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**Submission to Stage 2 of
the House of Representatives Standing Committee on
Industry, Science and Resources'**

Inquiry into increasing the value added to Australian raw materials

Department of Industry, Science and Resources

Introduction

This submission has been prepared following the completion of the House of Representatives Standing Committee on Industry, Science and Resources' first report of its inquiry into increasing the value added to Australian raw materials. It is designed to complement the Department's initial submission, which was provided to the Committee on 6 July 1999, and the additional material it subsequently forwarded.

Given that the focus of the Committee's work is to now be directed at a number of case studies to identify the drivers of, and impediments to, successful value adding in Australia, this supplementary submission primarily focuses on providing information on the case study industries. In particular, it provides some detailed background information on the two case study industries, aluminium and magnesium, that fall within this portfolio's purview.

While the submission also provides some additional comment on the broad policy issues underlying the Committee's work, this is essentially limited to commenting on the Committee's findings to date. In this regard, the submission does not attempt to repeat the comment and analysis that the Department provided in its earlier material, but rather is intended to meet the Committee's request for comment on the content of its first report.

The Department believes that the material it supplied to date remains relevant and trusts that the Committee will continue to draw on this input in formulating its conclusions from the case study stage of its work and in bringing together these findings to make its overall recommendations on how to encourage further raw material value adding in Australia.

Comments on the Committee's First Report

On examining the Committee's first report of its inquiry into increasing the value added to Australian raw materials, the Department considers that it provides a useful and comprehensive analysis of the current state of value adding in Australia and a solid basis for the Committee's continuing work in this area.

It is clear that the nation is already adding significant value to a range of raw materials and that this is providing substantial benefits for the Australian economy and is enhancing the community's standard of living. On the other hand, it is also likely that more can be achieved.

The more limited growth of our raw materials processing industries (an average 1.2 per cent a year the decade to 1998-99) compared to the growth being achieved in the agriculture, forestry and fishing, and the mining sectors (3.5 and 4.8 per cent a year respectively over the same period) is perhaps the most telling indicator of this potential. It seems that the growth in the nation's raw materials processing sector is not currently keeping up with the opportunities that are being presented to it.

The Department therefore agrees that the Committee's work is timely and that it is useful to examine the issues that are impacting on this performance with a view to identifying any impediments that may be holding back the development of raw materials processing in this country.

As indicated in its previous submission, however, the Department does not believe the pursuit of a larger raw materials processing sector or of further processing in any particular industry, should be an end objective in itself. It suggests that there are potential dangers in pursuing particular value adding proposals at any cost and therefore strongly endorses the Committee's suggestion that the fundamental aim of its work should be to enhance national income and living standards.

From the Committee's work, and the range of previous reports that have commented on this issue (see the listing in Appendix E of the Department's initial submission to the inquiry), there are signs that Australia has strong prospects in the raw materials processing area.

As indicated by the Committee, for example, there is little doubt that Australia's significant raw materials base provides it with a strong prospect of enhancing its national welfare through the processing of its resources.

The Committee has also received significant evidence that Australia is competitive in a number of the other factors of production that allow it to undertake successful value adding activity. As noted in the report, it can be expected that raw materials processing industries would be attracted to Australia because of its relatively low energy costs, its mature infrastructure, the lower raw materials transport cost and due to the generally capital intensive nature of these industries. Australia also offers the benefits of a democratic country with strong free-market and judicial institutions which foster investment.

The question of how Australia can draw on these advantages and develop further raw materials processing, however, is another matter. As indicated by the Committee, raising the value of a product through further processing is in itself not necessarily synonymous with increased value added. This outcome is very dependent on the nature of the measure used to encourage the additional processing activity.

We agree with the Committee that the solution to this apparent dilemma lies in directing any action by governments at ensuring there are no policy or institutional measures hindering the development of raw materials processing industries that have a comparative advantage.

In taking this approach, the Committee has identified a number of possible options that could be implemented to help realise Australia's full raw materials processing potential and we agree that this list covers the broad range of measures available. As indicated in our earlier submission, measures such as providing a sound macroeconomic environment, continuing microeconomic reform, providing an open, efficient and transparent regulatory framework, and encouraging free and open international trade can all enhance the prospects of adding to the raw material processing being undertaken in Australia.

Given the Department's views on each of these options were covered in its earlier submissions to the Committee, we believe there is little need reiterate them here. We agree, however, that the options identified by the Committee provide a good basis for examining the case study industries during the next stages of the inquiry processes.

The proposed case studies should provide a strong foundation for investigating how further initiatives in each of the areas identified by the Committee would facilitate further raw materials processing in these industries and, more generally, how the actions would impact on overall national income.

Importantly, the case studies may provide a more detailed knowledge of the cost structure of the particular activities involved in adding value to raw materials in these cases. Such knowledge is necessary for determining the relative importance of the various options and actions identified by the Committee in the first stage of its inquiry. The case studies may also provide insights into the decision making processes of business when they consider where to locate value adding processing facilities, working in a global environment. Again, such knowledge is important in assessing the relative effect that different possible areas of government action may have.

The Department therefore strongly endorses the broad thrust of the work undertaken by the Committee to date. As indicated above, the Committee's overall aim of enhancing national income provides a solid foundation for its ongoing work and the comprehensive list of possible options for encouraging further raw materials processing in Australia provides a good starting point for this work.

The case study work should provide a better understanding of the factors driving decisions on investment in raw materials processing and of how the initiatives examined could work to develop further processing across the economy more generally.

