# THE COMPETITIVENESS OF AUSTRALIAN INDUSTRY

**Report No. 3**

## The Minerals Industry

Australian Academy of Technological
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## FOREWORD

The Academy has identified the competitiveness of Australian Industry and the role of technology in enhancing competitiveness as being national issues.

A Symposium entitled “Australian Competitiveness - The Vital Role of Technology” was held in Canberra and Sydney in 1991 and the Academy has subsequently carried out studies in the following areas:

1 The Processed Food Industry
2 Science and Technology Based Industries
3 The Minerals Industry.

In this, the third of the studies, the competitiveness of the minerals industry and its contribution to the Australian economy and especially to exports is examined. The future shape of the industry and the involvement of companies in global expansion is considered, as is the role of technology. The study attempts to analyse the benefits and impediments to adding value to the Australian minerals base and it also makes recommendations for the future.

The Academy is grateful to Mr M R Rayner FTSE who led the Working Party, to Dr J C Nixon who wrote the report and to the individuals and organisations who provided information on which the study is based. The Council of the Academy has considered the Report and has endorsed the general tenor of its recommendations.

Sir Arvi Parbo AC FTSE
President
Australian Academy of Technological Sciences and Engineering

**ACKNOWLEDGEMENTS**

This Report was written by Dr J C Nixon AM FTSE. The project was initiated and guided by a Working Party of the Academy of Technological Sciences and Engineering comprising the following:

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The valuable assistance provided by Mrs Joy Dudine, Administrator of the Academy and Ms Rebecca Morton is gratefully acknowledged together with input from many Academy Fellows.

The Academy relied heavily upon the published statistical data and commentary from ABARE (Australian Bureau of Agricultural and Resource Economics), the former Bureau of Industry Economics, the Productivity Commission (formerly the Industry Commission), the Minerals Council of Australia (formerly the Australian Mining Industry Council) and minerals companies.

The Academy is grateful for the assistance received but wishes to advise that none of these outside bodies is responsible for the views expressed in the Report.

# 1. EXECUTIVE SUMMARY

## 1.1 RECOMMENDATIONS

The future of the industry will depend on the discovery of new mineral deposits and the ability to compete on world markets. The following steps are necessary to maintain and enhance Australia's competitiveness:

1. Adequate funding for Australian exploration must be found from company profits and other sources.
2. Continued first class survey and mapping programs are necessary to provide background information for exploration in Australia.
3. Exploration and mining companies must be able to negotiate reasonable, long term arrangements with traditional land owners.
4. Bureaucratic delays for approvals of new projects should be reduced and changes to conditions during their currency avoided.
5. Australian organisations must carefully study moves by overseas governments which encourage the export of Australian exploration funds and of technology and seek to gain matching incentives under local laws and regulations.
6. Australian Governments should be urged to remove impediments and reduce taxes and charges, at least to levels applying to non-mining companies, to allow mineral producers to earn a higher and more consistent return on capital so as to provide adequate funds for exploration and to avoid obsolescence of technology and equipment.
7. All concerned parties should seek to remove impediments to value adding of unprocessed or semi-processed minerals prior to export.
8. By accelerating all aspects of microeconomic reform (particularly in shipping), Australian participants should ensure that the combination of costs and labour productivity is not unfavourable in comparison with overseas competitors.
9. The industry should continue to concentrate on staff education and training so that management standards are equal to world best practice in order to cope with rapidly changing conditions.
10. Industry, public sector organisations (particularly CSIRO), universities and education and training authorities must cooperate to ensure that technological education is adequate to provide a continuing stream of management, operating and research staff for minerals companies, with special recognition being given to the geographical location of industry units.

## 1.2 THE REPORT

Australia's minerals industry is well into its second century of profitable operation. It had perhaps its period of greatest growth during the last 30 years and reached the level where it has become internationally competitive in the production and marketing of most of the world's industrially important minerals. In fact, production, exports and earnings are still increasing in many cases.

Recently, however, competition in world markets has intensified, often from countries with previously insignificant minerals industries. There is now some apprehension among the leaders of the industry that Australia is not generating the degree of competitiveness essential for the

industry's survival.

There is a second dimension of competitiveness in a country like Australia which has a small population and local market, namely the ability to process the mine output and transform it into finished or semi-finished products before export. The requirements for economic success in value adding further down the production chain are somewhat different to those for direct export of the initial mine product - for example, a lower power cost is often vital.

The minerals industry is made up of many parts and, to understand the trend of the industry as a whole, it is necessary to look at the individual components. The Review of Mineral Products in Section 3.4 covers these aspects and stresses the changes occurring. A summary of the potential for the economically more important commodities is given in the Specific Value Adding Opportunities in Section 6.2.

Section 4 examines some factors that are likely to affect the future of the Industry. As all mines will eventually be worked out, either for physical or economic reasons, the future of the industry depends on exploration for new deposits. Analysis shows that, while exploration expenditure of most of the Australian companies increased at a reasonable rate in the 1990s, the proportion spent overseas by the major minerals companies increased from 27.3% in 1991/92 to 40.5% in 1995/96. This was not due to poor technology - in many cases local practice led the world - but was probably due to various broadly based factors related to competitiveness and the opening up of regions of the world previously unavailable for mineral exploration.

Australian mining company investments overseas have increased substantially since the middle 1980s, although not much more, overall, than those of business generally, except for exploration, as mentioned above. Some of the reasons for the increase in the mining company investments overseas are discussed under the headings of Foreign Government Incentives, Land Access and Profitability.

Many foreign governments have recently made changes to their mining legislation and incorporated tax concessions, grants and subsidised infrastructure. Some countries have revised their mining and financial regulations in order to reduce sovereign risk and to improve access to resources by foreign nationals and the earlier inflation problems in South America have largely been overcome.

On the contrary, access to land in Australia has been made much more difficult and uncertain. The minerals industry's recommendations for improvement of the situation following the Wik decision are summarised in a statement by the Minerals Council of Australia which is included in Section 4.5. It is pleasing to note that more companies are negotiating with the traditional owners.

The profitability of mining companies is low compared with the capital risks involved and it fluctuates widely, making it difficult for companies to justify large, long term capital investments to the providers of finance. It is noted that the profitability of initial mining and preliminary processing is usually higher than in subsequent value adding and that the risks of marketing the products may be lower.

Discussion of factors in Australia's competitiveness from the standpoint of productivity includes some general problems that are also of concern to Australian industry as a whole, such as the costs of labour, energy, land transportation, shipping and government services. There are also questions of government regulation of the industry, taxation, tariffs and the availability and cost of capital. Where possible, comparisons have been made with world best practice. Australia has a good record in a few of these categories and minerals companies have generally made a positive effort to improve productivity, but there are still some important areas needing urgent attention.

The availability of the best technology is of great importance to the minerals industry. Generally it has been adequate in the past. Some valuable improvements have originated within the industry although more frequently they have been made in those divisions of CSIRO and departments of universities that have worked closely with technical people in industry.

Concern is expressed for the future, however, because less funds are now being made available for research by governments and the large equipment companies, not only in Australia but also in the overseas countries that have been leaders in the past. World industry is becoming more competitive, new technology may not be so readily available for purchase so companies may have to develop more of their own technology.

Similar concerns are apparent concerning the training of technical personnel and particularly of managers. Australia may be falling behind some of the countries that have recently entered in the intensive world competition, especially in South America.

The environment is a significant concern to all associated with the minerals industry because disturbance of the landscape is unavoidable with extraction of minerals. The Australian industry has taken positive moves to “do the right thing” and be seen to be doing so. It has established the Australian Minerals and Energy Environmental Foundation and member companies often list their achievements in their annual reports.

Australian companies would be at a competitive disadvantage if other countries took less trouble to protect their environments and there are examples that this has happened and may still be happening. It does not seem to be the case in the larger South America operations which is important since these will probably become even stronger competitors in the future.

## 3. THE AUSTRALIAN MINERALS INDUSTRY

### 3.1 INTRODUCTION

Australia has had an efficient and profitable mining and metallurgical industry for well over a hundred years. In recent times, it has extended its traditional exports of gold, silver, copper, lead, zinc and tin to become a major supplier of iron ore, coal, alumina, nickel and diamonds to growing world markets. It has recently been harvesting the benefits of several decades of intensive development and capital investment which were made possible by discoveries of world class mineral deposits and improving overseas markets.

The industry is, however, now facing a period of change due to strong competition from newly emerging mineral industries in South America, East Asia, South Africa and elsewhere. Also, India, China and the former Soviet countries are encouraging the exploration and development of their resources and are making their presence felt in the world minerals trade. They are aggressively bidding for a share of the international pool of investment capital and technological expertise. Therefore, to maintain its current position in the mineral world, and hopefully to improve it, the Australian industry has to maintain and enhance its competitiveness in all aspects of its operations - finance, exploration, mining, processing, shipping and marketing.

This study sets out to examine, both generally and specifically, what steps can be taken to enhance Australia's competitiveness in minerals, what measures might be taken to increase mineral exports and whether major increases in value adding before export are feasible.

For the purpose of the study the Minerals Industry is taken to include production of coal, ferrous and non-ferrous minerals and metals, precious metals, diamonds and mineral sands and their derivatives. It does not include oil and gas production although many of the conclusions of the study may well apply to this sector.

Production is taken to include all operations from exploration, mining, concentration and extractive processes which result in a product for sale. Such a product may be a concentrate, a purified product such as alumina, pigment grade titanium dioxide, uncut diamonds and pure metals. It may include production of metal alloys but does not include the processes of metal forming and fabrication or of coke production. It is broadly consistent with the approach of the Industry Commission in its analysis of "Mining and Minerals Processing in Australia" (1991).

### 3.2 COMPETITIVENESS: WHAT DOES IT MEAN?

Competitiveness of an operating mining company means, among other things, that the costs of exploration, mine development, construction of the treatment plant and all ancillaries must be recouped during the life of the mine and that adequate dividends are paid to shareholders, commensurate with the risks involved. The risks must take into account the inevitable fluctuations in revenue caused by movements in world commodity prices and in currency exchange rates and by the availability of adequate markets, especially in times of recessions in the world economy.

Competitiveness of a company planning a new mine means the forecasting of the above costs and revenues as if the mine was operating and then comparison with the world "cost curve" for the product(s). The cost curve relates the tonnage produced to the cash cost per tonne of all producers of that particular product throughout the world. The objective is for the project to lie in the bottom portion of the curve. This concept of competitiveness causes the Australian

minerals industry, being heavily dependent on exports earnings, to take a close interest in the factors making up the cost of a unit of product delivered to the market by all producers, wherever they may be.

By the same token, because of the lifting of restrictions on the flow of capital throughout the world in recent years, and other factors to be discussed later, Australian companies must consider whether they would do better by investing in a similar project overseas.

Competitiveness in value adding will be a major factor in increasing the revenue from Australia's mineral production. There are good industrial and national reasons for completing the processing of Australia's mineral products before export and the Review of Individual Mineral Products (Section 3.4) indicates there is still a long way to go. Two important factors are, firstly, the availability of adequate markets for the fully processed product, since the purchaser will often prefer to take unprocessed material and gain the value adding benefits itself, and secondly, the costs of doing so and these will usually have different emphasis (such as power costs) than those of the mining operation. Also, technological factors can be more important in the processing stage.

## 3.3 RECENT MINERALS PRODUCTION AND EXPORTS

Before discussing the production and export of Australia's minerals, it should be mentioned that there are substantial differences in opinion between the organisations publishing statistics in regard to the cut-off point between mineral production and manufacturing that is based on that production.

The statistics used in this Report are essentially those published by the Australian Bureau of Agricultural and Resource Economics (ABARE) [1] and the Minerals Council of Australia (MCA) [2]*. They are described as "Mineral Commodities" by Allen [3]. The following are included by ABARE: mineral exploration; coal, metal ore and construction material mining; oil and gas extraction; alumina and mineral concentrate production; basic iron and steel making; aluminium, copper, gold, silver, nickel, lead and zinc metal production. Allen adds petroleum refining and production of some basic chemicals. The Minerals Council excludes the latter and also iron and steel, oil and gas extraction and mining construction material.

This definition differs from that used by the Australian Bureau of Statistics (ABS) which is confined to "mining" in that it excludes processing and value-adding to minerals elsewhere than at the mine site. Those activities are classed as "manufacturing" and have the effect of minimising the contribution of the minerals industry to value-adding and to some exports.

A summary of the production of major mineral commodities for the years 1994/95 to 1997/98 (forecast) is given in Table 1 together with annual changes during this period. Oil, gas and other petroleum products are not covered.

Strong growth in output during the 1980s weakened during the early '90s due to lower world commodity prices after a peak in 1989/90. The changes in mine production during the period 1994/95 to 1996/97 were generally positive.

Table 2 shows the f.o.b. value of the major mineral exports for the same period. The mixed results in 1996/97 resulted from the interaction of decreases in world commodity prices with increased production and a lower Australian dollar. Despite the lower prices the total value of mineral exports increased from $34.7 b to $35.6 b or 2.5% and the proportion of total

*In relation to the ABS, ABARE and Minerals Council data, figures have been rounded in this report for clarity. This may have induced apparent inconsistencies in some of the derived values.

| **Mine Production** | **Unit** | **94/95** | **95/96** | **% change** | **96/97 prelim** | **% change** | **97/98 forecast** | **% change** |
|---|---|---|---|---|---|---|---|---|
| Coal, black, saleable | Mt | 192.3 | 194.5 | 1.1 | 203.0 | 4.4 | 214.3 | 5.6 |
| Bauxite | Mt | 42.3 | 43.3 | 2.4 | 42.8 | -1.2 | 43.9 | 2.6 |
| Copper (contained metal) | kt | 376.0 | 483.0 | 28.5 | 530.0 | 9.7 | 600.0 | 13.2 |
| Gold | t | 249.0 | 273.0 | 9.6 | 303.0 | 11.0 | 320.0 | 5.6 |
| Iron ore, conct | Mt | 137.0 | 148.0 | 8.0 | 149.0 | 0.7 | 152.0 | 2.0 |
| Lead (contd metal) | kt | 460.0 | 505.0 | 9.8 | 530.0 | 5.0 | 575.0 | 8.5 |
| Manganese ore | Mt | 2.0 | 2.2 | 10.0 | 2.2 | 0.0 | 2.2 | 0.0 |
| Nickel (contd metal) | kt | 98.0 | 106.0 | 8.2 | 118.0 | 11.3 | 132.0 | 11.9 |
| Silver | kt | 0.9 | 1.0 | 11.1 | 1.2 | 20.0 | 1.2 | 0.0 |
| Tin | kt | 8.0 | 9.2 | 15.0 | 9.0 | -2.2 | 9.1 | 1.1 |
| Ilmenite conc | Mt | 1.8 | 2.1 | 16.7 | 2.5 | 19.0 | 2.7 | 8.0 |
| Rutile conc | kt | 231.0 | 189.0 | -18.2 | 159.0 | -15.9 | 196.0 | 23.3 |
| Uranium oxide | kt | 2.6 | 5.1 | 96.2 | 6.0 | 17.6 | 6.8 | 13.3 |
| Zircon conc | kt | 527.0 | 495.0 | -6.1 | 464.0 | -6.3 | 461.0 | -0.6 |
| Zinc (contd metal) | Mt | 0.9 | 1.0 | 11.1 | 1.1 | 10.0 | 1.1 | 0.0 |
| Diamonds | Mct | 43.6 | 42.5 | -2.5 | 41.8 | -1.6 | 41.4 | -1.0 |
| Salt | Mt | 8.2 | 8.3 | 1.2 | 8.7 | 4.8 | 8.7 | 0.0 |
| **Processed, Smelted, Refined** | Mt | 12.9 | 13.3 | 3.1 | 13.2 | -0.8 | 13.6 | 3.0 |
| Alumina | Mt | 1.3 | 1.3 | 0.0 | 1.4 | 7.7 | 1.5 | 7.1 |
| Aluminium ingot | kt | 281.0 | 293.0 | 4.3 | 331.0 | 13.0 | 393.0 | 18.7 |
| Copper refined | Mt | 8.4 | 8.5 | 1.2 | 8.5 | 0.0 | 9.2 | 8.2 |
| Steel, raw | kt | 382.0 | 405.0 | 6.0 | 410.0 | 1.2 | 410.0 | 0.0 |
| Lead, refined, bullion | kt | 71.0 | 73.0 | 2.8 | 83.0 | 13.7 | 89.0 | 7.2 |
| Nickel, refined | kt | 489.0 | 517.0 | 5.7 | 604.0 | 16.8 | 676.0 | 11.9 |
| Rutile synthetic | kt | 165.0 | 185.0 | 12.1 | 161.0 | -13.0 | 178.0 | 10.6 |
| Titanium pigment | kt | 312.0 | 330.0 | 5.8 | 335.0 | 1.5 | 345.0 | 3.0 |
| Zinc, refined | | | | | | | | |

Table 1: Production of Major Mineral Commodities in Australia showing changes from 1994/95 to 1997/98 (forecast).
Source: Adapted from "Australian Commodities", March 1997, p 112.

commodity exports from 60.4 to 61.1% Taken in decreasing order of value for the unprocessed ores and where applicable, their immediate derivatives, they are:

> coal; petroleum products; gold; iron and steel; alumina and aluminium; lead and zinc; nickel; copper; the beach sand minerals of titanium and zirconium and their products; diamonds; uranium oxide and manganese ore.

