators who may have higher efficiencies. The industry's investment in new capital, table 20, has also assisted productivity gains.

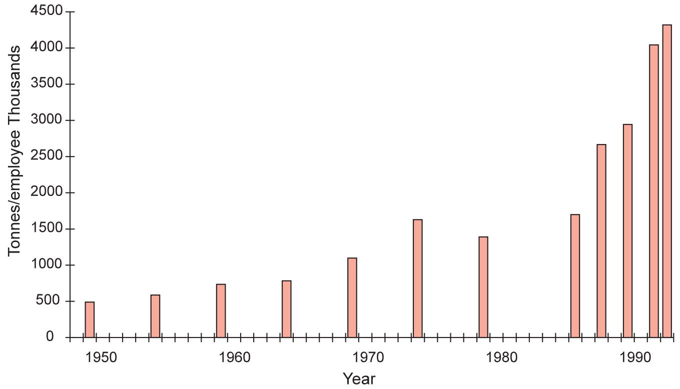
Market situation and integration patterns

The coal market has many producers. The market structure is outlined in table 21. While Solid Energy dominates production, yielding two-thirds of all output, and commands market leadership in some of the major user markets, e.g. NZ Steel, it does not attain dominance elsewhere in New Zealand.

Annual production figures from individual companies range from 2.5 m/tonnes to 100 tonnes. Although barriers to entry for firms are few, more barriers exist now than previously, such as consents, licences and higher set-up costs. Economies of scale, achieved by the larger firms, reduce the opportunity for small producers to compete for contracts with large users. In the main, cost, infrastructural and market barriers exist to prevent movement from small scale to large scale production.

FIGURE 7

Tonnes produced/sold per employee



(Source: Ministry of Commerce)

TABLE 21

Market structure of New Zealand coal producers

2,500,000+ tonnes	100,000+ tonnes	50,000-100,000 tonnes	under 50,000 tonnes
Solid Energy	Glencoal Energy	Kai Point	approximately 35
owns 10 coal mines,	Francis Mining		producers
4 North Island,	New Vale Coal		depending on the year
6 South Island	MacDougall Mining		

(Source: CRANZ)

The major producers in the 1990s

Solid Energy

The ownership of Solid Energy is discussed in Chapter 3. The Head Office is in Wellington and the operating local profit providers are located in Manukau City, Christchurch and Invercargill. The international division is named Solid Energy International. There are ten mines in operation.

Table 22 provides specific details about **Solid Energy.**

TABLE 22

Solid Energy

Mine names	(North Island) Huntly East, Rotowaro, Maramarua, Benneydale, (South Island) Stockton, Sullivan, Island Block, Terrace, Strongman, Wairaki.
Distribution areas	North & South Islands, International
Operating mines	10
Number of employees	approx. 600 full time equivalents
Output (tonnes p.a.)	2,500,000, with 1.4m/tonnes exported
Type of coal	Thermal and coking

Glencoal Energy

The New Zealand Dairy Association acquired access to coal deposits in 1919 and the lease was taken up in 1922 in the name of Glen Afton Collieries, later to be called Glencoal Energy. Prior to 1930, coal was principally delivered to the New Zealand Co-operative Dairy Company, factories and shareholders. Activity at Glen Afton peaked in 1931, with 430 men producing 188,165 tonnes.

Glencoal has been involved in mining at the Maramarua field since World War II. The coal there is owned 25 percent by the crown, 35 percent by Glencoal, 10 per cent by Solid Energy and 30 percent by other parties. Although Glencoal owns the Glen Afton mine, it is mined by BBL Ltd. The coal from this mine is supplied to Anchor Products Te Rapa.

In 1957, office administration was transferred to the New Zealand Co-operative Dairy Company's Head Office in Hamilton. Coal is supplied to Anchor Factories (87 percent), ECNZ (9 percent), industrial (1percent) and merchants/ domestic users (3 percent).

Table 23 provides specific information about **Glencoal Energy.**

TABLE 23
Glencoal Energy

Mine names	Kopako 3 (Maramarua), Renown (Huntly), Pirongia (Otorohanga) Glen Afton
Distribution areas	Waikato district
Operating mines	4
Number of employees	24
Output (tonnes p.a.)	265,000
Type of coal	Sub-bituminous

Kai Point Coal Company

Started by the late George Cross in 1947, Kai Point Coal is a family owned company. The present site has been mined since 1957. Coal is supplied 80 percent for industrial and commercial use, the remaining 20 percent being supplied to households. Kai Point Coal operates all the mining and screening operations and 60 percent of the coal distribution.