Case studies

Of the five industries to be examined by the Committee in the case study stages of its inquiry, only two fall within the purview of this portfolio, the aluminium and magnesium industries. The Department's input for this purpose has therefore been directed to these two industries.

This input is outlined in Appendix A to this submission and includes information on Australia's place in the world markets for these commodities and details on current and potential projects. In addition, some comment is provided on the role of government and the key issues affecting these industries.

We have also enclosed a number of recent Departmental publications which provide further information and comment on developments in these industries and on their future potential, including:

- *Magnesium: Opportunities in Australia*;
- *Ascent, Technology Magazine*, No 36, March 2000 (which contains a number of articles on the magnesium industry);
- *Energy efficiency best practice in the Australian aluminium industry;*
- Invest Australia's *Australia: Your Asia-Pacific Casting Location*; and
- Invest Australia's *Australia - leading advantages for the global automotive industry.*

The Committee may also wish to draw on the March 1998 Industry Commission study on *Micro Reform - Impacts on firms: Aluminium Case Study* during its deliberations. That report provides detailed comment on a number of the questions being examined as part of the Committee's inquiry.

The Australian Greenhouse Office April 2000 publication *Synthetic Gas Use in Non-Montreal Protocol Industries* also provides some detail about magnesium and sulphur hexafluoride (this is available on the Internet at: http://www.greenhouse.gov.au/pubs/ngs/synthetic_gas.pdf) and the June 1999 edition of *Metal Casting Technologies* (volume 45, no 5 and 6) also contains some useful background material.

The Department is of course happy to provide any assistance it can to help the Committee in its deliberations and is available to again appear before the Committee to comment on any of the issues raised in this submission or on any other issue coming to the Committee's attention during its inquiry processes.

ATTACHMENT

DEPARTMENTAL INPUT FOR CASE STUDIES ON ALUMINIUM AND MAGNESIUM

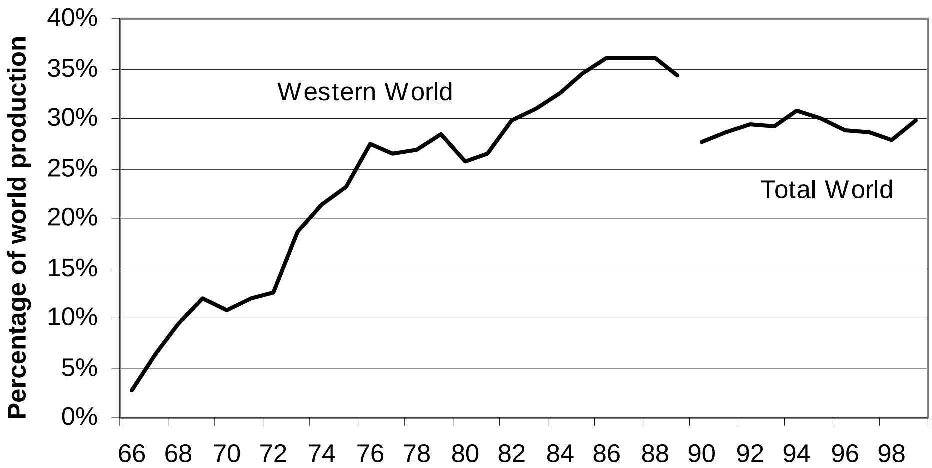
ALUMINIUM

CURRENT STATE OF PLAY

Place in the World

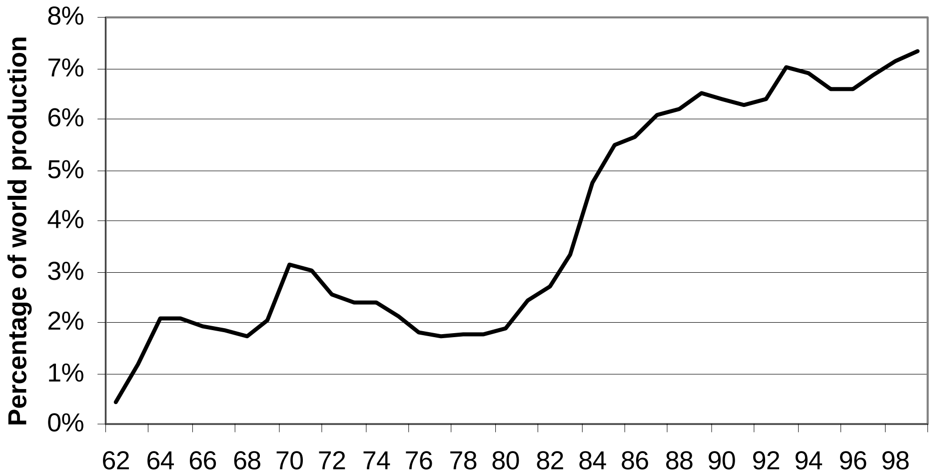
The Australian alumina and aluminium industries have grown rapidly over the past 30 years. Australia is the world's largest producer of alumina and the fifth largest producer of primary aluminium. Australia currently produces about 30% of the world's alumina. This proportion grew rapidly in the late 1960s, 1970s and early 1980s but has changed little since the mid 1980s. Australia produces over 7% of the world's primary aluminium. The proportion grew rapidly in the early 1980s but growth has been incremental since the late 1980s.

CHART 1: ALUMINA - AUSTRALIA'S SHARE OF WORLD PRODUCTION



Source: ISR calculations based on production figures from ABARE Australian Commodity Statistics 1999 and earlier editions.