The forecast growth in 1997/98 is strong in nearly all minerals and the expected increase export value is 9.9% due to increases in economic activity in nearly all regions leading to increased demand, according to ABARE.

## 3.4 REVIEW OF INDIVIDUAL MINERAL PRODUCTS

Competitiveness is made up of many factors and, while any one country can hardly excel in all of them, each will have to be pre-eminent in some of these in order to be internationally competitive. Likewise, in a Federation of States such as Australia, the relative competitiveness of the infrastructure in each State will determine whether it will assist or impede companies in the production of a particular commodity or manufacture. (This is discussed in more detail later in Section 5.8).

The following brief review will attempt to indicate which sectors of the minerals industry

| Commodity | 94/95 | 95/96 | % change | 96/97 prelim | % change | 97/98 forecast | % change |
|---|---|---|---|---|---|---|---|
| Coal, coking | 4098 | 4746 | 15.8 | 4724 | -0.5 | 4814 | 1.9 |
| Coal, steaming | 2775 | 3014 | 8.6 | 3198 | 6.1 | 3377 | 5.6 |
| Bauxite | 88 | 85 | -3.4 | 80 | -5.9 | 77 | -3.8 |
| Alumina | 2231 | 2717 | 21.8 | 2458 | -9.5 | 2954 | 20.2 |
| Aluminium ingot | 2173 | 2379 | 9.5 | 2118 | -11.0 | 2742 | 29.5 |
| Copper, conct & refined | 797 | 928 | 16.4 | 1054 | 13.6 | 1130 | 7.2 |
| Gold (Aust origin) | 3961 | 5013 | 26.6 | 4606 | -8.1 | 4916 | 6.7 |
| Iron ore & pellets | 2774 | 2865 | 6.9 | 3070 | 7.2 | 3232 | 5.3 |
| Steel, ferro alloys | 1458 | 1614 | 10.7 | 1512 | -6.3 | 1716 | 13.5 |
| Lead, conc, bull. & refined | 409 | 456 | 11.5 | 466 | 2.2 | 493 | 5.8 |
| Manganese ore | 202 | 220 | 8.9 | 231 | 5.0 | 228 | -1.3 |
| Titanium concs, products | 650 | 731 | 12.5 | 734 | 0.4 | 870 | 18.5 |
| Nickel | 978 | 1157 | 18.3 | 1133 | -2.1 | 1486 | 31.2 |
| Silver | 47 | 62 | 31.9 | 79 | 27.4 | 84 | 6.3 |
| Tin | 50 | 61 | 22.0 | 58 | -4.9 | 62 | 6.9 |
| Zinc conc & refined | 776 | 817 | 5.3 | 904 | 10.6 | 1146 | 26.8 |
| Zircon conc | 155 | 223 | 43.9 | 280 | 25.6 | 289 | 3.2 |
| Diamonds | 571 | 531 | -7.0 | 630 | 18.6 | 630 | 0.0 |
| Uranium oxide | 188 | 242 | 28.7 | 272 | 12.4 | 334 | 22.8 |
| Oil, gas, petroleum prods | 4321 | 4766 | 10.3 | 5750 | 20.6 | 5816 | 1.1 |
| Other | 1358 | 1500 | 10.5 | 1577 | 5.1 | 1661 | 5.3 |
| Total Mineral Resource | 30783 | 34709 | 12.8 | 35569 | 2.5 | 39100 | 9.9 |
| Exports | 51035 | 57459 | 12.6 | 58200 | 1.3 | 62429 | 7.3 |
| Total Commodity Exports | 60.3 | 60.4 | | 61.1 | | 62.6 | |
| % Mineral Exports | | | | | | | |

Table 2: Value of Major Australian Mineral Exports showing changes from 1994/95 to 1997/98 (forecast) - A$million.
Source: Adapted from "Australian Commodities", March 1997, p 122.

have been the most successful exporters and therefore, to a large extent, have been the most internationally competitive. These are the sectors on which the future of the minerals industry will most likely depend. Each sector has its own particular characteristics and each has to be studied individually in order to understand the composite picture.

### 3.4.1 ALUMINIUM

The aluminium industry grew rapidly since 1956 when a small Government owned alumina refinery and an aluminium smelter commenced operation at Bell Bay, Tasmania. In 1997, Australia is one of the largest producers of bauxite and alumina in the world and has six smelters producing 1.4 million tonnes (Mt) of aluminium metal out of a world production of 21 Mt.

Australia also has facilities for producing plate, sheet, extrusions and cast products to supply the local market but exports of these products have not generally been profitable over a long period. Development of the fabricating industry has been slow because the domestic market is small and there have not been enough comparative advantages for success in the export market. Some automobile wheels are however being exported directly to Japan from the Bell Bay smelter.

#### 3.4.1.1 Bauxite and Alumina

Australia has world class deposits of bauxite, the ore of alumina, containing 40 to 55% aluminium oxide of which 43 Mt were mined in 1996/97 at Weipa, Queensland; Gove, Northern Territory, and Kwinana and Pinjarra in south west Western Australia. Virtually all of the

bauxite was refined to pure alumina at Gladstone, Gove and south west WA, production of which was 13.2 Mt in 1996/97 of which 10.6 Mt was exported for $2.5 billion.

Alumina production in Australia will be fairly steady in 1996/97 but world production will increase to 46.8 Mt in 1996/97 as a result of the new Alunort refinery in Brazil and expansions in India and Ireland.

#### 3.4.1.2 Outlook for Australia

Australia can compete well on the world market in alumina production. The bauxite is a product of the natural weathering of lateritic rock and it lies at the surface with little overburden cover. It can be mined and transported cheaply, in some cases by conveyor belt. Although the Australian bauxites are not high in grade, that at Weipa can be beneficiated by simple washing and screening to remove siliceous impurities, while in WA, the even lower grade bauxite contains silica that does not react in the subsequent process.

A most important aspect of the alumina industry is the throughput. An alumina plant to be viable must produce in excess of one million tonnes per annum - that at Gladstone is the largest in the world and produces 3.3 Mtpa. The bauxite mine at Weipa and the alumina plant are served by dedicated shipping between company loading facilities, with conveyor or pneumatic handling of the product for export.

It comes as no surprise then to note that RTZ/CRA/Comalco have been considering a large, new alumina plant at Weipa or an east coast site but Malaysia is also a possibility.

#### 3.4.1.3 Aluminium

Australia will produce an estimated 1.4 Mt of aluminium in 1996/97 from roughly 3 Mt of alumina in six smelters and the Australian industry operates a seventh in New Zealand. Australia will export 1.4 Mt of metal valued at $2.1 b which is less than 5% of the world output. If all of the 10.6 Mt pa of alumina currently being exported could be smelted in Australia, the value would be over $12 b (less the cost of smelting and marketing).

Plans are in hand to increase local production by about 7% through brownfield expansions but there are no known plans for new greenfields smelters. The world production is estimated to increase to 21.4 Mt in 1997 to meet a consumption level of 21.2 Mt.

#### 3.4.1.4 Outlook for Australia

All aluminium is produced by the Hall-Héroult process which consists of the electrolysis of alumina dissolved in molten cryolite between carbon electrodes at 945-975 degrees Celsius. The cost of power is crucial in the smelting of aluminium and the continuity of power supply is crucial too, because if it fails, the pots will freeze and it may take weeks to bring them back into production.

Much of the world's aluminium industry uses hydro power because it is the cheapest source. (It should also be free from any future carbon tax!) Of the Australian and NZ smelters, only the New Zealand and the small Bell Bay smelter have access to hydro power and there is no likelihood of any further substantial amount becoming available in Australia. Hence it is to be expected that new greenfields smelters will be situated in countries such as Venezuela, Chile or Canada. Saudi Arabia is also a likely location on account of abundant low-cost natural gas although the risk of a carbon tax would still be present.

Three principal factors could improve the possibility of new greenfields aluminium smelters being established in Australia:

- a substantial and stable increase in the world price of metal;
- a lower power cost from new, coal-fired power stations;
- improved cell design to increase the efficiency of power use.

The world outlook for aluminium in ’97 and ’98 is encouraging with price increases of more than 11% due to increasing economic activity.

### 3.4.2 COAL

Australia was the world’s largest coal exporter in 1996/97 with 146 Mt valued at nearly A$8.2 b.

The total world seaborne coal trade is forecast to rise by 5.9% to nearly 440 Mt in1996/97 so there would appear to be plenty of scope for Australia to increase its overseas revenue from that source. (There are some discrepancies between published statistics).

#### 3.4.2.1 Outlook for Australia

There are immense deposits of clean, high grade coking and steaming coal relatively close to the coast of Queensland and NSW and to good port sites and centres of population. Much of the coal can be extracted by open cut mining. There is some potential for value adding of coal by washing and blending to suit customers’ requirements but there is no practical possibility for further value adding except in the sense of producing cheap power and using it to add value to other minerals before export.

There are opportunities for increasing labour productivity in the mining of coal, particularly as compared with benchmark American practice. As will be seen later, the ship-loading facilities and operations are in most instances highly efficient although the costs of government rail transport have some room for improvement.

### 3.4.3 IRON ORE, VALUE-ADDED PRODUCTS AND MANGANESE DIOXIDE

The world production of iron ore was 1.05 b tonnes in 1996/97 and is expected to increase by 25 Mtpa (2.4%) in 1997/98. The additional ore will go to produce blast furnace iron and to supply other new alternative ironmaking plants capable of supporting the general trend to electric furnace steel production. Over 75% of the world exports of 460 Mt will be required in the Asian region, for which Australia is well placed, the principal competitor being Brazil. BHP has recently committed $375 M to increase shipping capacity at Port Hedland.

In Australia, it is estimated that 15.5 Mtpa of iron ore will be consumed by the local steel industry in 1996/97 for the production of 8.85 Mt of steel of which 3.3 Mt will be exported. The value of all Australian exports of iron ores and products in 1996/97 will be about A$4.6 b.

#### 3.4.3.1 Trends in Steelmaking

The traditional blast furnace has been the basis of iron and steelmaking for over a century. An essential component of the furnace feed, in addition to lump ore and/or pellets, has been lump metallurgical coke. Coke manufacturing in ageing coke ovens causes severe environmental problems - for example, the US industry spent $500 million in 1995/96 to upgrade ovens, to

replace some of the lump coke with pulverised fuel and make various other technical improvements.

Although the blast furnace is still the backbone of the industry in countries with a large steel production, the number of blast furnaces and integrated steel plants in USA has been cut by half during the last 20 years. Meanwhile the share of raw steel production from electric arc furnaces (EAF) fed with scrap increased from 28% in 1980 to about 40% in 1995 - more scrap than blast furnace iron is now being used to make steel [4].

Warnock and Bensley [5] stated: "Compound annual growth rates of over 3% are forecast for EAF steel despite world steel production growing by only 1.5%".

BHP announced in June, 1996, after a $222 M write-off on the Newcastle steelworks, that the blast furnaces and coke ovens are to be scrapped and an electric steel mini plant built [6]. An announcement in May 1997 advised that all steel production at Newcastle would cease in 1999 but it will continue at Whyalla and Port Kembla.

#### 3.4.3.2 Direct Reduced Solid Iron Products

There will have to be alternatives to scrap as the proportion of available good quality scrap decreases and the growth of steel production in countries without blast furnaces increases. One type of substitute scrap feed to the EAF, known as direct reduced iron (DRI), should ideally contain of the order of 93% total iron with a minimum metallic iron content of 88%, less than 6% waste material (gangue) and low sulphur and phosphorus.

The first commercially-important DRI was produced by the HyL process in the 1970s by gaseous reduction of lump ore or pellets in a shaft furnace. This was quickly followed by the very successful Midrex shaft furnace technology. Iron carbide is another form of DRI based on fluid bed reduction [7].

World DRI production increased from 7.4 Mt in 1980 to 30.7 Mtpa in 1995. Eight countries had annual productions over 1.3 Mt; Venezuela is the world's lowest cost producer and had the largest output of 4.7 Mtpa [13, p 369].

BHP is building a hot briquetted iron (HBI) plant at Port Hedland with a capacity of 2 M tpa iron. The likely investment cost is around $1.0 billion plus associated infrastructure. After investigating all of the available technology, BHP decided on the FINMET Process which involves the treatment of beneficiated iron ore fines in fluid bed reducing reactors. The reductant will be reformed natural gas consisting of a mixture of hydrogen, carbon monoxide and methane. The first reactor is scheduled to commence operation in December, 1997. Eight other DRI plants have been proposed for WA.

#### 3.4.3.3 Direct Smelting

The only direct smelting technology producing molten iron in commercial operation at present is the COREX process. It involves the smelting of pellets or high grade lump ore in a two-stage shaft furnace using 100% pure oxygen and coal. The first commercial plant was installed by ICSOR, South Africa in the late 1980s with a capacity of 300,000 tpa. A plant of twice that capacity commenced operation at Pohang, South Korea in 1995 and a third (2 units) is under construction at the Hanbo works also in South Korea. Other plants have also been committed.

CRA's HIsmelt process had its origin in new bottom blowing steel technology developed in Germany in the 1970s and early '80s. A small pilot plant with 10000 to 12000 tpa capacity was operated in Germany from 1984 to 1990 and a 100,000 tpa pilot plant is being trialled at

Kwinana, WA. Initial trials have been successful and a commercial plant could be in operation before 2000.

The smelting process is conducted in a closed, molten bath reactor into which are injected iron ore fines, steaming coal and fluxes. The advantages of the technology are expected to include the following:

- it will be economic at a 0.5-1.0 Mtpa;
- air is used instead of oxygen;
- iron ore fines need minimum pretreatment;
- a wide range of non-coking coals can be used;
- the product is premium grade and suitable for refining in the ladle, basic oxygen or EAF steelmaking processes;
- economy of energy use [8].

The South Australian Steel and Energy Project, a joint venture involving Ausmelt Ltd, the SA Government and Meekatharra Minerals has a pilot plant in northern SA for the production of pig iron from local lump coal and iron ore using Ausmelt technology [9].