Table 24 provides specific information about the **Kai Point Coal Company.**

TABLE 24
Kai Point Coal Company

Mine names	Kai Point No. 2
Distribution areas	90% Balclutha and Dunedin
Operating mines	1
Number of employees	9
Output (tonnes p.a.)	48,000
Type of coal	Black lignite (almost sub-bituminous)

Francis Mining Company

Francis Mining is a private company wholly owned and operated by the Francis Group. In 1982, the parent company, North Otago Road Metals, become involved in contract work for Coal and Energy, from whom Francis Mining purchased the Welcome opencast mine in 1984.

Between 1986 and 1989, several other mines were purchased. Through the acquisition of Thomas Brown Ltd and Washdyke Coal, Francis Mining expanded the mining operations and gained the industrial and marketing arm of both companies. The current mines produce a range of coals for a variety of purposes.

Table 25 provides specific information about **Francis Mining Company.**

TABLE 25
Francis Mining Company

Mine names	Barrier, Welcome, Pyramid, Surprise, Echo, Topline, Hart Creek, Roa
Distribution areas	North and South Islands, some exports
Operating mines	8
Number of employees	35
Output (tonnes p.a.)	120,000
Type of coal	Mostly bituminous

New Vale Coal Company

The company began in the late 1930s as a partnership and mined further south of the current position in Eastern Southland. As mines became less viable, operations shifted until the present mining positions were established. Over time, partners moved in and out of the partnership. When the Waimumu Coal Mine was purchased, the two operational coal mines, now a business owned and operated by the Highsted family, became known as the New Vale Coal Company. In August 1992, the company purchased the Goodwin Coal Mine from the Alliance Group.

Table 26 provides specific information about the **New Vale Coal Company.**

TABLE 26
New Vale Coal Company

Mine names	Goodwin, New Vale
Distribution area	Southland
Operating mines	2
Number of employees	28
Output (tonnes p.a.)	160,000
Types of coal	Good quality lignite

MacDougall Mining Company

The company, formed in 1970, has one shareholder. In the 1970s it produced open-cast coal from small sites in the Glen Massey (Waikato) area. In 1976, the operation moved to the former State mine, Renown. Other workings included underground extraction with the company establishing the first privately owned, fully mechanised underground mine in New Zealand. Currently coal is sourced from the Rotowaro coalfield, eight kilometres south west of Huntly.

Vertical integration

Several producers are integrated with another stage of production. Glencoal Energy is owned by The NZ Dairy Group of companies, using its production primarily for its own purposes. Francis Mining owns retail outlets in Christchurch and Timaru; Kai Point owns retail outlets in Dunedin. Solid Energy is investigating integration with the distribution channels, already owning retail outlets in Hamilton, Invercargill, and Dunedin.

Rationalisation and profitability

The number of operating mines has fallen in the second half of this century. In 1967 there were 120 working mines, five fewer than in 1966. By 1981, 77 mines were operating and 64 in 1992. In 1996, 45 mines were operational, with 35 being operated by private producers.

The rationalisation over this time frame reflects the competitive nature of the industry, the falling real price of coal and the falling coal share of the local energy market. The more recent upward trend in output reflects the coal industry's export-related policies.

Since corporatisation, the drive for profitability by Solid Energy has been intense. As Solid Energy is a very large producer in the total coal industry, its policies impact on the market and while their total output is expanding, it is mostly export related.

Interdependence with other sectors - transport, storage, coal merchants.

Transport to domestic users

- Delivery to most customers is by road trucks and rail wagons.
- A 6km overland conveyor belt supplies coal from the Huntly West Mine to the Huntly Power Station.

Table 27 indicates the coal price per tonne/transport cost in selected places in New Zealand. Waikato coal services the North Island, West Coast coal services Christchurch and Ohai coal services Dunedin and Invercargill. The calorific value of Waikato coal (22.5CV) is less than that of the West Coast (26.0CV) and Ohai (25.0CV). This impacts on the relative $/GJ value.

Transport to overseas users

Major export projects on the West Coast are dependent on an economical system for transporting the coal from mines to ship loading facilities. This sector of the distribution chain currently incurs substantial costs. Coal is sent by rail to Port Lyttleton in Canterbury, from where it is loaded into ships. For rail to be cost-effective, its marginal cost needs to be just below that of alternatives. With quantities of export coal increasing, physical constraints may eventually reduce the viability of the rail link. Construction of the alternative options may depend more on physical quantities than on costs alone. Other options include a slurry pipeline, large sea-going barges delivering coal to off-shore vessels, and a deep water port in Buller Bay near the mining location. At the moment, a tug and barge business operates from the West Coast to the North Island, Australia and New Caledonia. It is estimated that internal transport costs will have to be reduced by 50 percent for export coal to compete against Australian, Indonesian and South African thermal coal in particular.