CHART 2: PRIMARY ALUMINIUM - AUSTRALIA'S SHARE OF WORLD PRODUCTION



Source: ISR calculations based on production figures from ABARE Australian Commodity Statistics 1999 and earlier editions.

Operations

Table 1 shows Australia's bauxite mines, alumina refineries and aluminium smelters. Their approximate locations are shown in Figure 1.

High grade bauxite is mined at Weipa and Gove. A small percentage of bauxite production from these mines is exported; the rest is refined into alumina at Gladstone and Gove.

Lower grade bauxite is mined in Western Australia's Darling Ranges. This bauxite is not suitable for export because of its low aluminium content but it is refined nearby at Kwinana, Pinjarra, Wagerup and Worsley.

TABLE 1: AUSTRALIAN BAUXITE, ALUMINA AND ALUMINIUM OPERATIONS

Operation	Company	State	Capacity kt
Bauxite Mines			
Weipa	100% Comalco [a]	Qld	11 000
Huntly	100% Alcoa World Alumina and Chemicals	WA	19 000
Willowdale	100% Alcoa World Alumina and Chemicals	WA	8 000
Boddington	56% Reynolds [b], 30% Billiton	WA	6 800
Gove	70% Swiss Aluminium, 30% Gove Aluminium [c]	NT	6 500
Total			51 300
Alumina Refineries			
Gladstone	30% Comalco [a], 28% Kaiser, 20% Pechiney, 21% Alcan	Qld	3 460
Kwinana	Alcoa World Alumina and Chemicals	WA	1 900
Pinjarra	Alcoa World Alumina and Chemicals	WA	3 200
Wagerup	Alcoa World Alumina and Chemicals	WA	2 200
Worsley	56% Reynolds [b], 30% Billiton	WA	3 100
Gove	70% Swiss Aluminium, 30% Gove Aluminium [c]	NT	1 800
Total			15 660
Aluminium Smelters			
Kurri Kurri	100% VAW [d]	NSW	150
Tomago	35% Pechiney, 35% Gove Aluminium [c], 15% AMP, 12% VAW	NSW	440
Point Henry	100% Alcoa World Alumina and Chemicals	Vic	180
Portland	55% Alcoa World Alumina and Chemicals, 22.5% Marubeni, 22.5% CITIC	Vic	345
Boyne Island	Lines 1&2: 50% Comalco [a], 17% SLM, 9.5% Kobe, 9.5% Ryowa, 9.5% YKK, 4.5% Sumitomo Chemical Line 3: 59% Comalco [a], 17% SLM, 14% Ryowa, 9.5% YKK	Qld	492
Bell Bay	100% Comalco [a]	Tas	137
Total			1 744

Source: Ownership details were obtained by ISR analysis of company reports and web sites. Capacity figures were from the ACIL Consulting May 2000 Report to the Australian Aluminium Council titled *Australian Aluminium Industry Contribution to the National Economy*.

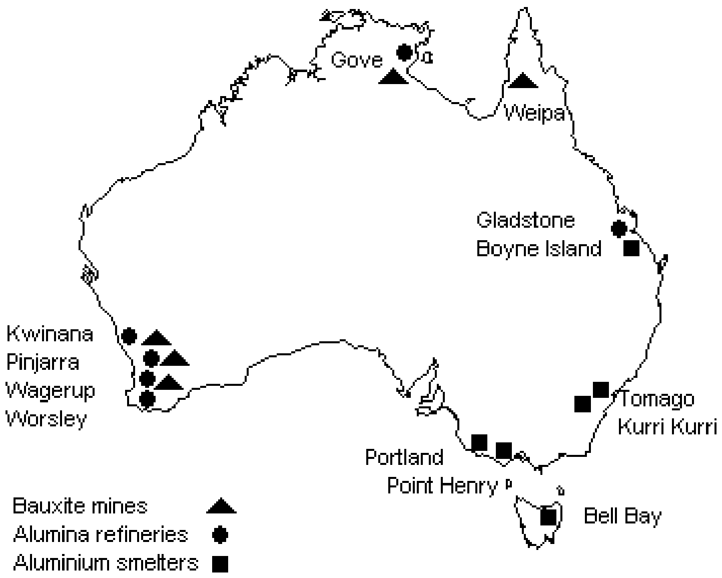
Note a: Comalco which was previously listed on the Australian stock market is now wholly owned by Rio Tinto.

Note b: Alcoa merged with Reynolds in May 2000. Competition authorities in the US, Europe and Australia allowed the merger subject to Alcoa selling the former Reynolds share of the Worsley project.

Note c: Gove Aluminium is 70% owned by CSR and 30% by AMP. CSR is seeking to sell its interest.

Note d: On 13 June 2000 Capral announced the sale of the Kurri Kurri smelter to Germany's VAW for $490m.

FIGURE 1: MAP OF AUSTRALIAN ALUMINIUM INDUSTRY OPERATIONS



Note: Locations are approximate only

Besides proximity to bauxite mines, the other factors important in the location of new alumina refineries are the availability and cost of natural gas, availability of a workforce and community facilities, proximity to port and facilities for disposal of waste products.

Alumina produced at Australia's six alumina refineries is either exported or smelted domestically at one of the six domestic aluminium smelters.

Two of Australia's aluminium smelters are located in the Hunter Valley and rely on low cost power generated by black coal. Similarly, the Boyne Island smelter in Queensland relies on low cost power generated by black coal from the Bowen Basin. Victoria's two smelters rely on low cost power from Victoria's brown coal. The Bell Bay smelter uses power generated from Tasmania's hydro schemes.