The Corex, HIsmelt and Ausmelt processes gain an advantage over the solid DRI technology because the systems are molten and the impurity gangue minerals can be discarded in a slag. There is a further premium if the molten iron can be fed directly into an oxygen converter to produce finished steel.

#### 3.4.3.4 Outlook for Australia

Much of the iron ore that has been exported from Australia was in natural lump form and it went to conventional blast furnaces. The growth of the industry over the years indicates that the trade has been competitive. A major factor has been the improvement in industrial relations in recent years.

A substantial portion of the growth in steel production worldwide will come from electric arc furnaces for which lump ore is not essential and upgraded products are favoured. The upgrading processes mostly require fine ore and they therefore provide an opportunity for the beneficiation of lower grade fine ores that are not suitable directly for blast furnace use. Providing costs (including that of energy) are competitive, Australia has a good potential for selling upgraded products and several plants are planned to come into production in the next few years.

#### 3.4.3.5 Electrolytic Manganese Dioxide

BHP is a major world producer of manganese ore from Groote Eylandt, NT and most goes directly into the steel industry. In 1992, a plant was commissioned at Newcastle to produce 180,000 tpa of high purity electrolytic manganese dioxide to be used in the manufacture of dry batteries, which was about 10% of world production. The value-adding factor was ten times that of the original ore with the product returning $2000 pt. The Company had been unable to purchase the technology and therefore developed it in-house at a cost of $20 million for R & D. The plant cost was over $100 million and it was the only one in the Asia Pacific region outside Japan when it was built.

The operation has been technically successful but BHP has some reservations about its

commercial success which illustrates that entry into a new value adding venture can have its problems [10].

### 3.4.4 COPPER

Although the mining and smelting of copper constitutes a large segment of the world minerals industry with a total output of an estimated 13.1 million tonnes in 1996/97, Australia is a small producer with only about 4% of the total. World mine production increased fairly steadily from 1993/94 to the 1996/97 estimate whereas Australian production was flat in the 1992-95 period but will increase sharply to 600,000 tpa in 1997/98 forecast.

Australia's production comes chiefly from Mount Isa and Olympic Dam (Roxby Downs) where the only two smelters are installed. Substantial escalations have been announced for both of these operations. MIM Holdings is investing $500 M in two developments at Mount Isa - the Enterprise Mine in the deep copper orebodies and the expansion of the smelter capacity to 250,000 tpa. WMC plans to invest a further $1.5 b to expand the Olympic Dam refined copper production to over 200,000 tpa.

Several new, smaller mines have come into production recently and Mount Lyell has re-started. The Ernest Henry copper-gold mine (MIM 51%) northeast of Cloncurry will come into production during the second half of 1997 with concentrate containing 95,000 tpa copper and 120,000 ounces of gold being trucked to Mount Isa for smelting. Natural gas will be available there in 1998. MIM's refinery at Townsville has processed virtually all of the copper from the Mount Isa smelter since 1959 and services both the Australian and export markets.

In addition, there is production of refined copper at the mine sites at Gunpowder, Qld; Nifty, WA and several other operations by the acid leach/solvent extraction/electrowinning system. It is growing in popularity as it overcomes the need for transporting concentrates and for conventional smelting and refining. The huge Escondida mine in Chile managed by BHP is now producing refined copper by an ammonia leach version of the technology.

Forecasts indicate that the world production of copper will exceed consumption between 1996 and 1998 and accordingly the price will continue to drop. Nevertheless, ABARE expects the Australian industry to earn over $1.1 billion from exports of copper in 1997/98.

#### 3.4.4.1 Outlook for Australia

The technology of copper smelting has progressed markedly in recent years. It is not a large consumer of energy when treating sulphide minerals because the heat available from their oxidation can be partially utilised. Any new large copper producer would most likely smelt at the mine or between the mine and a port.

Unfortunately, the very large, low grade copper deposits such as at Bingham Canyon in Utah, Escondida in Chile, Ok Tedi and Bougainville in PNG have not yet been discovered in Australia. Unless they are found, perhaps buried under substantial cover as at Olympic Dam, Australia's copper production is likely to grow slowly through the discovery of smaller, scattered deposits.

In other words, Australia is dependent on the success of future exploration followed by competitive operations and transport arrangements for any large increase in its export earnings from copper.

### 3.4.5 NICKEL

Nickel and copper have some characteristics in common although economic nickel deposits were only discovered in Australia during the 1960s whereas copper mining and smelting commenced in the 1880s. Sulphides mined at Kambalda, Leinster and Mount Keith, WA are smelted at Kalgoorlie and the resulting sulphide matte leached under pressure with ammonia at Kwinana to produce refined metal. Some sulphide concentrates from Mount Keith and other WA nickel concentrates are, or will be, exported to Finland for refining. Silver Swan, Cawse and Yakabindie mines will come on stream in 1997/98. Oxide nickel ore is imported from New Caledonia and reduced, leached and the nickel recovered by solvent extraction and electrowinning at Yabulu, near Townsville.

A laterite mine and extraction plant at Murrin Murrin near Leonora, WA, with a capital cost of A$900 m, was recently announced by Anaconda Nickel. It will produce 40,000 tpa nickel and 3,000 tpa cobalt in 1998 [11]. A smaller laterite plant is planned for Bulong, WA by Resolute Samantha at a cost of $500 million [12]. Other companies have also announced new ventures.

The world production and consumption of nickel are expected to pass the million tonne per annum level in 1997/98. The price declined during 1996 but increasing consumption in 1997 could lead to upward pressure - forecasts are for a rise of 7% in ’97 and 12% in ’98.

The estimated value of Australia’s nickel exports of 141,000 t is forecast by ABARE to be nearly A$1.5 b in 1997/98. The driving force in the market is the popularity of stainless steel - there was an increase of 28% in the Western World production during 1994 and 1995 and growth in 1997 is expected to be strong [13].

#### 3.4.5.1 Outlook for Australia

In spite of its relatively recent entry into nickel, Australia already has passed 10% of the world production while an increasing proportion of the mine production is being, and will be, refined locally. There are large areas of WA that may be considered prospective for nickel so, as with copper, any increase in future export earnings will be dependent on exploration and the expansion of the existing fields. The technology of nickel extraction and its separation from copper and cobalt, which are frequently found with it, is readily available and not heavily energy intensive. Overall, the future for nickel in Australia is very encouraging, in spite of the expected opening of the large plant at Voisey’s Bay, Canada around 2000.

### 3.4.6 LEAD

The market for lead is dominated by acid batteries and 50% of the requirement in the world, and 75% in USA, is met by recycling. Lead mostly occurs in nature as a sulphide with zinc. With some mine closures, a trend to lower lead ratios in new orebodies and the increase in the electrical requirements of new automobiles, world consumption surprisingly exceeded production since 1995 and the price rose from US 25 c/lb in 1994 to 35 c/lb in 1997 [15]. However, the predictions for ’97 and ’98 are for a weakening price (ABARE 3/97, p 56) as production exceeds consumption.

The lead smelting industry is however suffering from environmental problems and there will be pressure for the replacement of some of the existing older smelters by newly developed, more friendly technology. Examples are the QSL Continuous Oxygen Converter and the Isasmelt/

Ausmelt processes [16].

#### 3.4.6.1 Outlook for Australia

The world production of lead is forecast to be 5.9 Mt in 1997/98 of which 10% will be mined in Australia. About 70% of the Australian output is smelted in Australia at Port Pirie, Mount Isa and Cockle Creek, NSW and half of the bullion is refined locally. The value of exports in 1996 is estimated by ABARE to be just under A$0.5 b or $1.6 b if the lead and zinc figures are bulked together.

### 3.4.7 ZINC

Australia has been well endowed with zinc and, in conjunction with associated lead and silver, it has played a major part in the development of Australia's mining, metallurgical, fertilizer, forestry, paper and aircraft industries. While the old mines at Broken Hill, NSW and Rosebery, Tas are running down, significant new deposits have been or are being opened up or awaiting development in north-west Queensland.

Sulphide zinc flotation concentrates generally contain 50% zinc and 20% sulphur and usually the sulphur is recovered as sulphuric acid during smelting. The acid in Australia mostly goes into the production of superphosphate and other fertilizers.

Australia smelts about 30% of its zinc production at Risdon, Tas., Cockle Creek, NSW and Port Pirie, SA. It is unlikely that these smelters would be able to handle much of the concentrates from large, new deposits in Queensland.

The world zinc market was unstable in 1996 due to rapid growth in the galvanizing of steel (which consumes 30% of zinc production) and to price fluctuations. World production was 7.5 Mt of which Australia's mine production was 1.1 Mt. MIM's new McArthur River mine (MIM 70%) was a major contributor of mixed lead/zinc concentrates. Export earnings from zinc are forecast to increase by 10.7% to $904 million in 1996/97.

No new smelters were being built in the world during 1996 and none was planned for '97. Furthermore, there were some closures, so brownfields expansions and the re-opening of some idle capacity will be necessary to meet the demand. World prices are expected to increase by 20% in 1997 and 13% in 1998 [1, March 1997, p 34].

#### 3.4.7.1 Outlook for Australia

By its nature, the extraction and refining of zinc is capital - and energy - intensive and it has never been a very profitable industry. The increases in actual and planned mine production of zinc, the steady growth in world consumption and the obvious caution in the establishment of new smelters worldwide suggested there could be an opportunity for a new smelter in Queensland, with by-product sulphuric acid going into fertiliser production. Korea Zinc's new smelter in Townsville, due to be completed in 1999, is a $500m investment, employing traditional technology, which will treat concentrate railed from Mt Isa or imported from overseas [17].

Illustrating the need for microeconomic reform, the cost sensitivity of the proposed $1.1 b Century Zinc project in NW Queensland is such that a change in the feasibility study to shipment of the concentrates to Townsville by rail instead of pumping them to barges in the Gulf was said to "kill the project" [18].

BHP Minerals reported that their silver-lead-zinc deposit at Cannington near McKinlay in north west Queensland will be ready to commence production by the end of 1997. It is a world class deposit reminiscent of Broken Hill geology and is located within the Proterozoic Mount Isa block with similarities to silver-lead-zinc deposits at Pegmont and Dugald River and copper-gold deposits at Selwyn, Soborne, Ernest Henry and Eloise.

At full production, Cannington will treat 1.5 Mt pa of ore and produce 24 M ounces of silver contained in 250,000 t pa of lead concentrate and 100,000 t pa zinc concentrate. This will be trucked 180 km to rail sidings near Cloncurry [19].

### 3.4.8 GOLD

Gold is unique among the commercial minerals in that the greater part of the value-adding occurs before it leaves the site of even the smallest mine. This is of course a direct result of its being a "noble" metal. Exceptions occur when it resides, as it often does, in concentrates of lead and copper sulphides and in unrefined lead bullion or "blister copper" which are sent away for smelting and refining. Silver also follows these routes.

World mine production of gold in 1996/97 was expected to be 2433 tonnes while Australia's production was estimated to increase by 9.6% to 303 tonnes in 1996/97. Reflecting, among other things, strong growth in exploration expenditure earlier in the decade, Australia's economic gold reserves increased by 15% to 4000 tonnes, enough to last the industry at present consumption for nearly 15 years even without any further discoveries.

Exports of gold of Australian origin have flattened out over the period 1995-1998 with the value expected to be $4.9 b in 1997/98.

#### 3.4.8.1 Outlook for Australia

The greater understanding of geology and improved prospecting methods is assisting in new discoveries of gold in Australia and in neighbouring countries. Processing technology has improved markedly in recent years allowing the use of saline water in processing, the heap leaching of low grade ores and recovery by carbon-in-pulp procedures.

The occurrence of gold over such a wide area of Australia (especially in WA) is a reminder of the importance of water to the minerals industry. There is a case for a broad study of its availability, usage and conservation in relation to the industry as a whole.

The way to greater export income from gold is by continuing with the current procedures, involving exploration, mining and metallurgical improvements, cost control and good industrial relations practices. There are no indications that the supply of gold is likely to exceed the world demand in the foreseeable future. There is however a danger that the price would fall due to the influence of sales programs by central banks such as IMF and World Bank.

### 3.4.9 TITANIUM AND ZIRCONIUM MINERALS

The Australian mineral sands industry increased the value of its exports by over 25% between 1994/95 and 1996/97 (estimated to be just over $1 b). The increase between 1995/96 and 1996/97 was 10.2% reflecting strong prices and significant increases in ilmenite and synthetic rutile export volumes.

However, rutile and pigment exports decreased in 1996/97 due to the closure of Tioxide's sulphate plant at Burnie partly due to the slump in the pigment market overseas. A planned

expansion of the Kemerton chloride plant at Bunbury, WA was deferred indefinitely. Nevertheless, Westralian Sands' synthetic rutile plant at North Capel will add another 100,000 t of capacity by mid-1997 to bring it to 230,000 tpa.

Two new mineral sands plants have been announced. They are at Beenup, WA by BHP with 600,000 tpa ilmenite and 20,000 tpa zircon and a new plant at Goondlum, Qld by Monto Minerals N L [20]. Zircon recently experienced a remarkable increase in price due to strong growth in demand in Europe and Asia. However, Australian production of zircon will not increase significantly in 1996-1998 because of the nature of the sand deposits to be mined.

#### 3.4.9.1 Outlook for Australia

The Australian mineral sands industry has for over 40 years been an important contributor in the world scene for titanium pigment and zircon for the ceramics and foundry industries. The industry still appears to have a good future in Australia in spite of the restrictions that are placed upon it and the fluctuations in the market for its products.

It will be noted that the production of synthetic rutile is over three times that of natural rutile and there is scope for more of the same given the substantial reserves of ilmenite. Further production of finished chloride route pigment could well be expected if markets were available.

The world markets for titanium minerals are improving and Australia should increase its revenue from this and from increased export tonnages.

### 3.4.10 URANIUM

World production of uranium oxide in 1996/97 was forecast to be 50.1 kilotonnes while the consumption was expected to be 73.8 kt. Consumption will exceed production substantially for 6 successive years.

Australian production in 1996/97 was at the rate of about 4.0 kt uranium oxide at Ranger, NT and 2.0 kt at Olympic Dam where it is a co-product of copper production. Exports were 6.0 kt in 1995/96 valued at A$272 M.

The spot price of uranium oxide has been rising strongly in recent years from $US15.60/lb in 1996, to $US17.00/lb in 1997 and is forecast to increase to $US18.00/lb in 1998. World stocks are being depleted so there is no fear of oversupply in the foreseeable future.

ERA is planning increased production by 47% in 1996 and will commence mining their Number 3 orebody in 1997/98 after which production will approach 5.0 ktpa $U_3O_8$. Western Mining Corporation has announced a major increase in copper and uranium production within 4 or 5 years.

#### 3.4.10.1 Outlook for Australia

The London-based Uranium Institute recently predicted that Australia would supply an extra 7 kt per annum by the year 2000, according to Mr Phil Shirvington, Chief Executive of Energy Resources of Australia. The middle of three scenarios predicted a demand of 76.6 kt by 2015 and a supply of only 69.5 kt. Only the scenario with the highest supply and the lowest demand would give a balanced position.

The additional uranium oxide would come from the further increases from Ranger, the development of Jabiluka, increases from Olympic Dam and the commencement of the RTZ-CRA Kintyre deposit in north-west Australia.

Australia was estimated by the Uranium Institute to have 46% of the world's uranium resources but Shirvington said that Australia had only 30% of the world's low-cost reserves.

The spot price of uranium oxide is expected to increase from $US11.5 per pound in 1995 to over $18.20 in 1997 (ABARE). Australia's production of 5.1 kt in 1995 was second behind Canada with 10.5 kt [21].