TABLE 27

Indicative industrial coal prices with transport cost component

City/Region	Average coal price ($/tonne without freight)	Freight charge ($/tonne)	% Freight proportion of cost per tonne	$/GJ
Hamilton	65	7	10	3.20
Auckland	65	14	18	3.50
Whangarei	65	30	32	4.20
Hawke's Bay	65	32	33	4.30
Wellington	65	45	41	4.85
Christchurch	60	25	29	3.25
Dunedin	65	25	28	3.60
Invercargill	65	11	14	3.00

(Source: Solid Energy)

Storage for users

Coal is a bulk storage item, with potential dust and moisture loss problems. Storage is open air for the major users. Alternatively, industrial and smaller users may store their supplies in an elevated or underground bunker, fed by a chute. The bunker may be built to suit the terrain, with a conveyor system feeding the coal in to individual hoppers. Bunker storage minimises dust problems and handling issues.

Coal merchants

The distribution chain demonstrates both vertical integration of the major coal extracting organisation (Solid Energy) and the opportunity for small business participation. Solid Energy has bagging plants and has taken control of merchandising through a range of retail outlets. Solid Energy Retail is an operating division of the SOE. Waikato Coal Supplies is a 100 percent owned subsidiary, bagging and selling coal direct to the public. Francis Mining and Kai Point Coal maintain some retail outlets in the South Island and there are a number of independent merchants. Other industry producers also have exclusive supply arrangements with merchants.

Case Study

The need for research and development — the quality assurance aspect

Role of the Coal Research Association of New Zealand Inc.

The large reserves in New Zealand coal fields are not all capable of being mined. Some are inaccessible with current technology; some do not have the currently required properties of low sulphur and low ash. Although coal is lower priced than all other energy sources, it is viewed by many as an environmentally unfriendly fuel. Research and development provides opportunities for greater use and more efficient, environmentally sound mining, distribution and burning. Coal Research Association contracts out projects for the coal mining industry to improve overall use. There are several types of research carried out in New Zealand — resource research, utilisation research and testing and evaluation research and development.

Resource research

Geologists are able to help with:

- size and shape of coal seams (coal quantity)
- subsidence and mining problems
- knowledge of coal properties (coal quality).

By using geologists, the coal industry is responding to market requirements.

Modelling coal seams is an example of recently undertaken geological research. This has led to a more efficient way of interpreting the variations in occurrence of coal beds and a more accurate picture of coal seams. Before investment in a mine is undertaken, the owners and financiers want to be assured of the commercial viability of the mine.

Subsidence can have environmental effects. Geologists can predict what type of roof the mine will have and how much mud and rock is mixed with the coal. Strata behaviour predictions minimise safety problems, lost production time and subsidence problems.

Research into **coal properties** aims to achieve optimum evaluation, extraction and utilisation. Recent research has identified a way of interpreting the geographical variation of properties in coal beds. Undesirable properties may not be evenly distributed. Trace elements, like arsenic, can be heavily concentrated in parts of the seam but not found so much elsewhere. Exporters' clients are more demanding about the specification range over a long period of time and the range can be very tight. For example, a concentration of 0.5 - 0.3% sulphur concentration can be specified. Producers need to know in advance if they can supply these to these specifications in the long term before signing contracts. Once mining has begun, on-going core sampling of properties can direct mining in the most economical way.

Core analysis research frequently gives an indication of the likelihood of petroleum source potential for commercial purposes.

Utilisation research

Research is designed to increase the understanding of the nature and behaviour of New Zealand coal so that it may be used with increased efficiency and minimised environmental impact. Currently, research is being carried out in several areas including:

- gasification
- combustion
- self-heating of coal.

Gasification is a process applicable to a wide range of coals and relevant to many of the clean coal technologies being developed and demonstrated in other countries. New power generation technologies have efficiencies in excess of 45 per cent (compared with 35 per cent for the Huntly Power station) and may involve a gasification step. New Zealand coals do not behave in exactly the same ways as their overseas counterparts and it is important to know in advance how readily they may be used in the new technologies. Much of the work focuses on the inorganic matter in the coal because it has been found that:

- inorganics may speed up the gasification process
- they may alter the product gas composition
- they may therefore alter the heating value of the gas
- they may become volatile and damage the gas turbine.

Usually the coal is mined before gasification but in some cases, it may be more economic to gasify it in the ground. The first such trial project in the Southern Hemisphere was carried out at a site near Huntly in 1994.

The aim of **combustion** research is to observe and understand the behaviour of New Zealand industrial coals when burned on very different types of plant. Issues, such as clinker build-up and related processes, which can cut down heat transfer and lead to plant damage, and the environmental impacts of inorganics in the coal, are being addressed.

Related research on ash leaching is also underway with interest being shown in finding alternate uses for ash. If generated in sufficient and regular quantities, ash can, for example, be used as a road base or as an additive in cement and concrete. Economies of scale currently count against these options from being routinely taken up in New Zealand.