Australia has four aluminium rolling mills. Three of these are located in Sydney's western suburbs and one at Point Henry near Geelong in Victoria. Australia does not produce marine grade aluminium sheet for use in Australia's fast ferry industry. This material is currently imported at a cost of some $120m per annum. Australia has some 11 aluminium extrusion mills and some 20 aluminium casting operations.

Ownership

Ownership of Australia's bauxite mines, alumina refineries and aluminium smelters is shown in Table 1. Australian ownership in the industry has declined in recent years as assets have been sold to overseas interests. In particular Aluvic was sold to Marubeni and CITIC, Eastern Aluminium has been taken over by Alcoa, Capral's interest in the Kurri Kurri smelter is being sold to VAW, and Comalco, which until recently was an Australian company, is now wholly owned by Rio Tinto which is a joint UK/Australia company. Furthermore, CSR's share of Gove Aluminium appears likely to be sold to foreign interests.

The foreign owned companies include those from the US (Alcoa, Kaiser), UK (Billiton, Rio Tinto), Switzerland (Swiss Aluminium - also known as Alusuisse), Germany (VAW), France

(Pechiney), Canada (Alcan), Japan (Marubeni, Sumitomo, Kobe, Ryowa, YKK, SLM) and China (CITIC).

Two of the aluminium rolling mills are owned by Kaal, a joint venture between Japan's Kobe Steel and Alcoa of the US. Capral, an Australian company, owns the other two rolling mills but one will close at the end of 2000.

Production

Charts 3 and 4 and Table 2 show Australian production of alumina and aluminium. As can been seen, the growth of the Australian alumina and aluminium industry over the past 30 years has been quite remarkable. However, there have been no greenfield alumina refineries or aluminium smelters built in Australia since 1986. Production growth since that time has been as a result of brownfield expansions and "capacity creep".[1]

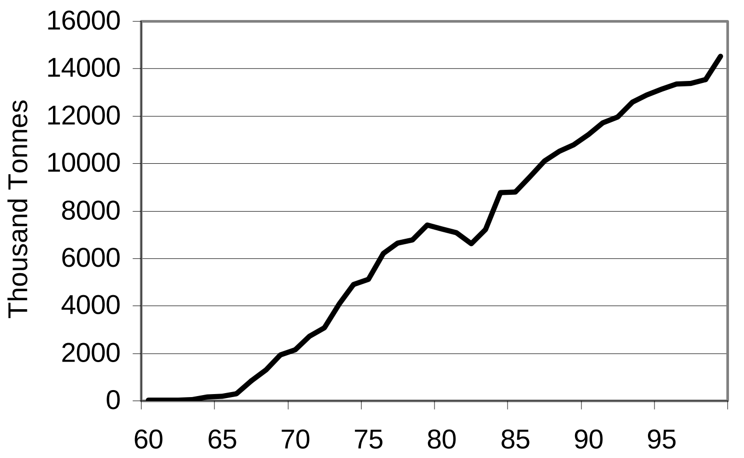
Planned and possible expansions are discussed in the Investment Section below.

TABLE 2: AUSTRALIAN ALUMINA AND ALUMINIUM PRODUCTION, THOUSAND TONNES

	1997	1998	1999	Change 1998 to 1999
Alumina production, kt	13 384	13 853	14 532	4.9%
Aluminium production, kt	1 495	1 627	1 719	5.7%

Source: ABARE Australian Commodity Statistics 1999, Australian Mineral Statistics December Quarter 1999

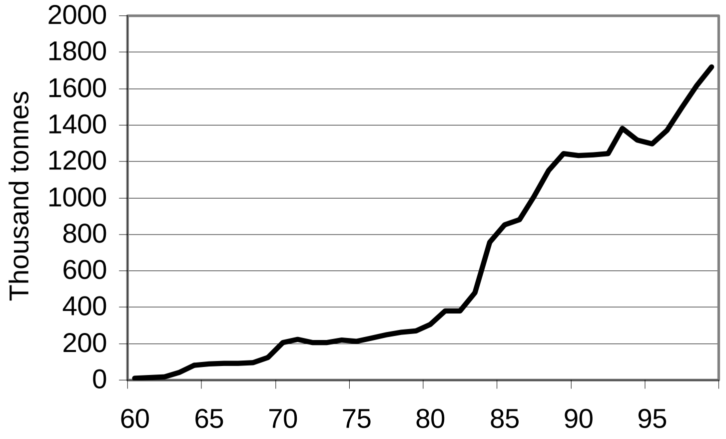
CHART 3: AUSTRALIAN ALUMINA PRODUCTION



Source: ABARE Australian Commodity Statistics 1999, Australian Mineral Statistics December Quarter 1999

[1] Capacity creep is where production capacity is increased without significant capital expenditure. It arises from utilising the same equipment in a more productive manner. Although not in the aluminium industry, the best Australian example is the Port Kembla steelworks which increased production by 36% between 1990 and 1994 using the same equipment. Comalco's Mr Tracy Stevenson noted at the 31 May - 1 June 2000 Aluminium and Alumina Summit that hot metal production per cell at the Bell Bay smelter has increased by a compound 4% per annum since 1997.