### 3.4.11 MAGNESIUM

A very large deposit of high purity cryptocrystalline magnesite, magnesium carbonate, was discovered in 1985 by Queensland Metals Corporation Ltd (QMC) at Kunwarara in central coastal Queensland. QMAG Pty Ltd, initially a joint venture between QMC Ltd, Pancontinental Mining and Radex of Austria, and now wholly owned by QMC, processes beneficiated magnesite to both dead burned and electrofused magnesia at its plant at Parkhurst, near Rockhampton. The current dead burned capacity of 80,000 tpa is being increased to 120,000 by year end 1997, and at 30,000 tpa the electrofused plant is one of the largest high grade magnesia producers in the world. High density magnesium hydroxide slurry is being produced on a commercial basis in a joint venture with ICI, and other environmental and manufacturing applications of processed magnesite are under way.

Large deposits of magnesite are known in north west Tasmania, but have not yet proved amenable to commercial exploitation.

#### 3.4.11.1 Outlook for Australia

There is as yet no commercial production of magnesium metal in Australia, but in January 1997 QMC, Ford Motor Co, Normandy Mining Ltd and CSIRO agreed to an investment in pilot plant production and commercial feasibility studies for the production of metal from Kunwarara magnesite [22]. This investment is forecast to exceed $70 million. The innovative and low cost process technology is based on minipilot plant demonstration of technology developed predominantly by QMC and CSIRO over the last five years in which high purity anhydrous magnesium chloride is electrosmelted in a high efficiency Alcan cell. Ford has committed to invest US$30 million in the project, not for equity in the process but rather for a supply agreement rising to 45,000 tpa of magnesium metal, over a ten year period from startup of the commercial plant.

The 1,000 tonne pilot will commence operation in Gladstone in 1998, and the commercial plant is expected to start up in late 2002. Equity will be held through Australian Magnesium Corporation Ltd, with Normandy and QMC each initially 50%, with Fluor Daniel, the design and construct engineers, subject to negotiations taking up to 10%.

In recent years there has been close liaison between Australian research and development and companies interested in automotive diecasting. There is potential for a substantial diecasting industry drawing on both magnesium availability and aluminium from Comalco's aluminium smelter which is also close to Gladstone.

### 3.4.12 DIAMONDS

Commercial mining of alluvial diamonds by Argyle Diamond Mines Joint Venture in the Kimberleys, WA commenced in 1983 and production from the main lamproite mine started in 1985.

Output has been fairly constant in recent years around 41-43 million carats. That for 1997/98 is estimated to be 41.4 million.

#### 3.4.12.1 Outlook for Australia

Argyle has about 10 years of reserves at current production rates. Other companies are exploring for diamonds in Australia.

## ;4. POSSIBLE THREATS TO THE GROWTH OF THE AUSTRALIAN INDUSTRY

### 4.1 INTRODUCTION

The Review of Australia's principal mineral production and exports could well lead one to the conclusion that these industries are strong and internationally competitive. Surely they should continue to grow and support the economy of Australia in the future at least as well as they do at present - although preferably with more value adding. Of the minerals discussed, only four are not likely to be up-graded before export in the near future: coal, natural rutile, zircon and uranium oxide.

Of the rest, all of the production of iron and manganese ores, bauxite, ilmenite and the sulphides of copper, lead, zinc and nickel could theoretically be up-graded to finished products before export. For economic or other reasons, however, none of all of these minerals is wholly up-graded, although a proportion of all of them is!

What of the future? Mines are truly "wasting assets" and eventually every mine will close. The goldfields in Victoria, Queensland, WA and Northern Territory; the copper mines and smelters at Moonta, Mount Lyell and Mount Morgan; the rich silver-lead at Broken Hill; the tin mines in Tasmania, Queensland and Northern Territory; and many, many others have already moved into history, or soon will do so. Furthermore, changing economics can be just as final as the physical exhaustion of ore reserves.

The life-blood of the industry is exploration. A mining company will cease to exist unless it discovers new economic deposits or purchases same from others. Fortunately, substantial improvements have recently been made to the technology of exploration which compensate to some extent for the increasing difficulty of finding new surface mineral exposures. But the technology knows no international boundaries. The current opening up of hitherto poorly explored countries to mineral exploration is giving the world industry a great impetus. We must be aware however that it may have a negative influence on countries with a long mineral tradition like Australia by intensifying competition in world markets, especially for copper as discussed later.

### 4.2 EXPLORATION

There is no doubt that Australia is lucky in being endowed with most of the useful minerals needed by mankind. The Bureau of Resource Sciences stated that Australia in 1995 had more than 20% of the world's economic reserve of uranium, lead, mineral sands, tantalum, zinc and cadmium; more than 15% of diamonds; and more than 10% of brown coal, silver, iron ore and bauxite [23]. Also, the reserves of many of these and of gold and black coal have continued to increase in recent years in spite of past consumption.

Governments can make a substantial contribution to exploration by conducting or subsidising geological surveys and mapping. "The breakthrough in petroleum exploration in Australia came as a result of Government subsidies to early strategic drilling" [25].

The mineral industry's annual Australian exploration expenditure is reported by ABS and ABARE and is summarised for recent years in Table 3. It will be noted that Australia's local exploration expenditure has been increasing substantially in recent years.

In order to give a broad estimate of overseas exploration expenditure by Australian companies, the Minerals Council conducts an annual survey of members in which they are asked to include

| Australian Exploration | 91/92 | 92/93 | % change | 93/94 | % change | 94/95 | % change | 95/96 | % change |
|---|---|---|---|---|---|---|---|---|---|
| Gold | 305 | 320 | 4.9 | 454 | 41.9 | 555 | 22.3 | 547 | -1.4 |
| Base metals | 145 | 183 | 26.2 | 192 | 4.9 | 201 | 4.7 | 252 | 25.4 |
| Diamonds | 36 | 38 | 5.6 | 59 | 55.3 | 48 | -15.2 | 53 | 10.4 |
| Other | 118 | 90 | -23.7 | 88 | -2.2 | 89 | 1.1 | 108 | 21.3 |
| Total | 604 | 631 | 4.5 | 793 | 25.7 | 893 | 12.4 | 960 | 7.5 |

Table 3: Private Mineral Exploration Expenditure excluding petroleum ($A million)
Source: Australian Commodities, March 1997, p 102

the expenditure of their overseas subsidiaries (which is not included in the ABS survey). The coverage of the Minerals Council survey in terms of Australia's exploration expenditure was only 67% of the ABS figure in 1995/96 but it included the major Australian overseas explorers. The latter are also included in a subset identified as a "constant group" comprising companies who have consistently reported in each year of the survey.

The figures reported for 1991/92 to 1995/96 by this "constant group" are given in Table 4. It is noted that the proportion spent on exploration overseas by this constant group has increased substantially over the period from 27.3% in 1991/92 to 40.5% in 1995/96.

An interesting facet of these figures is that the overseas expenditure went largely to "greenfields" locations whereas local exploration was largely in and around existing mining leases. Presumably this was partly because not many companies owned properties overseas and also because of the influence of the Commonwealth Native Title Act 1993 on exploration in new areas in Australia and the high cost of establishing infrastructure [24].

| Exploration by Constant Group | 91/92 | 92/93 | % change | 93/94 | % change | 94/95 | % change | 95/96 | % change |
|---|---|---|---|---|---|---|---|---|---|
| Australia | 332 | 316 | -4.8 | 403 | 27.5 | 461 | 14.4 | 469 | 1.7 |
| Overseas | 124 | 146 | 17.7 | 238 | 63.0 | 286 | 20.2 | 319 | 11.5 |
| Total | 456 | 462 | 1.3 | 641 | 38.7 | 747 | 16.5 | 788 | 5.5 |
| % overseas | 27.3 | 31.6 | | 37.1 | | 38.3 | | 40.5 | |

Source: Minerals Industry Survey Report '96, Minerals Council of Australia, p25.
Table 4: Private Mineral Exploration Expenditure excluding petroleum by the "Constant Group" ($A million).

## 4.3 GLOBALISATION OF AUSTRALIAN MINERALS COMPANIES.

Many Australian minerals companies, both large and small, have moved to increase their overseas investment and participation. They are interested in world class deposits that have the potential to perform at the bottom of the international "cost curve". Some prospects and operations will be the result of the companies' own exploration but, to date, more have probably arisen from investment in overseas operating or exploration companies.

The number of Australian minerals companies with activities offshore in 1996 was as follows: Eastern Africa 3; Western Africa 13; Southern Africa 11; South America 17; China 6; Canada 5; Eastern Europe 8, Western Europe 7; Indonesia 27; Japan 1; New Zealand 13; Philippines 9; PNG 18; Vietnam 8 and USA, 10 [26]. For example, BHP has investments or interests in 9 of these areas or countries.

The overseas trends have not of course been limited to the Australian minerals industry as many non-minerals companies now earn a fair proportion of their revenue from offshore

subsidiaries or partners. There has been an upward trend in direct investment abroad since the early 1980s following the relaxation of restrictions on inward capital flows by many overseas governments. The expansion has been facilitated by technological changes such as improved communications. Closer integration of world markets and greater uniformity of patterns of demand between countries have also promoted higher levels of foreign direct investment.

The Industry Commission Inquiry into Australian Direct Investment Abroad draft report in May, 1996 indicated that the value of total Australian direct investment abroad increased by an average A$3.2 billion per annum in the three years to 1993/94 when it reached $48 billion. This level was not considered high by the Industry Commission in relation to international standards. Reasons include the fact that the size and turnover of the companies participating had become large enough, that the markets were bigger than at home and that growth opportunities were better. Generally, it is considered that overseas involvements will at the same time enhance rather than diminish Companies' local earnings [27].

The average rate of increase in overseas investment in mining, exploration and basic metal products combined in the period 1991 to '94 was similar to that of "total industries". However,

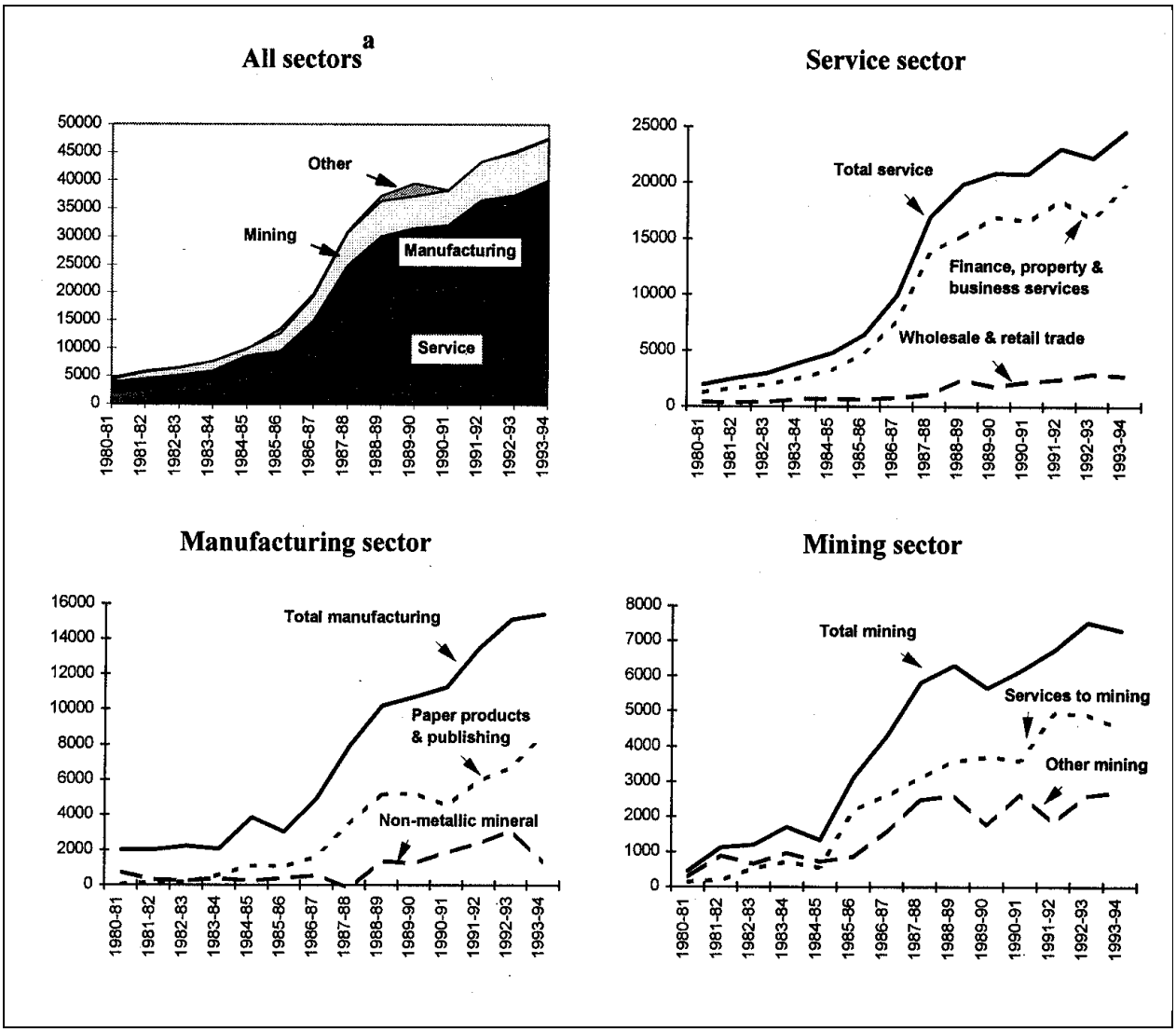


Figure 1: Australian Direct Investment Abroad, 1980/81 to 1993/94 (A$ million).
a - the "other" category refers to agriculture and unallocated industries.
Sources: ABS Cat No 5363.0 and 5352.0. Industry Commission Inquiry into Australian Direct Investment Abroad, Draft Report, 1996, p 27.

the mining and exploration sectors investment increase was much higher than the average whereas that for the basic metals sector was well below the average (Figure 1).

Reasons why Australian minerals companies are increasing their offshore investments are:

- the record of successful major discoveries in Australia (apart from gold) has declined in recent years;
- companies to be competitive must mine high quality, low cost mineral deposits, irrespective of their location;
- the current restrictions in Australia on exploration and development are causing uncertainty;
- there is the possibility of lower cost regimes overseas;
- there may be an advantage in being able to supply markets from more than one country;
- sovereign and other risks can be minimised;
- there may be an advantage in trading in several different currencies;
- markets may be closer;
- advantage may be taken of various incentives for rapid economic development in developing countries.

Under the heading "Why CRA is in Indonesia", CRA advised the Industry Commission Inquiry on Australian Direct Investment Abroad (1996) that it had maintained an active presence in Indonesian mining for 25 years and that it is Australia's largest single investor there with two operations: Kaltim Prima Coal and Kelian Equatorial Mining (gold).

Attractions of Indonesia are: high prospectivity for gold, copper, nickel and coal; the strong desire of the Indonesian Government to encourage mining investment; a stable political climate; a regulatory system that provides certainty for large capital investment over long development periods; investment governed by "contracts of work" which provide "fiscal and legal certainty" and "can be negotiated to cover the expected duration of the mining operation". CRA said that Australian Governments should not try to stop Australian companies from going offshore but should make Australia more attractive by microeconomic reform and land access so it becomes a better destination for new mining investment.

Pioneer International told the Inquiry that it invested offshore because Australia is dominated by a few companies and hence the scope for significantly increasing size in Australia is limited by the Trade Practices Act. Export potential is uneconomic in Pioneer's type of business but the company is competitive offshore where the market is much larger.

BHP was quoted as saying that it wished to remain one of the world's largest low-cost copper producers - part of its desire to operate world-class mines with high-grade ore and/or low extraction costs.