Flue gases are also monitored for greenhouse and other gases of environmental significance.

Studies in **self-heating,** which may lead to spontaneous combustion of coal stockpiles, are well advanced. By understanding the chemistry involved in the development of self-heating, it is possible to try to avoid and to identify coals that are more prone to undergo spontaneous combustion. Basically, the cause is oxidation. Once coal is dug up, it begins reacting with air in heat-forming reactions. If it is not dissipated, hot spots build up and may eventually lead to combustion. As a rule, the process is more likely to happen in a dry or partially dry coal because this increases the number of reactive sites where oxidation may occur, and lessens the effect of heat dissipation by water. If the coal is rewetted, there may be an added contribution from heat of wetting.

Oxidation also destroys the coking ability of coking coals. Again the research has led to an ability to distinguish between coking coals that are more likely to rapidly lose their coking properties and should therefore be used quickly and those that are better equipped to withstand the damaging effects of oxidation.

Testing and evaluation research and development

Equipment testing and evaluation is also carried out using coal and other fuels. For example, chemical and physical properties of four different types of coal-based briquettes were determined to assess their suitability and viability for the domestic market. Other factors affecting coal use that have been investigated include:

- coal drying
- coal washing
- splint and bulk coal properties and stockpiling.

Chapter Six

Environmental Issues

Impact of coal mining on the landscape

Under the Resource Management Act (RMA), an environmental assessment is required for all industrial activity, including mining, before work commences. Environmental reports anticipate future environmental effects in order to manage and minimise the impacts of the mining operation. The industry also regulates its own operations to avoid potential problems arising.

For the assessment, studies are carried out on water and air quality, archaeological and biological implications, background noise levels, traffic flow aspects and vibration levels. Rehabilitation trials are carried out for projects that disturb the ground surface over significant areas. Potential environmental problems and their solutions are summarised in table 28.

The Resource Management Act 1991 provides the framework for sustainable management. No company or individual can prospect or mine without a licence. The licence applications must include details of the expected effects on the environment. The mitigation of these effects and a restoration plan are required in the application. Larger proposals require a detailed environmental impact study. Objections to the proposal are heard by the Planning Tribunal. Ministry of Commerce inspectors check on activities.

Conflicting land use

Mining can sometimes cause conflict with other uses of land. Historic sites may be disturbed. Maori claims under the Treaty of Waitangi may also affect the mining industry.

The greenhouse effect and CO_2 emissions

The potential for global warming from the accumulation of greenhouse gases in the atmosphere has focused attention on policies to reduce the emissions of carbon dioxide, methane and nitrous oxide. In 1992, the New Zealand Government established a policy objective of stabilising net CO_2 emissions at 1990 levels by the year 2000. Based on the expected levels of GDP growth, CO_2 emissions were expected

TABLE 28

Potential problems, effects and solutions of mining

Potential problems	Possible effects	Controls and regulations	Solutions
Land subsidence (under ground)	• Drainage problems • Ponding and marsh formation • Effects on buildings and services • Decreased land values	• Coal Mines Act states the mine owner is responsible for damage • Resource Management Act 1991 establishes mining duties and responsibilities	• Premining surveys of the area to be mined and regular monitoring • Compensation and repair work undertaken
Water disturbance (both underground and opencast)	• Water flow patterns change • Water quality becomes a problem	• Water right required by the Regional Council	• Spray-irrigation for part disposal of treated waste water • Settling-ponds and on-site water treatment plants • Dilution of contaminants • Removal of coal dust, clays and other minerals at treatment plants to avoid water course contamination
Land disturbance (opencast)	• Formation of pits can be visually unpleasant	• Regional Councils conform to RMA principles	• Land rehabilitation to restore former contours; erosion control; topsoil and subsoil replacement; seed bed preparation; vegetation cover; extensive tree planting.
Air and noise pollution	• Opencast and underground mining both create dust • Dangerous gases released (CO and methane) • Vehicle fumes • Heavy machinery causes noise	• Ministry of Health monitors dust and noise and levels	• Fast-growing tree plantings provide a barrier to noise and dust • Heavy trucks and excavating machinery should not exceed set noise levels, especially at night

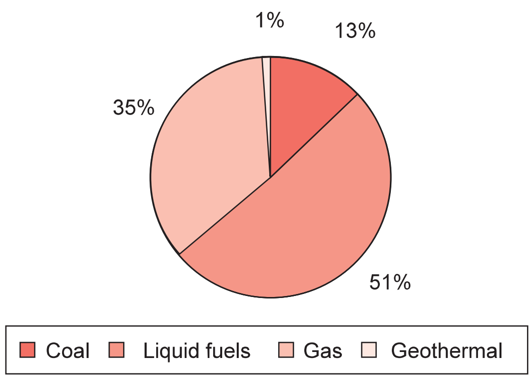
to increase by about 20 percent between 1990 and 2000. A 20 percent reduction in CO_2 emissions was required. To achieve the required stabilisation of CO_2 emissions, at least one fifth of the reduction is to come from energy efficiencies (gross emission reductions) and the remainder by forestry planting (carbon sinks).