CHART 4: AUSTRALIAN ALUMINIUM PRODUCTION



Source: ABARE Australian Commodity Statistics 1999, Australian Mineral Statistics December Quarter 1999

Exports

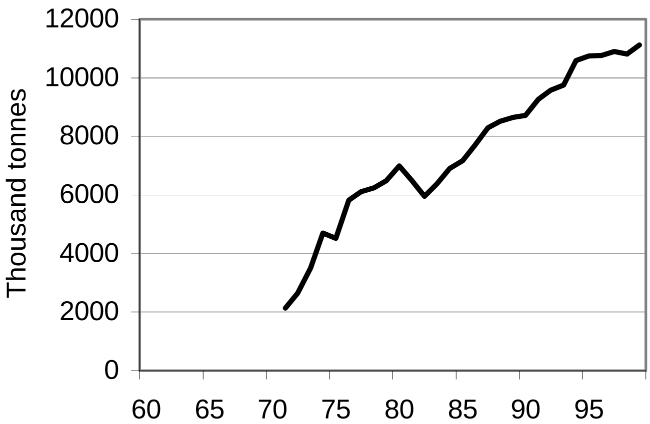
Charts 5 to 7 and Table 3 show Australian exports of alumina and aluminium. Australian export volumes grew strongly in calendar year 1999 but export values fell as a result of lower prices. Export values are expected to grow strongly in 2000-2001 (Chart 7) as prices have risen since calendar year 1999. The ABARE forecast in Chart 7 for the combined exports of alumina and aluminium to reach $7.7 billion may prove to be an underestimate as a result of the decline in Australian dollar against the US dollar. Alumina and aluminium prices are negotiated in US dollars.

TABLE 3: AUSTRALIAN ALUMINA AND ALUMINIUM EXPORTS

	1997	1998	1999	Change 1998 to 1999
Alumina exports, kt	10 902	10 804	11 128	3.0%
Aluminium exports, kt	1 156	1 312	1 381	5.3%
Alumina exports, $m	2 735	3 055	2 877	-5.8%
Aluminium exports, $m	2 527	2 935	2 918	-0.6%

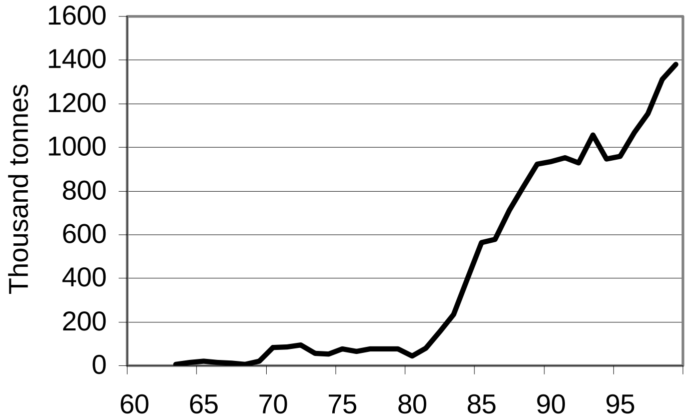
Source: ABARE Australian Commodity Statistics 1999, Australian Mineral Statistics December Quarter 1999

CHART 5: AUSTRALIAN ALUMINA EXPORTS BY VOLUME



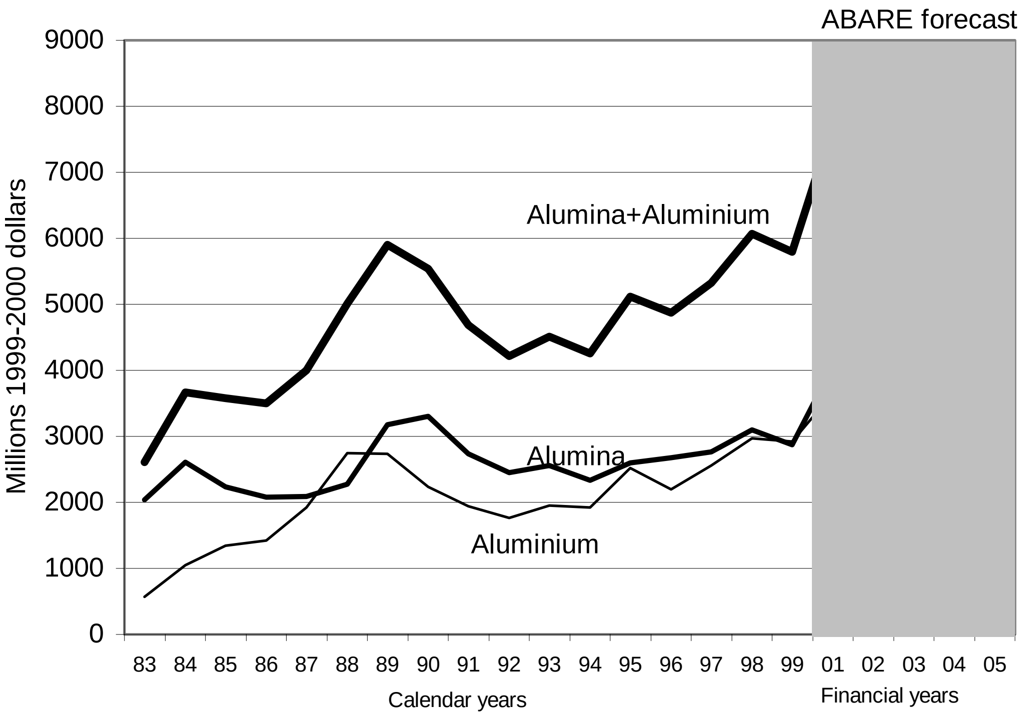
Source: ABARE Australian Commodity Statistics 1999, Australian Mineral Statistics December Quarter 1999

CHART 6: AUSTRALIAN ALUMINIUM EXPORTS BY VOLUME



Source: ABARE Australian Commodity Statistics 1999, Australian Mineral Statistics December Quarter 1999