The Industry Commission said that a survey of 150 companies from the manufacturing, service and mining sectors engaged in direct investment abroad indicated that commercial considerations were generally more important than government related influences in inducing firms to undertake offshore operations. Also, that offshore investment will have a positive influence on overall company trade volumes. Both internal and direct overseas investment were affected by global economic conditions in a complementary relationship.

In recent surveys of perceived country risk, Australian minerals companies felt that the level of risk in Australia increased in 1996. Ten categories of risk were considered and those that caused the most concern were land access and land claims. Australia dropped to third place in the 1996 assessment after Chile and Argentina [28].

## 4.4 FOREIGN GOVERNMENT INCENTIVES TO ATTRACT AUSTRALIAN INVESTMENT

In addition to those mentioned above, the efforts being made by many developing countries to attract investment and participation in their minerals development take various forms such as tax concessions, trade barriers, grants, import duty rebates and subsidised infrastructure. They appear especially in new mining legislation and financial arrangements.

The following countries made changes to their mining legislation, taxation and/or foreign investment regulations in 1994 and 1995: Indonesia; Malaysia; Philippines; Myanmar; Laos; Vietnam; Mongolia; China; India and Mexico. Details are summarised in a submission by Minerals Council of Australia to the Industry Commission Inquiry mentioned above.

Negative factors include restrictions on profit repatriation and foreign ownership and local content requirements. However, "increasing awareness of the benefits associated with removing impediments to inward foreign investment has resulted in a global trend to liberalise investment regimes" [27].

Chile, Brazil, Bolivia, Peru and Argentina account for the bulk of present and likely future mineral production in South America. These countries have largely overcome the earlier problems of poor economic growth, high inflation and restrictions on foreign investment and mineral exploration.

There is now much scope for new mineral discoveries, particularly because of the favourable geology in the above countries and the lack of previous activity in some areas.

Many South American countries have revised their mining and financial regulations in order to reduce sovereign risk, improve access to resources, provide taxation concessions and facilitate repatriation of profits. These factors make the countries more attractive to exploration and investment by overseas minerals companies.

New exploration and investment is naturally going into those countries with successful operations, namely, copper in Chile; bauxite and iron ore in Brazil; gold, copper, tin, tungsten and silver in Bolivia; gold and copper in Argentina and zinc, copper, lead, tin, silver, tungsten, bismuth and molybdenum in Peru. Australian companies BHP, MIM and CRA have substantial involvement in one or more of these countries [29].

A recent ATSE technical mission to Peru reported as follows:

> "Peru is making land available (for exploration) at a rapidly increasing rate. Last year (1995) was 4 million ha and the previous four years was 6.5 million ha, against 5.3 in the previous 40 years! Over 7,000 applications for concessions between 1992 and 1994 following the new release of land ..." [30].

There is a challenge in Australia, where the minerals are owned by Federal and State Governments, to ensure that minerals companies are not disadvantaged more than is the case in competing countries where there is only one set of laws and central control.

Foreign Governments can also have an important influence on the location of smelters or other facilities for adding value to Australia's mineral production when they do not have to be tied to the mine site because of economic factors. For example, countries that are Australia's chief mineral processing competitors in the north lie on or close to the transport routes to the growing Asian markets. Governments can influence investment decisions in many ways, particularly in taxation regimes or direct incentives.

## 4.5 LAND ACCESS

Of the many concerns the minerals industry has, the most basic is access to land. For 150 years, methods and laws have been developed and refined to provide equitable compromises to accommodate land disturbance. In spite of Australia's widespread minerals industry, the land disturbance due to mining is only about 0.02 % of the land mass and much of it is in very remote locations.

The modern mining industry is now much different to the alluvial gold and tin mining of last century when care of the environment came a poor second to survival in the harsh living conditions. Traces of the old workings are often still visible but these days, technology is available and community pressure is such that there needs to be little unattractive evidence of mining after the operations cease, as they inevitably will.

The Industry Commission in the Inquiry mentioned above [27] found that land access in Australia had become more difficult and uncertain in recent years whereas in other parts of the world with comparable or better prospectivity for minerals, such as Asia and Latin America, it had become less difficult. The main reason for this was lack of clarity about native title. The Northern Land Council said that "The limiting factors are not the Native Title Act but the unwillingness of governments, mining companies and others to negotiate with native title holders". (There can sometimes be problems in identifying the latter).

Nevertheless, it was reported that, although the proportion of exploration offshore has been rising due to uncertainty about land tenure, especially since Mabo, the demand for exploration tenements continues at a high rate [31].

"On the subject of Native Title, the minerals industry acknowledges that Australia's indigenous peoples are entitled to participate in mineral development projects on indigenous land but sees participation by way of direct employment and related economic and business opportunities where the marginal cost to the project is manageable in the longer term" [24]. This comment from the Minerals Council of Australia was prompted by some unrealistic expectations of windfall economic gains.

Some recent examples of successful arrangements are as follows: Anaconda Nickel, which is planning to develop a lateritic nickel deposit near Leonora, announced an arrangement with the local indigenous people for the establishment of a trust to be known as the Murrin Murrin Foundation to which it will contribute some $5 million over the 30-year life of the project. Other mining companies in the Goldfields area will also contribute amounts related to the scale of their activities, possibility bringing the total to more than $2 million per year. The Foundation will support Aboriginal businesses, a health centre, a heritage centre, a training centre and other educational benefits.

Mr Don Meredith, Chair of the Goldfields Land Council, which helped to broker this deal, was reported to have said "Aboriginal people have been locked out of the benefits of mining development in the past 100 years in the Goldfields. The Land Council is now looking to this example as a first step in redressing the balance." [33].

CRA has advised that the local Aboriginal groups were offered a 20-year, $60 million package of benefits in connection with the Century Zinc project in northern Queensland.

Energy Resources of Australia's Ranger mine in NT has had an agreement since 1978 of a royalty of 4.25% of net sales of uranium oxide which is paid to Aborigines. It amounted to $3.76 million in 1995.

Zapopan's Mount Todd, NT gold mine went ahead when the Jawoyn people surrendered Native Title rights for freehold title of some land, jobs and other benefits.

Acacia Resources in WA awarded a three-year $50 M mining contract to a joint venture in which Carey Mining, a company owned by local aborigines, has a 25% interest. The $48 M Sunrise Dam project will produce at least 100,000 ounces of gold per annum beginning in mid-1997 [33]. Hamersley Iron recently completed an agreement with the traditional owners over the development of the Yandicoogina iron ore deposit in the Pilbara.

It is important that broad policies relating to Native Title be finalised as soon as possible because all stakeholders will lose if companies decide that it is more attractive to invest their funds and expertise in countries with less onerous land tenure conditions. The controversy following the Wik Decision of the High Court in 1996 has highlighted the uncertainties in the community concerning Native Title. The Minerals Council of Australia produced a statement on 16 January 1997 explaining the mineral industries position and key points of it are as follows:

The Minerals Council of Australia:

- Acknowledges the High Court's decision that native title is common law right and that it may coexist with property rights of lessees.
- Acknowledges that the High Court has determined that the rights of lessees would prevail over the native title rights to the extent of any inconsistency between the respective rights.
- Reaffirms the necessity to retain the integrity of the role of State/Territory Governments to effectively administer land grants to:
  - provide valid and secure titles;
  - confirm mineral rights being vested in the Crown consistent with current State/Territory legislation;
  - confirm and protect the property rights of freeholders and lessees, as well as providing for the rights of native title holders.

The Minerals Council of Australia, therefore, urges the Federal Government to:

- Evaluate all legislative options that are available to confirm and protect property rights; providing always for appropriate compensation where extinguishment is necessary to provide for the rights of lessees to prevail over native title rights where these respective rights are inconsistent. The legislation must confirm that all mineral tenements and associated grants, ancillary licences and permits, licences and renewals are valid acts and, once granted, are not subject to further native title claims.
- Re-evaluate the Governments proposed amendments, finalised prior to the Wik Decision, to:
  - identify the extent and scope of consequential amendments arising from the decision;
  - determine whether it is practical to proceed with the proposed amendments as a separate package;
  - determine whether the proposed amendments be deferred and included in a composite package in light of the Wik Decision. A critical factor will be an assessment of the time required to provide a considered composite legislative response to ensure the integrity of land administration issues. Any significant delay in determining a legislative response to the coexistence issue should result in a re-examination of de-coupling the two packages and proceeding separately with the "workability" package.
- Provide leadership to:
  - determine a coordinated and inclusive approach to developing any necessary legislation;
  - ensure that effective land administration is not comprised by native title legislation;
  - substantially reduce/eliminate the uncertainty and delays experienced over the past three

years in complying with the Native Title Act.

## 4.6 PROFITABILITY

Examination of the total revenue of the minerals industry in Australia over the past 5 years shows little overall growth, particularly in 1993/94 and 1994/95.

The ratios of effective after-tax return on year-end assets, and the net profit return on average shareholders funds, dropped in 1994/95 to their lowest levels in the past 10 years (4.2 and 5.3% respectively), around half of the average level for the past 10 years (Table 5).

| | **91/92** | **92/93** | **% change** | **93/94** | **% change** | **94/95** | **% change** | **95/96** | **% change** |
|---|---|---|---|---|---|---|---|---|---|
| Assets | 43.8 | 44.9 | 2.5 | 48.6 | 8.2 | 49.5 | 1.9 | 52.0 | 5.1 |
| Total Revenue | 25.0 | 26.1 | 4.4 | 25.6 | (1.9) | 26.2 | 2.3 | 28.1 | 7.3 |
| Profit before taxes | 4.4 | 4.6 | 4.2 | 4.6 | 0.0 | 3.6 | (21.7) | 5.0 | 38.9 |
| Taxes | 2.6 | 2.3 | (11.5) | 2.0 | (13.0) | 2.1 | 5.0 | 2.4 | 14.3 |
| Net Profit | 1.8 | 2.3 | 27.8 | 2.6 | 13.0 | 1.5 | (42.3) | 2.6 | 73.3 |
| Return on average assets (AT)% | 5.6 | 6.5 | 16.1 | 6.7 | 3.1 | 4.2 | (37.3) | 6.3 | 50.0 |
| Net-Profit return on average shareholders funds % | 8.1 | 10.2 | 25.9 | 10.2 | 0.0 | 5.3 | (48.0) | 8.8 | 66.0 |
| Net Capital Expenditure | 3.6 | 2.7 | (23.2) | 4.0 | 47.1 | 4.5 | 10.5 | 5.0 | 12.4 |

Table 5: Profitability of Australian Minerals Industry and New Capital Expenditure ($A billion).
Source: Adapted from Minerals Industry Survey '96, p 2 & 30.

In spite of the low returns, the net capital expenditure in the mining, smelting and refining industries increased by 12.4% to $5.0 billion in 1995/96. The trend is likely to accelerate in 1996/97 and in fact there were no less than 100 mining projects in progress or under consideration covering all of the minerals discussed earlier plus another 17 projects in petroleum and natural gas [34].

One sometimes wonders how the large capital expenditure can be justified in view of the low return on investment in the industry and also, how much of the scheduled new investment will go into just maintaining the current levels of production.

The minerals industry may even be penalised in relation to other Australian exporters. As some 60% of Australia's exports are mineral products, increased world commodity prices (including minerals) cause the Australian dollar and the exchange rate to move upwards. In fact, rises can occur on the anticipation of increased prices, whether or not they actually occur. The Commonwealth Government should make an effort to keep the value of the Australian dollar down and also to reduce interest rates which are among the highest in the developed world and are driving the dollar up.

The increases cause much of the competitive advantage of the minerals industry to be shared with the total community and its preferential position is therefore lost.

On the subject of value adding, 69 of the 100 mining projects mentioned above are mining per se, including gold mining which mostly yields a metallic gold product at the mine site. Only 31 were for further processing, the reasons for the low proportion are probably among the following:

- The return on investment generally decreases as one passes through the processing stages. Therefore additional capital if available tends to go to greater mining production if possible.

- New capital invested in processing competes with other, often overseas, operations which are frequently well amortised and which are prepared to drop prices to keep out competition.
- The capital investment in processing is likely to incur a higher risk due to technological changes.
- There is a danger that a miner/processor might have trouble selling its output when it is competing with its customers. This may be less of a problem when the market is undersupplied or when a new type of product is produced.

Generally, given reasonable labour and energy costs, the greatest influence on profitability is likely to be the capital cost per annual tonne of the operation. The grade of the deposit, the technology available, the complexity of processing, the location, the transportation arrangements and the availability of infrastructure are also likely to be important.

## ;;;5. IMPORTANT FACTORS IN AUSTRALIA'S COMPETITIVENESS

### 5.1 INTRODUCTION

Australia needs continually to look closely at all of the factors that affect the cost of whatever product is manufactured and exported, including those of:

labour
energy, power and fuel
transportation
shipping
communications
total infrastructure
availability of technology
environmental matters
regulatory issues
taxation and tariffs
availability of capital

Not only should the local costs be examined but also those of competitors, both in the production of the raw materials and in processing. The countries of particular or potential importance in the first connection are chiefly: China, Indonesia, Malaysia, Philippines, Papua New Guinea, India, Argentina, Chile, Brazil, Peru, Bolivia, South Africa, Zimbabwe, USA, Mexico and Canada. In a second category are those countries without significant resources, except perhaps energy minerals, who are keen to process imported raw minerals: Saudi Arabia, Bahrain, other Gulf countries, Korea, Japan, Singapore and Iceland [35].

### 5.2 GENERAL LABOUR

The figures for the labour cost for manufacturing workers on an hourly basis show that Australia is at the bottom end of the developed countries at about US$15 in 1994 as quoted by US Department of Labour (Figure 2). (The Australian Bureau of Statistics has quoted a figure of A$30,022 pa which includes $3368 (12.6%) oncosts per employee in the private sector for 1993/94. This is substantially lower than in Figure 2 but the relativity with the other countries in the Figure is probably correct).

The important point is that Australian skilled or semi-skilled labour costs, even allowing for productivity improvements, are far higher than those of our principal competitors. In the future, these are likely to be the less-developed nations where the labour costs range from US$2.50 for Mexico to $7 or $8 per hour for those to Australia's north. Furthermore, the latter - Indonesia, Malaysia, Philippines, Singapore, China, Taiwan and Korea - are located close to the transport routes between Australian commodity producers and their principal markets and therefore are well placed for toll value adding.

An analysis of the comparative costs of construction indicates that the cost per skilled person in 1989 was twice as high in the Pilbara than in Perth. Costs in Australia can be 100% to over 200% more than the same work done in developing countries even including expatriate supervision [36]. Other information suggests that a commercial building in Sydney would cost about twice that of a similar building in Singapore, Jakarta or Kuala Lumpur.

While the detailed analysis of labour costs, oncosts and productivity, though difficult, is of

much interest, it is clear that Australia's future competitors are most likely to have labour costs well below ours and that there is nothing we can or would want to do to alter the position. The mitigating factor must therefore be in the way that labour is used.

In their Inquiry into Australian Direct Investment Abroad, the Industry Commission said: "Mining and minerals processing operations are generally capital intensive, employing labour that is relatively highly skilled and remunerated. In such cases, it is work practices, rather than labour cost levels which are important for unit labour costs. For example, it is typically important to have flexible working arrangements that allow equipment to be used more intensively and permit productivity-based pay." Also, "There is little scope to reduce labour on-costs significantly without fundamental changes in taxation and national savings policies" [37].