Two factors appear to be contentious:

- forestry planting/absorption rates may not be as high as initially forecast (possibly due to the age mix of the trees)
- economic growth is higher than forecast so that CO_2 growth for the decade may be greater than the 20 percent forecast.

Other mechanisms for reducing CO_2 emissions may be required.

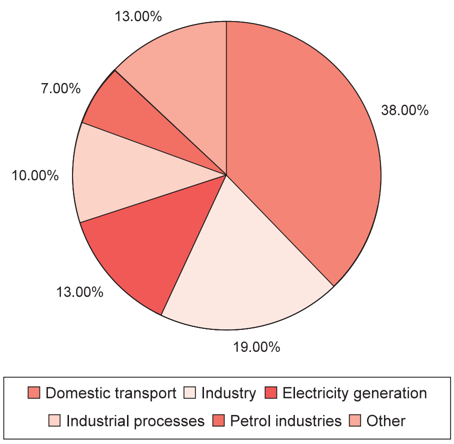
FIGURE 8
Carbon dioxide contributions by fuel (percentages) 1994



(Source: Ministry of Commerce)

Coal is one of several energy sources which contributes to the greenhouse effect. Figure 8 shows the relative contribution of CO_2 from different fuels in 1994. The annual amount of CO_2 emitted by each fuel depends on the amount of fuel that has been used, as well as the emission rate per unit of energy of that fuel. Geothermal Energy has the lowest CO_2 emission rate per unit of energy, followed by natural gas, then liquid fuels and then coal. Industry sectors make different contributions to the gross CO_2 emission situation as shown in figure 9.

FIGURE 9
Gross CO2 emissions - sectoral shares (1994)



(Source: Ministry of Commerce)

TABLE 29
Energy-related gross carbon dioxide emissions per capita for selected OECD countries (1990)

Country	Tonnes CO_2 per person
USA	20.0
Canada	16.4
Australia	15.9
Germany	12.4
United Kingdom	10.4
Japan	8.6
New Zealand	7.7
Norway	7.6
OECD average	12.1

(Source: International Energy Agency, 1993)

New Zealand has relatively low emissions per capita, significantly below the industrialised world, mainly because of the dominance of hydro in electricity generation. Table 29 identifies the energy-related gross carbon dioxide emissions per capita for selected OECD countries in 1990.

Reducing CO_2 emissions

If a reduction in CO_2 emissions is to be achieved, then one or more of the following needs to occur:

- a reduction in fossil fuel consumption
- a shift towards less carbon intensive fuels
- improvements made in energy efficiency.

Policies for achieving the target reduction level:

- reliance on forests acting as carbon sinks
- voluntary agreements with industry to reduce CO_2 emissions
- tradeable permits
- carbon tax
- regulations, rules or penalties.

Forests as carbon sinks

Trees absorb increasing quantities of carbon as they grow. Currently there is debate about the number of new trees required to achieve the 16 percent reduction target for carbon absorption by forestry sinks. The Tasman Institute believes that if New Zealand continued to plant an additional 50,000 hectares a year of *pinus radiata* pine forest, carbon sink credits would offset the post-1990 growth in fossil fuel emissions for the next 45 years. The Forestry Research Institute has recently changed its methodology for calculating absorption rates and believes that despite very high planting rates (98,000 hectares in 1994), the 16 percent target will not be achieved until after the year 2000. Improved management of the indigenous forests, by, for example, possum control, would enhance their ability to act as carbon sinks.

Voluntary agreements

Voluntary agreements to restrain emissions of CO_2 are mechanisms widely in use or under consideration. They accord with the "light-handed" regulatory approach. There is a clear goal (1990 net emission level by 2000) and the details of implementation are left up to industry. If this does not work, there is an implied sanction. The agreements are negotiated with each industry or business and signed by government. Businesses have been introduced to the benefits of the voluntary agreements scheme. Some industrial coal users are now involved in monitoring energy usage, tracking improvements and savings of CO_2. Voluntary restraints have the advantage of being flexible as:

- they are not part of government regulations or taxes
- they are not part of the revenue stream (as are taxes)
- they operate on a one-to-one basis and allow abatement strategies appropriate to specific circumstances.

Improved combustion efficiencies can reduce CO_2 emissions, hence the value of current research and the workability of voluntary agreements.