CHART 7: AUSTRALIAN ALUMINA AND ALUMINIUM EXPORTS BY VALUE



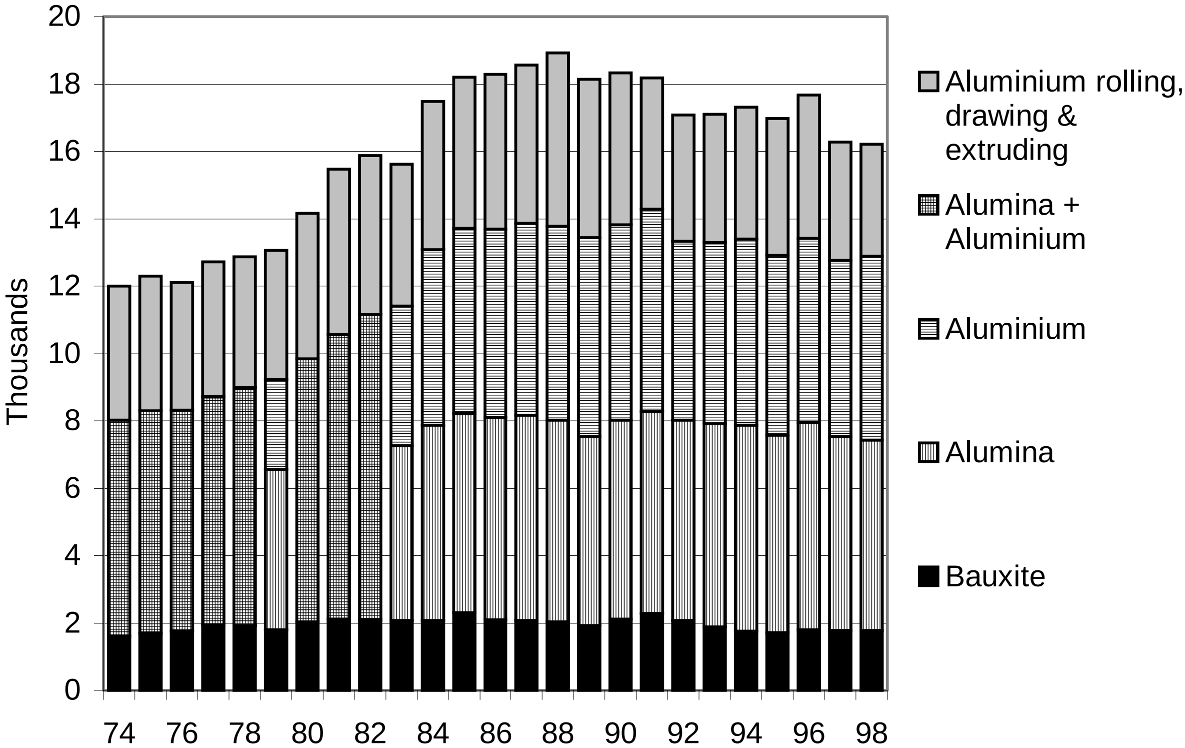
Source: ISR analysis of data from ABARE Australian Commodity Statistics 1999, Australian Mineral Statistics December Quarter 1999, ABARE 2000 Outlook papers.

Employment

Direct employment in the Australian aluminium industry (Chart 8) is about 16 000 persons, comprising 1 800 in bauxite mining, 5 700 in alumina refining, 5 500 in aluminium smelting and 3 300 in aluminium rolling, drawing and extruding. The ABS does not separate aluminium casting from other non-ferrous metal casting.

Employment in alumina refining and aluminium smelting grew strongly from the mid 1970s to mid 1980s but has changed little over the past 15 years. Employment in aluminium rolling, drawing and extruding has fallen by 36% since peaking at 5 100 in 1987-88. This figure will fall further when Capral's Granville aluminium rolling mill closes at the end of 2000. About 220 persons will lose their jobs as a result of this closure.