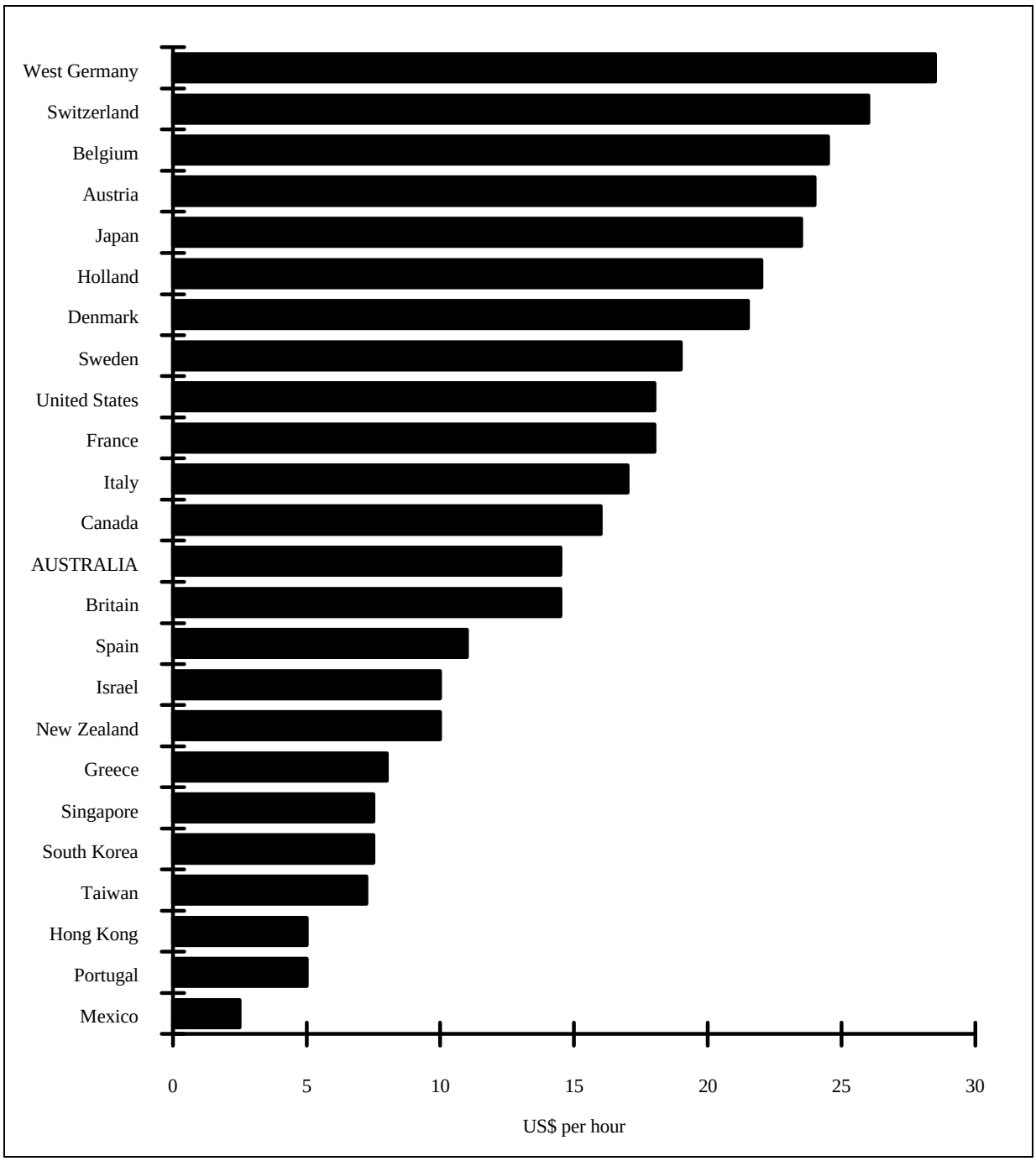


Figure 2: Total labour costs for manufacturing workers, 1994 (US$ per hour).
Source: The Economist, 9 December 1995, p 119, based on data from the United States Department of Labour.

However, the Industry Commission said that the present labour market arrangements were complex and costly and inhibit the adoption of more flexible work policies. Continuing reforms are necessary to facilitate more productive and competitive workplaces [26]. The Minerals Council's submission to the Industry Commission Inquiry said that there was strong growth in productivity during the last decade but genuine labour reform had not gone far enough. "The (low) current level of flexibility does impact on domestic productivity and imposes a constraint on international competitiveness." [24].

The Industry Commission Inquiry concluded that, while labour market regulation on labour costs and flexibility has not been a primary motivation for locating offshore, it has been a contributing factor for some companies.

## 5.3 MANAGEMENT AND EDUCATION

There is evidence that poor management practices are holding back productivity in the Australian workplace, largely because many managers have not been able to adapt to new systems where all employees work together. Some Australian companies are however achieving significant improvements in productivity by adopting new systems and achieving improvements of the order of 25% in revenues. Managers in these situations see their roles as emphasising coaching, counselling and planning for improvement rather than supervising untrustworthy subordinates and fighting operational fires. These companies have demonstrated that the Australian workforce can be as productive as any other in achieving bench mark productivity.

Examples are the BHP Steel Group which achieved production improvements from 180 to 550 tonnes per employee per year over a ten year period and productivity improvements of 20% per annum in several years, early in the current decade. Hamersley Iron achieved a real cost improvement of nearly 25% in the cost of iron ore shipped. Aerospace Technologies Australia improved the level of annual sales revenue per employee from $38,000 to $107,000 in three years while at the same time greatly improving employee relations.

The thrust behind the innovations made in managerial leadership is based on the belief that all businesses must use effectively the talents of all employees, all of the time.

In fact, Malcolm Richmond is of the opinion that "the source of competitive advantage for Australian mining is no longer our ore bodies but our management and learning capabilities" [38]. He believes that, although the world mining industry was having difficulty attracting high calibre managers, Australia was in an even worse position than some other countries (eg, Brazil) in relation to ability, experience and formal management education. The use of modern technology in a country was largely the result of having well educated and trained managers in industry.

While Australia's universities were as good as any in the world, Richmond notes the decline in the number of mining and metallurgy schools and feels it is now below the critical mass.

## 5.4 ENERGY, POWER AND FUEL

The Bureau of Industry Economics in their Report 95/20 on "International benchmarking, 1995" reported that a survey of industrial power prices in Australia showed a range from 3.79 to 7.21 Australian cents per kWh in 1994. The lowest industrial electricity price was that of Electricity Services Victoria (the old SECV) at 4.88 per kWh for the 10/80 tariff which is typical of that used for mineral processing operations. (It refers to 10 MW, 80% load factor). Their international survey showed that only two coal fired stations had lower prices: TransAlta in Alberta (3.79) and ESKOM, South Africa (3.82) while BCHydro was 4.03. Prices for ETSA,

South Australia were 6.10; SEQueensland, 6.48; Sydney Electricity, 6.95 and SECWA, 7.21. No figure was quoted for Tasmania [39] (Figure 3).

Capital productivity factors in Australian power stations were good by US standards except that Australia's reserve margins were higher than average in 1991 and productivity figures per employee in the industry were lower.

The cost of sources of fuel that could be used for adding value will depend on their location. The availability of natural gas in the Pilbara is no doubt one reason why BHP is building a FINMET Direct Reduced Iron plant at Port Hedland.

Gas is also available to the Gladstone and WA alumina plants and to some WA gold and nickel mining and smelting areas. A pipeline is being constructed to Mount Isa and it will serve other important developments in NW Queensland.

In WA, the publicly-owned AlintaGas Corporation now operates WA gas transmission and distribution systems; five companies purchase gas directly from the North-West Shelf producers. WA's labour productivity in the gas supply industry is the best in the world [40]. AlintaGas is to sell its Dampier/Bunbury gas pipeline by the end of 1997 [41].

The average industrial gas price in Australia in 1991 was A$4.16 per gigajoule, according to BIE. Only USA and Canada were lower, the US average being A$3.16. Within Australia, SA at $3.25 had the lowest industrial cost but it was only slightly lower than Victoria ($3.39) [42].

Australia may have many disabilities in the industrial sense but the availability and low cost of energy is perhaps its most valuable asset which must be safeguarded if Australia is to remain competitive in the commodity markets of the world.

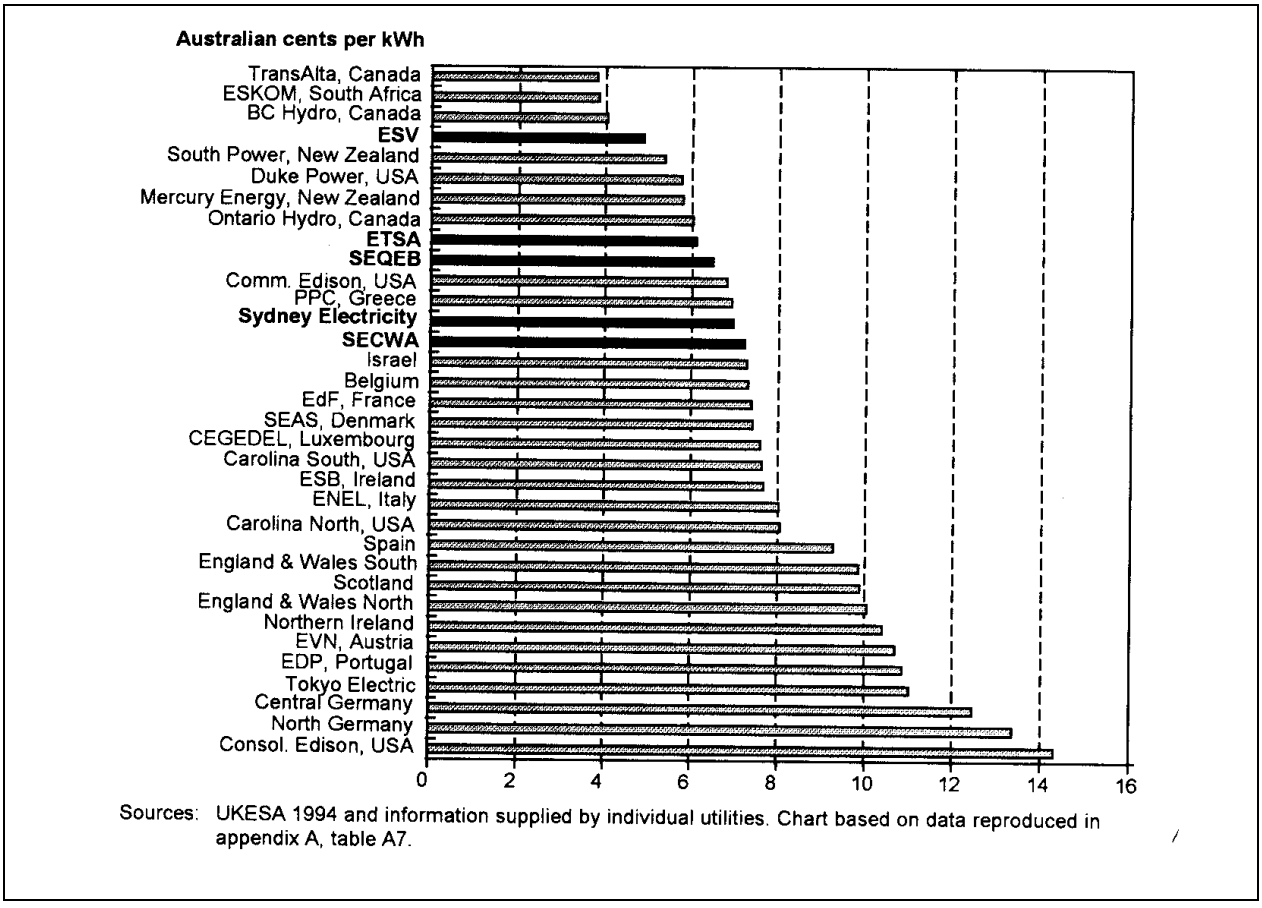


Figure 3: International published 10/80 industrial prices for electricity, January 1994.

## 5.5 TRANSPORTATION

Australia has a mixed system of rail transportation for mineral products. Traditionally, the mines depended on State systems. One of the earliest was the SA Government rail from Cockburn near Broken Hill, NSW, to Port Pirie. Lead-silver concentrates were smelted at Port Pirie while zinc concentrates were shipped through that port either to Risdon, Tasmania or overseas for smelting. The 56 km connection from Broken Hill to Cockburn was built and operated by the Silverton Tramway Company Ltd and opened in 1888 [43].

Queensland Government Rail serviced the Mount Isa mine from its early days, bringing in coal for power generation and coke for smelting, and taking out copper anodes to the refinery at Townsville, lead bullion for refining in the UK and zinc concentrates for the world market. Queensland Rail now also services the massive coal industry for shipment in wagons and over track (funded by Utah/Central Queensland Coal Associates and other companies such as Pacific Coal) to Hay Point south of Mackay, and to Gladstone and Abbot's Point. The organisation is phasing in commercial pricing principles for coal and other minerals so that, by 2000, all coal haulage contracts will be on a commercial basis with no Government royalty element in them [42].

Transportation of iron ore in the Pilbara developed quite differently and more in line with the major iron ore railways overseas. The tonnages moved meant that the rail trucks and track had to be of the heaviest construction which required enormous capital investment. There are three major private rail systems which service the iron ore ports in north-west WA: Port Hedland for the Mount Newman and Mount Goldsworthy mines; Dampier, principally for Mount Tom Price and Paraburdoo, and Point Sampson for Pannawonica.

In the early days, the WA Government developed rail systems to the goldfields at Kalgoorlie, Norseman and Leonora which were connected to Perth, Esperance and the Commonwealth Rail system the east. The State rail systems have made improvements in recent years by reducing surplus employees, locomotives and wagons. "However, further significant reforms are essential if Australian systems are to close the very considerable performance gaps and reach achievable World Best Practice. These gaps exist in regard to labour and capital productivity, some freight rates (eg coal) and the level of operating costs" [44].

BIE felt that the government systems of greatest tonnage importance to the minerals industry require the following operating cost reductions to reach WBP: Queensland Rail 29%; NSW 26%.

The BIE report did not discuss the company-owned rail systems in WA but it is generally believed that these operations are well within WBP costs.

Australia was also close to WBP in long haul road freight charges, as were freight delivery times and loss and damage rates.

In view of the importance of rail freight costs as a component of commodity exports, one wonders if the current moves to privatisation of power and other government-owned services should be extended to facilities that are used chiefly for mineral transport.

## 5.6 SHIPPING

The principal form of shipping used by the exporting minerals industry is "bulk commodity". The others are containers, and "break bulk" such as for timber, steel coil, newsprint and vehicles.

The Bureau of Industry Economics stated: "The performance of Australia's coal ports

appears to provide this important export industry with a slight edge over competitors, although there is scope for further improvement in some areas. Given the highly competitive nature of the world coal market, it is important to protect this advantage and improve upon Australia's good performance ... low Australian waterfront charges for coal are supported by high capital utilisation in the coal handling terminals" [45].

The waterfront charges at the wholly-owned and operated wharf of Central Queensland Coal Associates, Hay Point Queensland at A$3.09 per tonne were the lowest in the world. Richards Bay, South Africa was A$4.51 per tonne in 1995 while the range of Australian coal ports was $3.09 to $5.80 [46].

Unfortunately, Australia's waterfront container charges are high by world standards and it generally takes 50 to 100% longer to unload and load a container ship than in comparable ports overseas. In addition, the turnover times are more variable. Break bulk charges are also high by international standards. BIE says: "It seems that reforms to work practices and modernisation of facilities should be high priorities" [47].

Commenting on the March, 1996 container handling productivity figures, the Bureau of Transport and Communications Economics said that productivity of Australian wharves remained lower than that of 2.5 years ago and overall productivity was not significantly above the levels achieved at the end of the (waterfront reform) process in 1992 [48].

It is to be hoped that the new Federal industrial relations legislation and procedures will be able to provide the much-needed improvement to productivity in the Australian waterfront.

## 5.7 TELECOMMUNICATIONS

Australia's overall performance in telecommunications was "reasonably encouraging" compared with OECD countries and it has improved markedly since the introduction of competition. However, labour productivity and service quality were still well below WBP [49].