Tradeable permits

Government could decide to set a limit on the quantity of carbon emission per year. Each firm could be allocated a share of the right to emit CO_2. If the business managed to emit less than its share, it would be given permits representing the shortfall which it could sell to those who could not meet their targets. Such a scheme harnesses the motive of profit-seeking as businesses will have an incentive to emit less and profit from selling surplus permits. It enables an environmental objective to be achieved via the market. Improved combustion efficiencies can reduce CO_2 emissions, hence the value of current research.

If tradeable permits are put in place, small consumers may find it difficult to participate in tradeable options, causing equity issues to arise. This could be overcome by producers or importers of fossil fuels purchasing the permits, and passing on the costs to consumers.

Carbon taxes

Bureaucratically simple to implement and administer, a tax per unit of carbon emitted could be an alternative way of reducing carbon emission levels. The effect of such a tax is to encourage the market to reach the desired outcome. The tax would be added to the costs of production, raising the producers's costs, which may be passed on to the consumer in the form of higher prices. Businesses may decide to switch fuels or work out how to become more energy efficient using the existing fuel. The government may place the tax it collects into a dedicated fund for capital improvement for energy efficiency.

The effect of the tax is to encourage the market to reach the socially desirable outcome where marginal social benefit equals marginal social cost. Businesses, then, confront the correct price of all resources and internalise the externalities created by their activities, including those that impact on the environment.

A carbon tax will be considered in 1998 if the government assesses that current policy measures are not achieving the objectives. The impact of a carbon tax for various scenarios is detailed in table 30.

Table 30 shows that a $30 tax per carbon tonne would result in a 22 percent increase in price of coal, but only a 5 percent increase in the price of gas and a 2 percent increase in the price of petrol. The differential in price rises is partially attributable to the existence of sales and other taxes, the initial price of the fuel and the percentage of carbon in a tonne.

TABLE 30

% Changes in retail prices to industry of various carbon taxes (Including existing taxes)

$Tax per tonne of carbon	Coal	Gas	Petrol	Diesel	Fuel oil	Outcome desired by year 2000
$30 per carbon tonne	22	5	2	5	7	20% reduction in gross emissions
$60 per carbon tonne	43	10	4	9	13	displace new coal-fired plant beyond 2000
$100 per carbon tonne	72	17	7	16	22	stabilise gross emissions at 1990 levels

(Source: Ministry of Commerce model)

Regulations and setting of standards

Government can put in place regulations to limit the way businesses operate and the types and quantities of carbon discharges permitted, but cannot prevent carbon discharge without a complete ban on carbon based fuels. Setting standards which determine socially acceptable levels of pollution may be a way for society to handle greenhouse gas problems. Building codes promoting energy efficiency and reducing vehicle speeds to cut petrol consumption are possibilities. Monitoring and enforcing regulations entail additional resources for enforcement and add to costs.

Impact of the policy measures

New Zealand is a very small contributor to CO_2 emissions by world standards. At current growth and plantation rates, New Zealand accounts for 0.3 percent of total gross carbon emissions and 0.1 percent of net emissions from Australia, United States, Canada, the European Union and Japan, according to the International Energy Agency. Gross emissions of CO_2 refer to all CO_2 emitted. The gross figure is reduced to a net figure by the carbon credits available through the absorption in carbon sinks, for example.

At present, few countries are meeting their reduction obligations and it would appear that the imposition of significant economic costs, particularly on certain industries, would be difficult to justify. Australia, for example, has decided the implementation of a carbon tax is too harmful to the economy. A large proportion of CO_2 emissions come from the use of fossil fuel in the transport sector and no proposed policy measure will have much impact on that sector.

Forestry policies in the past have provided New Zealand with a comparative advantage in carbon sinks. Further reductions in carbon emissions via other means could impact on economic development. Possible costs of a carbon tax sufficient to achieve gross carbon emission stabilisation, include:

- loss of (gross) domestic product of about 0.5 percent
- loss in exports of about 0.5 percent
- loss of disposable income of about 0.9 percent
- rise of consumer prices of about 1.6 percent.

A high enough carbon tax would shift the use of fuels in many industries from coal to gas, which is in itself expected to run down in the next decade. Energy costs to industry would rise and flow through the whole economy. Some current coal users would be highly affected. These include steel, cement and other energy intensive industries such as meat, dairy and timber — all important export industries. These export income-earning industries add value through energy usage. For example, low-cost coal-fired thermal energy is a significant factor in the international marketing of milk powder, a key export product. Energy accounts for 10 percent the cost of milk powder and to remain internationally competitive, the dairy product needs to retain its energy pricing advantage. There are fears that:

- some industries will move off-shore to Asian countries which have no greenhouse commitments
- competition with low energy-cost countries will be added to existing competition with low-waged countries
- unemployment will rise as a result.