CHART 8: EMPLOYMENT IN THE AUSTRALIAN ALUMINIUM INDUSTRY

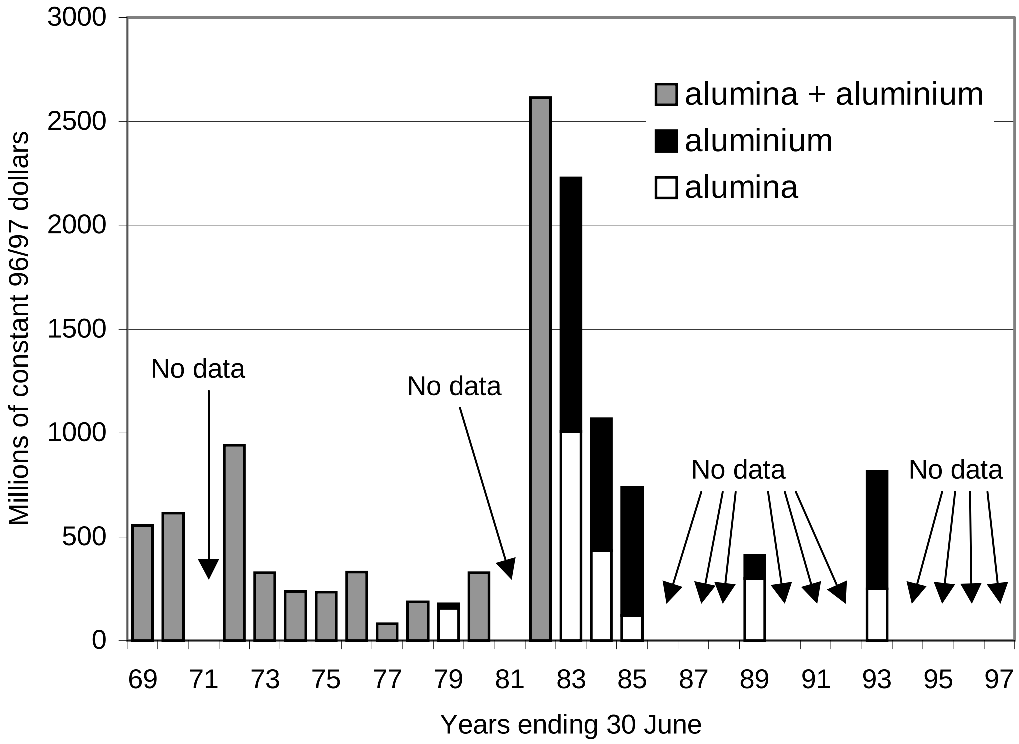


Source: ABS 8221.0 and predecessor publications. Note: the data is for years ending 30 June. The ABS did not undertake a manufacturing survey for 1985-86. The data for this year has been extrapolated.

Investment

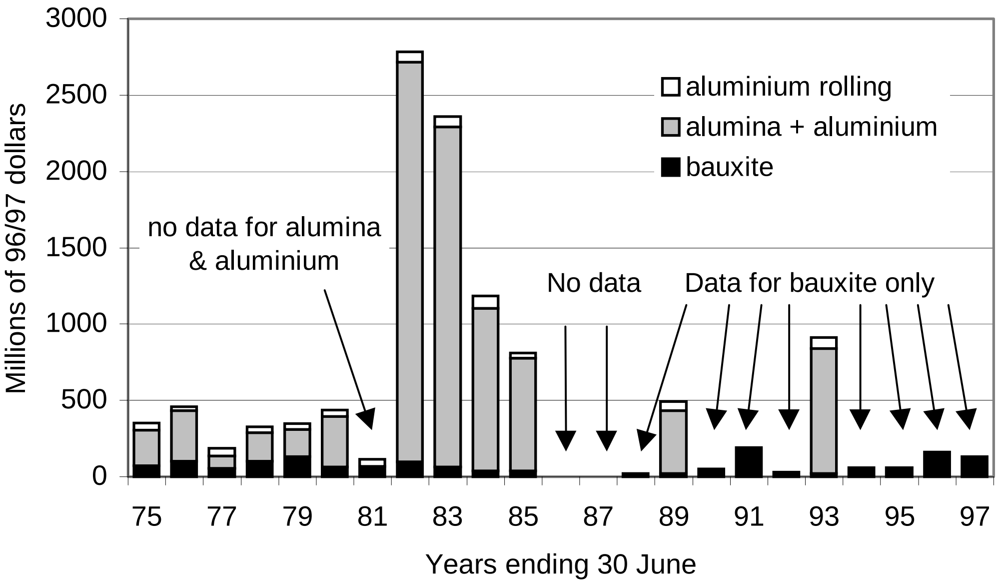
Chart 9 shows ABS data for capital expenditure in alumina refining and aluminium smelting. Although data is not available for some years, it is apparent that there was a spike in investment in the 1980s. Chart 10 shows ABS data for bauxite mining and aluminium rolling, drawing and extruding in comparison to alumina and aluminium. The level of investment in bauxite mining and aluminium rolling, drawing and extruding is quite modest compared to that in alumina refining and aluminium smelting.

CHART 9: CAPITAL EXPENDITURE FOR ALUMINA AND ALUMINIUM



Source: ABS 8221.0 and predecessor publications.

CHART 10: CAPITAL EXPENDITURE FOR BAUXITE, ALUMINA AND ALUMINIUM AND ALUMINIUM ROLLING



Source: ABS 8221.0, 8402.0 and predecessor publications.

Table 4 lists current investment projects that are in the public arena. In addition there are a number of brownfield and greenfield projects under active consideration that are not included on the list because they are not yet in the public arena. The list includes two alumina refinery expansions, one greenfield alumina refinery and a greenfield aluminium smelter proposal.

TABLE 4: PROPOSED ALUMINA AND ALUMINIUM PROJECTS FOR AUSTRALIA

Proponent	Proposed facilities & location	Cost ($m)	New Capacity (kt)	Status
Alcoa World Alumina	Process improvement at Pinjarra alumina refinery	na	165	Committed
Alcoa World Alumina	Wagerup alumina refinery expansion	700	1100	Feasibility
Comalco	Greenfield alumina refinery at Gladstone	1400	1400	Feasibility
Aust-Pac Aluminium	Greenfield aluminium smelter at Lithgow	2750	450	Feasibility
TOTAL		4850		

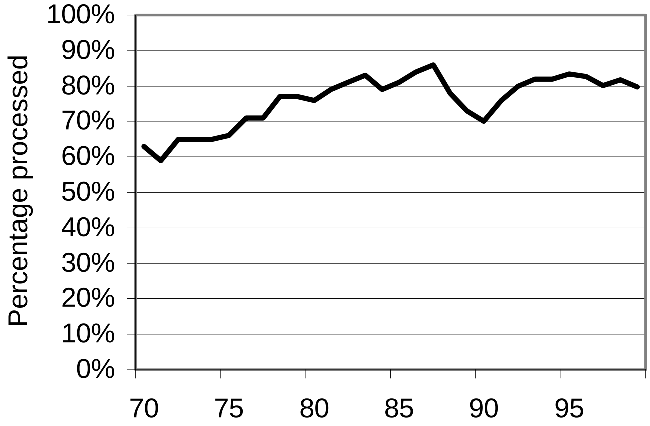
Source: ABARE project listing updated by ISR, WA CCI Resource and Energy Projects Service

In addition to the projects in Table 4, the Latrobe Valley Energy Park is actively seeking to establish greenfield aluminium and magnesium smelters within the Park. However, at the time of writing no details on any specific project proposal have been issued and thus this project is not included in the table.