Deployment of optical fibre, itemised billing, mobile penetration and the proportion of public phones that were card phones were quite high by comparison (based on 1992 figures).

## 5.8 INFRASTRUCTURE - AUSTRALIAN STATES AND WORLD BEST PRACTICE COMPARISON

The Bureau of Industry Economics has produced an interesting and useful comparison of many of the factors that affect competitiveness for the Australian States and NT and with World's Best Practice. It is reproduced with permission as Table 6 [51].

No State led in all aspects of infrastructure but the leaders in specific areas during 1994 or later (which were also WBP) were as follows:

| | |
|---|---|
| Queensland | capital productivity in electrical generation. |
| | lowest waterfront charges for coal. |
| NSW | coal handling and rail freight reliability. |
| WA | labour productivity in the gas supply industry. |

BIE said that even the best performing Australian States have considerable scope for further improvement before they approach overall best practice.

Table 6: State and best practice infrastructure performance, 1994 or latest data.

| | *Indicator* | *NSW* | *VIC* | *QLD* | *SA* | *WA* | *TAS* | *NT* | *Best practice* |
|---|---|---|---|---|---|---|---|---|---|
| **PRICE** | | | | | | | | | |
| Electricity | cents per kWh, demand(kW)=10000, load factor(%)=80 | 6.95 | 4.89 | 6.48 | 6.1(a) | 7.21 | na | na | Transalta 3.79 |
| Rail freight | av revenue c/ntkm | 4.59 | 4.19 | 4.73 | 3.08 | 4.91 | - | na | United States 2 |
| Waterfront (containers) | waterfront charges ($A/TEU) | Sydney 288 | Melbourne 292 | Brisbane 284 | Adelaide 278 | Fremantle 282 | | | Johor (Malaysia) 98 |
| Waterfront (coal) | waterfront charges ($A per tonne) | Newcastle 3.67<br>Port Kembla 5.23 | | Hay PT CQCA 3.08<br>Gladstone 3.52<br>Hay Pt DBCT 4.56<br>Abbot Pt 5.8 | | | | | Hay Pt CQCA 3.08 |
| Aviation | airport landing charges (Index worst = 100) | Sydney 23 | Melbourne 23 | Brisbane 23<br>Cairns 29 | | | | | Toronto 15 |
| Gas supply | industrial price($A per Gj) | 4.99 | 3.39 | 6.37 | 3.25 | 4.27 | | | Oklahoma 1.99 |
| **RELIABILITY** | | | | | | | | | |
| Electricity | av outage (min/cust/yr) | 201 | 126 | 230 | 118 | 472 | 166 | 331 | Tokyo Electric 3.0 |
| Rail (timeliness) | % late arrivals (after 30 minutes)l | 15 | 22 | - | - | 39 | - | na | SRA 15 |
| Rail (loss and damage) | claims (c/$100 revenue) | 2 | 27 | 6 | 2.6 | na | - | na | NSW 2 |
| Aviation | on-time departures (%) | Sydney 84 | Melbourne 78 | Brisbane 83<br>Cairns 85 | | | | | Copenhagen 95 |
| **LABOUR PRODUCTIVITY** | | | | | | | | | |
| Electricity | gWh/employee | 2.84 | 4.43 | 3.69 | 3.36 | 2.37 | 4.45 | 2.3 | Transalta Can 12.95 |
| Waterfront (coal) | tonnes ('000)/employee | Newcastle 158<br>Port Kembla 65 | | Hay Pt DB 128<br>Hay Pt CQ 133<br>Abbot Pt 106<br>Gladstone RGT 99 | | | | | Kaltim Prima 245 |
| Waterfront (containers) | boxes per terminal employee | Sydney 843 | Melbourne 677 | Brisbane 627 | Adelaide 542 | Fremantle 581 | | | Rotterdam 1194 |
| Aviation | aircraft movements/fire & rescue employee | Sydney 3460 | Melbourne 2000 | Brisbane 1800<br>Cairns 1100 | | | | | Toronto 7200 |
| Gas supply | tj/employee | 55 | 68 | 18 | 52 | 230 | | | WA 230 |
| Rail | ntk/employee (mill) | 1.67 | 1.53 | 2.12 | 3.19 | 1.91 | 3.19 | 3.19 | United States 11.36 |
| **CAPITAL PRODUCTIVITY** | | | | | | | | | |
| Electricity | capacity factor (%) | 44.8 | 55.4 | 63.6 | 44.5 | 48.5 | 40.6 | 41.2 | Queensland 63.6 |
| | reserve plant margin | 48.2 | 24.6 | 27.5 | 19.7 | 36.7 | | 54.2 | SERC - USA 10.0 |
| Rail (wagons) | mill ntk/wagon | 2.24 | 1.23 | 2 | 2.24 | 2.04 | 2.24 | 2.24 | United States 5.58 |
| Rail (locomotives) | mill ntk/loco | 46.12 | 57.21 | 72.14 | 76.74 | 76.53 | na | na | |
| Waterfront (coal) | annual throughput/annual capacity (%) | Port Kembla 70<br>Newcastle<br>PWCT 103 | | Hay Pt DB 83<br>Hay Pt CQ 101<br>Abbot Pt 43<br>Gladstone RGT 72 | | | | | Newcastle 103 |
| Waterfront (containers) | crane rate (moves per hour) | Sydney 14.7 | Melbourne 17 | Brisbane 18 | Adelaide 17.8 | Fremantle 18.5 | | | Rotterdam 30.3 |
| Aviation | passengers per gate | Sydney 291.8 | Melbourne 293.2 | Brisbane 265<br>Cairns 295.3 | | | | | Hong Kong 629 |
| Gas supply | tj/total main (km) | 4 | 8 | 3 | 6 | 13 | | | Illinios 29 |

Notes: (a) Estimated - the BIE notes that as at August 1995 ETSA's published 10/80 tariff was 5.52 cents per kWh — around 8 per cent *less* than the January 1993 price.

## 5.9 AVAILABILITY OF TECHNOLOGY

The minerals industry is based on many disciplines ranging from geology, rock mechanics, mining engineering, mineral beneficiation, smelting, hydrometallurgy, metal refining, metal fabrication and physical metallurgy. Many supporting disciplines are also involved such as the various branches of engineering, chemistry and physics. Computer technology and mathematics play a major part in all of these and are of great value throughout the industry.

The nature of the industry is such that not many of the technological activities are subject to strict confidentiality. Thus technology transfer between companies and also countries through visits and professional meetings is one of its most pleasing features. Many mineral deposits, and the techniques required to discover and transform them into useful materials, are similar throughout the world.

It is not until the ores and the mineral concentrates reach the final or penultimate stages that information on some of the more recent technological developments becomes restricted to any great degree. Many mines do not take their products to final processing and therefore will not have technological secrets - their competitive advantage will lie in the nature of the ore deposit, the location, the availability of adequate capital and the standard of management of the operations.

In special cases, the later stages of value adding might require prolonged research and development and expensive pilot plant testing, leading to the construction and commissioning of the first commercial plant. These steps may be so costly that companies will look to protection of their intellectual property by patenting. In most instances, however, the necessary technology, if it is not already available “in house”, will be available for purchase and experienced engineering companies can usually be contracted to provide a guaranteed “turn-key” operating facility.

Even patented new processes will sooner or later become available for licensing and there would be relatively few mineral processes these days that are not obtainable by payment of reasonable royalties. An exception may occur when the industry in question is relatively small as is the case with magnesium metal which has a world production of only about 300,000 tpa. The existing operators may not encourage a new company to come in with say 60,000 tpa of new capacity, which would be about the minimum economic unit for an electrolytic plant. Consequently, and also hopefully to reduce potential operating and capital costs, Queensland Metals Corporation Ltd is working with CSIRO to develop improved technology for the production of anhydrous magnesium chloride from magnesite as mentioned in Section 3.4.11.

CSIRO became involved during the 1970s in the reduction of certain metals from their ore by techniques involving the injection of oxygen or oxygen-enriched air into a molten bath. The technology could be investigated on a small scale in relatively inexpensive equipment and it became known as “SIROSMELT”. The process was commercialised at Mount Isa during the 1980s as ISASMELT where it supplemented conventional copper and later, lead smelting processes. ISASMELT copper smelters have been installed at Miami, Arizona and in India. An ISASMELT lead smelter is recycling lead at an MIM site in the UK and a copper-lead plant is being built in Belgium.

The principal inventor of Sirosmelt, Dr John Floyd, left CSIRO in 1981 and formed AUSMELT Pty Ltd which was floated on the Australian Stock Exchange as Ausmelt Ltd in 1994. The technology has been successfully applied in various world locations and shows great promise for many of the common metals except aluminium and magnesium. A large tin smelter is under construction south of Lima, Peru as is an iron-making pilot plant in northern South Australia. It is being applied to the environmental treatment of spent pot bottoms in the aluminium industry. The compactness of the Ausmelt process and its versatility augers well for

value-adding at the site of even small base metal mines. It is unlikely that Australian mining companies would lose competitiveness for lack of suitable technology if the injection method continues to be practicable and economic.

Technology in the aluminium industry was at one time tightly held and it could not have been purchased at the time of the Weipa bauxite discovery in 1955. A joint venture had to be arranged to obtain the technology. However, in recent years, it is usually possible for an aluminium company to buy the best available expertise for an expansion from the competitor whose technology is the best at the time. This situation must also stimulate operating companies to spend more on development when they know that the cost of improvements can be partly recouped from others. Of course, aluminium production now is over 20 million tpa so any increment of expansion, or even a new smelter producing several hundred thousand tpa, will not affect the world market for very long.

In summary, it can be said that the Australian minerals industry is not limited in the short term in its competitiveness by poor technology. In fact, it is quick to take up new ideas and apply them, particularly when the underlying companies have good ore reserves and are sufficiently profitable. The industry has competent technical staff and strong links with the teaching institutions and government and private research and service organisations. It is an exciting industry and is attractive to young technical people - the worry is that not enough of them will take up the challenge of living outside the urban society of the large coastal cities. In fact, the Chamber of Minerals and Energy WA recently raised concerns about the availability of suitably qualified people to meet the current wave of expansion. Nor can the industry recruit significant numbers of professionals from overseas as it has often done in the past. Many of the mining and mineral processing schools in overseas universities that were sources of graduates for the Australian industry have been shut. In Australian universities, it is becoming increasingly difficult for small schools such as mining and metallurgical engineering to survive. There is no doubt that these changes could adversely influence the competitiveness of the Australian industry over the next 5-10 years [52].

## 5.10 R&D IN VALUE-ADDING

In the longer term, the availability of suitable graduates is of concern not only in industrial operations but also in the implementation of new technology through research and development. With the passage of time, the technology necessary for finding the orebodies and mining and processing them will gradually become obsolete and non-competitive and it must be updated or renewed.

Research and development in the minerals industry is conducted for the following reasons [53]:

- to improve existing processes to maintain competitiveness,
- to improve existing products to create differentiation as a marketable quality,
- to produce better or cheaper products,
- to initiate products new to Australia but with accepted markets elsewhere,
- to modify and improve purchased technology,
- to evaluate potential technologies prior to buy-in or adoption, thereby minimising risk,
- to undertake environmental impact assessments for improved environmental protection.

R&D is of particular concern in the further processing and value adding of the minerals output and it plays a progressively larger part as the product moves closer to its final marketable form.

There is evidence that many of the sources of new technology accessed by Australian industry in the past are no longer available. Many National Coal Board in UK and the US

Bureau of Mines have been shut. Much of the publicly funded R&D infrastructure related to the minerals industry worldwide has been closed or is a shadow of its former self. Furthermore, the in-house R&D effort within the industry and its equipment suppliers has been considerably curtailed over recent years. It will be increasingly difficult for the Australian industry to obtain a continuing stream of innovative technology from these sources to help it remain competitive [54].

However, Australia is fortunate that, for decades, those divisions of CSIRO and departments in tertiary education institutions with responsibilities and interests in minerals and metals have generally maintained close relationships with their corresponding industries. They have mostly been comfortable with the alignment of their research activities with business aims. Both sides have supported the "facilitating" bodies such as the Australian Mineral Industries Research Association, the original Amdel organisation and its successors, the coal industry research bodies, etc. Professional societies such as The Australasian Institute of Mining and Metallurgy have assisted indirectly. Overall, Australia has developed a unique publicly- and industry-funded research infrastructure in the minerals area which is the envy of minerals producers overseas.

Whereas the boundary between public and private R&D was often diffuse in relation to the topics studied, significant changes have occurred recently due to increasing international competition and restrictions and transfer of information and knowhow. The public sector research establishments are now often required to obtain higher levels of support from individual companies and the results obtained may become confidential to the sponsor. Other public research is funded by groups and consortia of companies interested in specific topics or in the generation of background information which is often not confidential.

These trends have facilitated the formation and growth of the Cooperative Research Centres, for example, whereby universities, CSIRO divisions and industry collaborate in research which often is directed towards industrial-type objectives, albeit remote. It is to be hoped that the CRC structure and other such joint arrangements will help protect and preserve valuable information and alliances and make public funding less vulnerable to sudden curtailment due to economic or political pressures.

## 5.11 THE ENVIRONMENT AND REHABILITATION

Concern is sometimes expressed that Australian minerals companies may be at a competitive disadvantage compared to operators in some other countries because of the failure of the latter to spend comparable amounts on environmental and rehabilitation activities. The petroleum and nuclear power industries in the former Soviet Union are often mentioned.

Recent annual reports of some Australian mining companies indicate that environmental matters often receive special and prominent mention. In fact, Western Mining Corporation included with its 1995 Annual Report to shareholders a separate 36 page Environmental Progress Report giving details of various aspects of environmental and rehabilitation work at their many sites. The annual expenditure was given and mention was made of the Company's membership of the World Business Council for Sustainable Development and of the International Council on Metals and the Environment.

The Mining Industry Council of Australia conducts an annual survey of member companies to summarise their expenditures in these areas. The aggregate rose from $129 million in 1990/91 to $152 million in 1995/96.

The minerals industry has formed the Australian Minerals and Energy Environmental Foundation to encourage excellence in relation to the environment. The monthly Bulletin of the Australasian Institute of Mining and Metallurgy contains environmental news in each issue - that

in June, 1996 had articles on the rehabilitation of the environment around the defunct Narbarlek uranium mine and of the Mount Lyell copper mine which is now undergoing a revival after over 100 years of operation..

The Australian industry would concur with the Industry Commission's findings in their 1991 Report on Mining and Minerals Processing in Australia (Vol 1, p li): "There is no reason why modern rehabilitation techniques should not prove to be generally successful, if success is understood to be reasonable compatibility with the surrounding area" and: "There was no evidence presented to the Commission that modern mining practices are inconsistent with sustainable development (including ecologically sustainable development)".

It would take a considerable effort to review overseas environmental practices in detail but Middleton, Huggan and Clarke [29, p 83] made the following statement in their review entitled "South America - The New Minerals Frontier": "Foreign exploration and mining companies have also become increasingly aware of the need to self-regulate high environmental standards so as to protect their corporate reputation in South America and to avoid the substantial costs of environmental retrofitting should local standards be raised. This occurred in 1992 when Chile legislated to apply US emission standards in the country's mining districts ... The Southern Peru Copper Corporation has invested US $300 million to bring Toquepala and Cuajone mines into compliance with the Peruvian Government's environmental legislation". Argentina has also given attention to environmental controls. Further information is needed to monitor the situation in countries to Australia's north.

The cost of environmental controls has a bearing on competitiveness, as mentioned above. Because environmental standards are often determined by international consultation, the Australian minerals industry should be alert to any attempts by companies located in other countries to gain advantage by adopting lower environmental standards.