The coal industry has taken government policy seriously. It is taking a pro-active role in encouraging voluntary agreements, energy efficiency initiatives and research and development programmes. The community's role is to debate whether the social equilibrium is being achieved through these policy measures, that is, does the marginal social benefit of the 20 percent reduction in carbon emissions equal the marginal social costs involved in meeting that target.

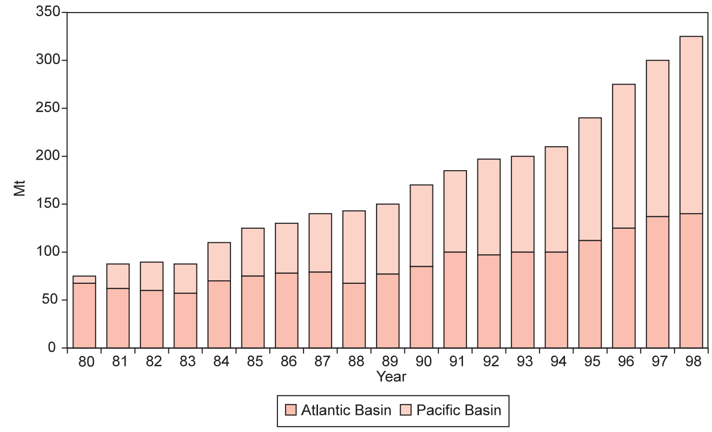
Chapter Seven

Future Developments

The international market

International trade in coal is expected to increase in the next few years, especially in the Pacific region, as shown in figure 10, World seaborne trade — thermal coal. As coal is a bulk commodity item, trade will most likely be intraregional and coal producers in that region can anticipate growing markets. New Zealand's major competitors for supply of coal in the Pacific Basin are Australia, China, Canada and Indonesia. The type and quality of coal, ocean freight rates, and the nature of the contract often influence purchasing arrangements.

FIGURE 10
World seaborne trade - thermal coal
Growth by region 1980 - 1998



(Source: M.D. Velzeboer, Shell Company of Australia)

Asian economies increase coal demand

The increase in trade stems from the economic development of the North and South East Asian nations. China's economy, for example, grew by 13 percent in 1993. Energy demands to sustain that rate of growth will mean that China could soon change from being an exporter to a net importer. If China were to import 10 percent of its coal requirements, its demand would exceed the combined imported tonnage of Japan and South Korea. This would lead to a sharp increase in the price of coal.

Japan's coal industry output has been falling over the past thirty years from 55 to 10 million mt/pa. and, as a result, imports have risen accordingly. Table 31 indicates Japan's future demand for coal will also continue to rise.

TABLE 31

Japan's demand for steam coal (million metric tonnes)

Sector	1990	1995	2000
Electricity	26.3	37.7	59.0
Cement	8.3	7.0	6.5
Other	10.4	15.0	17.5
Total	45.0	59.7	83.0

(Source: Energy and Mining Journal)

International coal price determinants

The price of coal for export is determined by supply and demand, but non-price factors such as competition from other fuel sources on the world market, relative transport costs and the relativity of the exchange rate impact of the supply and demand situation. A falling New Zealand exchange rate assists New Zealand exporters and the value of the US dollar is particularly important, as coal is sold internationally in US dollars. Some countries subsidise their domestic coal production, giving producers in those countries competitive cost advantages when exporting. Coal in Germany, the United Kingdom, France and Spain all enjoy subsidies but are under pressure to phase them out by the year 2000.

The move to contract arrangements

In recent years, prices have been established through the spot market rather than long term contracts. The move more recently among energy users is to gain guarantee of supply, making long term contracts possible. Recently, the Steel Authority of India Limited (SAIL) signed a three year contract with a New Zealand coal producer to establish long term supply. Previously, Japanese contract negotiating prices have been used as the international price benchmark but that is changing with a switch to tendering on the open market.

International developments influence the New Zealand coal industry

Despite the favourable outlook for exporting, the international market remains highly competitive. The New Zealand coal industry can expect to:

- continue the need to reduce costs
- react to demands for improved quality and consistency
- improve performance in areas such as safety and the environment.

Cost reductions have focused on labour costs over the last twenty years. The other major cost factor is equipment and its maintenance. Much effort is being directed to ensuring the new investment in capital is cost efficient and effective.

The New Zealand market

The projected energy shortage

Population and economic growth, consumer tastes and technological advances all influence future energy demand. Government environmental and tax policies and developments in world energy markets will also have an impact on demand.

However, current projections indicate that New Zealand will soon be facing an energy shortfall with resulting increases in energy prices. Maui gas is forecast to run down within the next ten years and large hydro dams will be difficult to build because of environmental constraints. The opportunity costs for electricity generation must be considered and are outlined in table 32.