## 5.12 REGULATORY ISSUES IN THE MINERALS INDUSTRY

"Regulatory issues are defined as any government action which, either directly or by financial inducement, encourages business to alter their commercial behaviour" [50].

All levels of government - Commonwealth, State/Territory and local - take part in the regulation of the minerals industry, often without coordination and with frequent and sometimes ad hoc changes. "This has resulted in a bewildering mish-mash of regulations" [55].

A frequently-quoted anecdote is that of the Olympic Dam copper-uranium project in South Australia which had to obtain approvals from 54 government agencies over the 13 years from its discovery to the first receipt of revenue. The Minerals Council of Australia, in a submission to the Inquiry into Direct Investment Abroad (1996), indicated that some of the industry's problems have been recognised in recent years. The Australia and New Zealand Minerals and Energy Council (comprising Ministers of Mining and/or Energy from the Commonwealth Government, all Australian States and Territories and New Zealand) conferred with the Commonwealth Office of Regulation Review and its State counterparts and made recommendations in 1995 that the Governments should review and reform regulations governing the industry, particularly, those affecting competitiveness. Also, that principles

endorsed in 1995 by the Council of Australian Governments for the setting of regulatory standards should be applied to the minerals sector. The Council of Business Regulation should include a representative of the minerals sector and it should review Federal Government regulations currently in force.

A Minerals Council recommendation of great importance is that systems should be introduced whereby only one government department in each State/Territory should be responsible for regulatory matters, thereby preventing the type of situation of multiple approvals concerning mineral exploration and development mentioned above.

The Industry Commission in 1991 made many recommendations about regulation, some of which have been implemented, like the removal of the former coal export duty and the three mines uranium policy, but many others still remain.

The Minister for Resources and Energy, Senator Warwick Parer told a meeting of the Victorian Chamber of Mines on 13 May, 1996 that the Commonwealth Government was committed to removing impediments to mining. He said: "Every year, more countries are recognising the wealth-generating potential of mining and removing impediments and providing incentives to mineral investors. Last year, for the first time, Africa attracted more exploration than USA ... Unfortunately, the fact is that in Australia - and in the US and Canada - the industry has been finding the going harder at home because of increasing regulation, restriction on land access and policy uncertainty". He promised that the Federal Government would reduce perception of sovereign risk; improve land access; foster multiple and sequential land use policies; reduce costs through accelerated microeconomic reform, and advance and promote Australia as an attractive place to invest. The Minister also said that the industry should play a greater role in promoting its contribution to the economy [56].

The following reference confirms the Minister's reference to the US industry's regulatory problems under the heading "The Permitting Process": A study by Professor Michael Evans of the Kellogg School of Management at Northwestern University concluded that delays in securing permits for gold mining threaten the viability of the US gold mining industry. "This time consuming process takes 4 to 5 years, forces companies to reduce investment in exploration and mine development in the US and encourages overseas activity ... Countries outside the US are offering major tax and regulatory incentives to US companies. As a result, investment in South America and East Asia has risen dramatically while investment and mine development in the US has declined". Professor Evans forecast that by 2006, the investment in the US gold mining industry will decline from US$423 to $317 million pa, and the net loss to the Federal Government will be $1.24 billion and to State and local Governments, $353 million. The US trade deficit will increase by $1.6 billion because of decreased gold exports and 9500 jobs will be lost in the gold mining industry with an overall loss of 41,600 jobs [57].

## 5.13 TAXATION AND TARIFFS

The level of taxation of the minerals industry is considerably higher than the average of all Australian industry due to mineral royalties, charges and licence fees, which were $642 million or 30.5% of all taxes paid by minerals companies in 1994/95. The total amount of tax was $2.1 billion, or 58.8% of the operating profit before taxes and abnormals.

The resource-based taxes of $642 million did not include "disguised" royalties buried within charges for government services such as excessive rail freights. The total amount for such services was $4.9 b in '94/'95. Income tax paid by employees was another $1.4 b.

The Minerals Council of Australia considers that taxation is a significant factor in

competitiveness in relation to interaction with major trading partners and newly industrialised countries. It made the following recommendations to the Industry Commission Inquiry into ADIA:

a) The Industry Commission be requested to undertake a comprehensive review of the taxation system with a view to assessing how the issue of vertical fiscal imbalance can be addressed while at the same time reforming the indirect tax system.
b) Amendments to the income tax law should be made to eliminate Australian non-deductible business expenditures many of which are deductible in overseas jurisdictions with which Australia competes in terms of both trade and investment flows. This would also provide a more appropriate base for company income tax, enhance the competitiveness and growth of Australian industry, provide greater certainty to taxpayers and substantially reduce compliance costs.
c) A specific section to be inserted in Sub Division A of Division 3 of the *Income Tax Assessment Act* to allow immediate deductions for native title related expenditures. In addition, or as an alternative, the mining provisions of the Act should be amended to allow deductions for all native title related expenditures, whether of a capital or revenue nature, in the year in which the expenditure is incurred.
d) i) Dividend imputation be extended to cover international dividend streaming by Australian companies in line with the recommendations of the Bureau of Industry Economics Dividend Imputation Policy Forum (1993).
   ii) The Commission examine existing imputation policy to assess how franking credits can be made available from tax paid on overseas offshore earnings.
   iii) Urgent attention be given to renegotiating the dividend and other withholding tax clauses in Australia's international taxation treaties aimed at reducing or eliminating withholding taxes on dividends and other passive income flows thus bringing them into line with international trends.
e) The Commission noted that there should be clear specification in advance of investment (including investment in exploration) of the royalty arrangements to be in force; and secondly, there should be stability over time. Uncertainty and instability in fiscal arrangements raise the supply price of investment, and thereby diminish the mineral rent potentially available for the public revenue.
f) i) Reduction of the net cost of diesel fuel excise for mining to the level applying to the rural sector. The Industry Commission (1994) has endorsed this approach and the use of the rebate scheme to minimise the impact of taxation of intermediate inputs to production.
   ii) The Diesel Fuel Rebate Scheme be reclassified as a negative revenue item so that the net revenue figure once more appears in the revenue side of the annual Budget. It should not have been reclassified as an outlay (a change only recently introduced).

In addition, MCA recommended that relief should be provided on taxation of business inputs in both domestic and export markets where competing goods often have tax free advantage over Australian goods. Taxation on coastal shipping inputs such as excise on fuel are an indirect tax on the minerals industry because the bulk on this trade is of mineral origin. In 1993/94, petroleum products were 20% of the coastal trade, iron ore 38%, bauxite and alumina 22%, plus manganese ore and mineral concentrates. Transport costs are always an important factor in determining the location of mineral processing plants.

Publicity about the possible increase by $800 M in the Federal tax on diesel fuel ("removal

of the rebate") brought forward some interesting comments relating to competitiveness. The fuel tax was introduced in 1958 with the intention of funding construction and maintenance of public roads and infrastructure whereas the major usage of diesel fuel by the gold mining industry in WA is for electric power generation. The cost of the fuel would rise from 28 to 58 c/l which is said to compare with 21 c in Indonesia and 28 c in Chile.

Placer said that the effect of the added tax to their Granny Smith mine in WA would be to increase the cost of gold production by $50 per ounce. The development of their deep gold resource would not be likely to go ahead meaning that up to 600000 oz of gold would be "sterilized" and there would be a loss of 350 jobs over 4 years [58].

Minerals Council makes a strong case for improvement of Australia's competitiveness by removing tariffs on imported goods and materials: "It is essential to remove tariff protection if we are to continue to be internationally competitive. The tariff and industry protection reforms of the last decade are clear examples of success which has reduced the input cost disadvantage faced by a number of Australian industries in competing for market share in Australian and export sectors". MCA recommended that tariffs on imported goods be phased out for all goods by 2005 and for goods attracting the 5% rate by 1 July, 1999.

## 5.14 AVAILABILITY OF CAPITAL

The minerals industry is highly capital intensive as is apparent from a total revenue in 1995/96 of $28.1 b that was achieved with a labour force of 73,201, an average of over $380,000 per employee.

In spite of the relatively poor return, the net capital investment increased by 12.5% in 1995/96 to over $5 b [2, '96 p 27].

Infrastructure and local community welfare are major capital expenditure items in the minerals industry, a burden that city-based industries do not have to carry [24].

Another aspect is that capital expenditure in mining does not end with the commencement of operations as it often does with the building and equipping of a new factory. In underground mining, capital-type expenditure is required to extend the workings and delineate the future ore to be mined throughout the life of the mine. In open cut mining, more overburden has continually to be moved. As ore grades decrease, and they usually do, the tonnage has to be increased and the treatment plant expanded to maintain an adequate cash flow. When the orebody is finally depleted, there is little of value to be salvaged.

The high capital intensity of mineral production means that adverse macroeconomic factors affect the industry particularly hard, such as high interest rates. Hence the industry tends to keep the level of borrowing down when possible. It was $8.6 b in June, 1996. Being highly dependent on export earnings, even small variations in exchange rates are important in both borrowings and revenue. The proportion of foreign denominated debt increased from 45% at the end of 1990/91 to 63% at the end of 1995/96. It provides a natural hedge as most of the revenue is denominated in foreign currency. The lower overseas interest rates also help [2, '96, p 16].

Generally, it can be said that the Australian minerals industry has depended on overseas equity and borrowings since the earliest times. The high quality of the mineral deposits and the good technical and economic performance of the industry has encouraged an adequate flow of capital.

The participation of more countries in the minerals industry, their excellent orebodies, their lower labour costs and sympathetic treatment by governments is already providing Australia

with substantial competition for overseas capital - and in fact for some of our local capital as well. These factors must be taken into account, along with direct physical competition of products in world commodity markets, if the Australian industry is to remain viable and expand in the future.

;**6. CONCLUSIONS**

## 6.1 GENERAL

1. Australia's mineral production is currently at a high level and rising. Exports are forecast to be $35.6 billion in 1996/97 which is a record and is 61.1% of total commodity exports.
2. The future of the industry looks promising, with over 100 new projects scheduled although only a small proportion of them is for further local processing.
3. In spite of the current strong performance, there is concern within the industry that traditional markets may be lost to overseas competition, particularly from countries that are relatively new to the minerals industry.
4. The future of the industry will depend on the discovery of new deposits and the ability to compete on world markets.
5. Recent exploration expenditure of Australian companies has increased satisfactorily but the proportion spent overseas by the major companies has increased from 27 to 40% in the last four years. There is also a strong trend towards participation by Australian companies in overseas mining and smelting operations.
6. Reasons for these trends include successful exploration activities overseas, availability of more world-class deposits, provision of more favourable investment conditions by foreign governments, better access to land, lower labour costs, closer proximity to markets, etc.
7. Reasons for concern about the future of the Australian industry include problems of land access, dissatisfaction with bureaucratic regulation, lack of rapid microeconomic reform, high taxes, royalties and freight charges, problems at ports, and low and irregular returns on capital invested.
8. In spite of the negative influences, the potential for further value adding in Australia is improving. New plants are planned for the reduction of iron, copper, zinc and nickel and for the production of titanium pigment while major expansions of copper smelting and uranium oxide production have been announced.
9. Australia's abundant reserves of energy minerals should enable the further processing of a much greater proportion of the minerals that are being exported in their original form.
10. Insufficient numbers of minerals professionals including managers are being trained in Australia.
11. The Australian minerals industry may not receive enough new technology from local and overseas sources in the future for the industry to remain competitive unless suitable measures are taken and Australian companies may have to develop more of their own technology through R&D.

## 6.2 SPECIFIC VALUE ADDING OPPORTUNITIES

Australia's success in adding value to more of its minerals before export will depend in large measure on its international competitiveness. There is further potential in the following commodities:

### 6.2.1 ALUMINA AND ALUMINIUM

Australia is a major producer of alumina and aluminium metal and is very competitive but it should be able to increase its current production substantially. Overseas companies have been reducing their production costs and, if Australia is to remain competitive, it will have to achieve cost reductions, particularly in power supply. Improved technology, a reduction in construction costs and increased labour flexibility may be the keys to new greenfields alumina capacity.

### 6.2.2 IRON ORE

High grade iron ore will be a major export for the next decade or so but much of the future large reserves, while of reasonable iron content, will mainly comprise fines with impurity disadvantages. The challenge will be to develop technology to allow these reserves to be exploited competitively. Direct reduction processes using natural gas are under construction in the Pilbara to supply metallics to electric mini steel plants in the West Pacific and other areas. Also, major pilot plant operations are in progress in WA aimed at a higher grade product.

### 6.2.3 COPPER

Apart from significant increases in smelting capacity like that planned for Olympic Dam, further value adding opportunities will depend largely on the development of new mines. There are good possibilities for one or more relatively small, intensive smelters being established in northern Queensland and of leach/SX/electrowinning operations producing refined copper in several locations.

### 6.2.4 NICKEL

Most of Australia's nickel sulphide concentrates are already smelted and refined in the country and new mines will follow this procedure. Lateritic (oxide) ores are being and will continue to be treated by hydrometallurgical methods.

### 6.2.5 LEAD

Australia is a major exporter of lead metal but environmental pressures may force the introduction of new smelting technology. The future of the world's largest lead smelter at Port Pirie will depend on the successful integration of its operations with the zinc smelter in Hobart. This investment will address environmental issues at both sites.

### 6.2.6 ZINC

Australia is a major exporter of refined zinc as well as of concentrates. Further increases in zinc concentrate production are occurring and more are likely. The proposed new smelter in Townsville will increase refined zinc exports by 180,000 tpa.

### 6.2.7 TITANIUM DIOXIDE

Some additional titanium pigment production capacity from mineral sands is being installed in

Australia and there is potential for additional developments in WA and elsewhere.

### 6.2.8 MANGANESE DIOXIDE

The development of technology for high purity manganese dioxide production required a long time and a high cost. Expansion of the Newcastle operation will undoubtedly be considered as the world market for battery oxide expands.

### 6.2.9 MAGNESIUM

There is potential for significant world growth in magnesium metal consumption, particularly if the cost can be reduced. Commercialisation of improved production technology and the realisation of a competitive advantage in terms of the cost of electricity could enable Australia to base a greenfields development upon its substantial reserves of high grade magnesite.

## ;7. RECOMMENDATIONS

The future of the industry will depend on the discovery of new mineral deposits and the ability to compete on world markets. The following steps are necessary to maintain and enhance Australia's competitiveness:

1. Adequate funding for Australian exploration must be found from company profits and other sources.
2. Continued first class survey and mapping programs are necessary to provide background information for exploration in Australia.
3. Exploration and mining companies must be able to negotiate reasonable, long term arrangements with traditional land owners.
4. Bureaucratic delays for approvals of new projects should be reduced and changes to conditions during their currency avoided.
5. Australian organisations must carefully study moves by overseas governments which encourage the export of Australian exploration funds and of technology and seek to gain matching incentives under local laws and regulations.
6. Australian Governments should be urged to remove impediments and reduce taxes and charges, at least to levels applying to non-mining companies, to allow mineral producers to earn a higher and more consistent return on capital so as to provide adequate funds for exploration and to avoid obsolescence of technology and equipment.
7. All concerned parties should seek to remove impediments to value adding of unprocessed or semi-processed minerals prior to export.
8. By accelerating all aspects of microeconomic reform (particularly in shipping), Australian participants should ensure that the combination of costs and labour productivity is not unfavourable in comparison with overseas competitors.
9. The industry should continue to concentrate on staff education and training so that management standards are equal to world best practice in order to cope with rapidly changing conditions.
10. Industry, public sector organisations (particularly CSIRO), universities and education and training authorities must cooperate to ensure that technological education is adequate to provide a continuing stream of management, operating and research staff for minerals companies, with special recognition being given to the geographical location of industry units.

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