The opportunities for coal

The research and development in coal combustion efficiencies, extraction methods and the extent of the coal reserves make coal an environmentally viable option. It is expected that coal will have an increasingly important role in both direct energy supply and thermal generation of electricity by coal-fired generating plants, which, with the new technology available, have the potential to fill the energy gap. At current rates of extraction, there is more than sufficient coal to supply New Zealand for the next three hundred years. This situation will enable New Zealand to see the shortage through until the economic use of renewable energy develops. Future developments in the thermal energy sector will depend partly on the government's greenhouse gases policies.

The drive for efficiency

Future energy price predictions mean that consumers have large incentives to minimise their energy costs. One of the most effective ways of achieving a reduction is to invest in the latest technology. Willingness to invest depends on three factors:

- cash availability
- the return on investment
- the cost proportion of energy in the total budget.

The dairy industry has improved energy efficiency considerably already and further efficiencies are possible. The meat industry, on the other hand, has suffered from major inefficiencies and recently has had an overcapacity problem, which is now being corrected. Upgrading in this sector is now occurring with some payback periods as short as one year. Energy costs are an even higher proportion of the steel and cement production budgets. These industries might typically have a three to four year payback period for new energy efficient plant, because easy energy gains have been made over the last decade.

Future price and investment factors can influence location choices

Coal usage tends to be location based, that is, an industry close to a coal source is more likely to use it as its source of energy rather than one which has to incur considerable transport costs. As a result of a realisation of expected energy pricing developments with gas, electricity and coal, certain industries may acquire cost benefits over others. This could cause some heavy energy-using industries to consider a change of location.

TABLE 32

Future options for electricity generation

Option	Issue
• Hydro generation	• Conservation issues arise • Resource consents necessary and difficult to obtain • Potential sites diminishing in number
• Nuclear	• Politically and socially unacceptable currently in New Zealand
• Wind farms/Biomass facilities	• Resource consents required and difficult to obtain • Capacity too small for large scale generation
• Coal-fired plant	• Carbon tax issue may increase the price and raise environmental concerns
• Gas generation	• The availability of gas post - Maui • Price issues for exploration and extraction of possible new gas fields • Lead time for development becoming tight

(Adapted from: Energy and Mining Journal)

Future integration arrangements

Opportunities in the export scene have led to the development of joint ventures in coal exploration, mining and distribution activities. New Zealand companies are looking for international expertise to maximise the use of their coal resources and gain access to markets.

Underground gasification technology is being domestically developed by a consortium of Glencoal Energy Ltd., ECNZ and Williams Field Services (USA).

Greymouth Coal Ltd is owned by a consortium of Solid Energy 44 per cent, Todd Group 28 percent, Japanese partners (Kanematsu) 28 percent. The consortium is undertaking feasibility studies on mining high rank thermal coal for export to Japan. Exploration activities, such as geological test bores, are underway. The mine development is expected to start in a few years. Demand for thermal coal is highly price sensitive and part of the viability of the project will depend on transport rationalisation before fully proceeding.

Joint venture investment in demethanation plant (partners are Enerco Gas 30 percent, The Power Company 30 per cent, Solid Energy 30 percent and R.C. MacDonald Ltd 10 percent). The consortium pools the knowledge and resources of electricity and gas producers, petroleum explorers and marketers and coal owners. The project involves draining methane gas from deep coal fields for use in electricity production.

The Pike River Coal Company, a wholly owned subsidiary of New Zealand Oil and Gas Limited, has undertaken exploration activities on a **cost sharing basis** with Mitsui Mining Overseas Limited. If the mining licence is approved, there is a possibility for a joint venture relationship. Pike River Coal is likely to be blended with Australian coal for the Japanese market.

Due to expected export growth of 200 percent between 1995 - 2000, and the current physical constraints currently existing on **distribution networks** from Greymouth, alternative routes for getting the coal to its export destinations are required. Solid Energy's objective is to rationalise its internal coal transport costs, by introducing contestability into the distribution system. Technical feasibility studies are being undertaken to confirm the viability of a jetty in Buller Bay. It is planned to transport coal directly to the jetty using arterial cableways and conveyor belts. This would partially or fully displace rail and give the coal extractors some control of the transport network.

Funding options include:

- jetty ownership partly by Solid Energy and partly by a consortium of investors
- 100 percent ownership and control by Solid Energy and financed by merchant banks.

New product development

Coal is not only a source of energy. As a carbon source, it can be converted into coke and activated carbon. Activated carbon can be used as a filtration device for substances as diverse as water, sugar, pharmaceuticals, and air, enabling removal of toxic substances and impurities. As such, city water treatment stations could use activated carbon to decolorise water and to remove its impurities. Activated carbon also has uses as a catalyst in the petrochemical industry. Some of the West Coast coals with good coking properties and low ash could be used to produce carbon fibres or specialised electrically conductive pitches for aluminium smelting.

Enterprise New Zealand Trust

Promoting enterprise education in partnership with New Zealand business