Percentage Processed

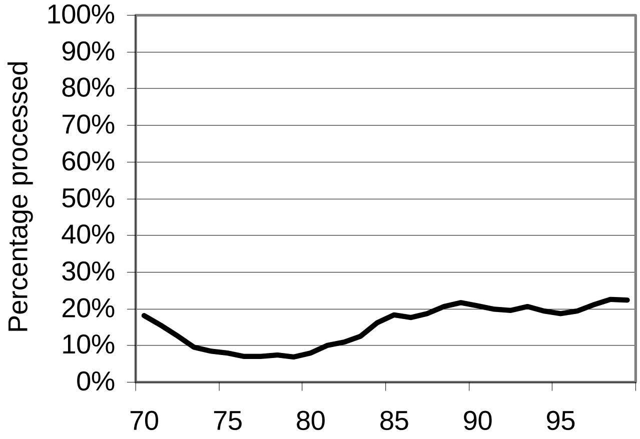
Chart 11 shows the percentage of Australian bauxite processed to alumina domestically. As can be seen, the percentage processed has consistently been above 70% since 1976. However, the proportion of alumina processed domestically to aluminium (Chart 12) is much lower and was 22% in 1999.

CHART 11: PERCENTAGE PROCESSED - BAUXITE TO ALUMINA



Source: 1970 to 1987 - BMR; 1988 onwards - ISR calculations based on production figures from ABARE Australian Commodity Statistics 1999, Australian Mineral Statistics December Quarter 1999.

CHART 12: PERCENTAGE PROCESSED - ALUMINA TO ALUMINIUM

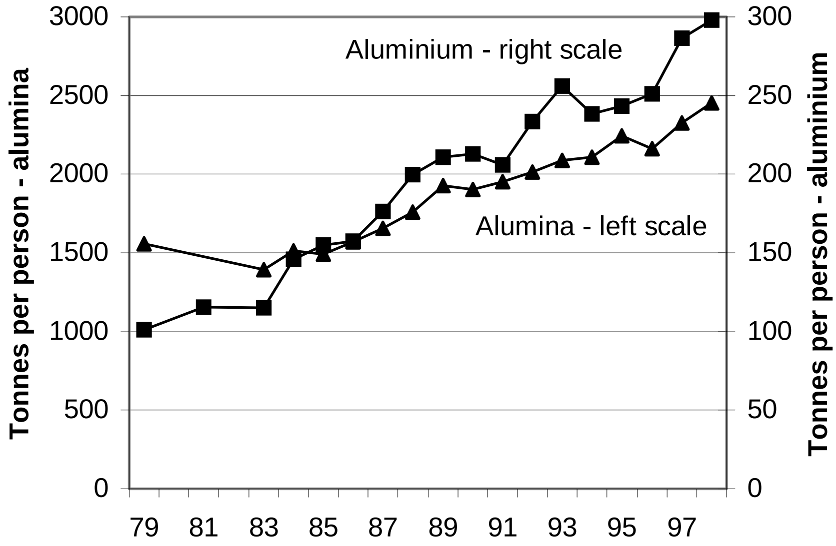


Source: 1970 to 1987 - BMR; 1988 onwards - ISR calculations based on production figures from ABARE Australian Commodity Statistics 1999, Australian Mineral Statistics December Quarter 1999.

Productivity

Chart 13 shows productivity growth in the Australian alumina and aluminium industries. ABS employment data earlier than 1978-79 does not distinguish between alumina and aluminium. The growth in productivity in the period from 1979 to 1998 was 57% for alumina and 195% for aluminium.

CHART 13: PRODUCTIVITY IN ALUMINA AND ALUMINIUM



Source: ISR calculations based on calendar year production figures from ABARE Australian Commodity Statistics 1999 and 30 June employment figures from ABS 8221.0, 8402.0 and predecessor publications. Note that the employment figures will include employees not actually engaged in production.

Energy Efficiency

Recently, the Department commissioned a study into the energy efficiency in the Australian aluminium industry. A copy of the report *Energy Efficiency in the Australian Aluminium Industry* accompanies this submission. The study found that the Australian alumina industry was very low in energy intensity by world standards and was within 2% of world's best practice. In aluminium smelting, Australian smelters were beaten only by the newer African smelters for electricity efficiency. The Australian average electricity consumption in aluminium smelting was 3% better than the world average, 5% better than the US average and 6% better than the Europe average.

The Australian aluminium industry has participated in the Greenhouse Challenge program. The alumina sector has achieved a reduction of 8.9% in greenhouse gas emissions per tonne of product between 1990 and 1999. For aluminium smelting, the comparable figure is 22% including emissions from externally generated electricity.[2] Comalco claims to have reduced its greenhouse emissions by 34% since 1990 despite a production increase of 57%. On a per tonne basis Comalco claims a 58% reduction in emissions.[3]

Role of Government

The Australian aluminium industry was born as a direct result of Government intervention with the Government building and owning the Bell Bay aluminium smelter in the mid 1940s/early 1950s. It was privatised in about 1960. Since that time, the Commonwealth and State Governments' roles have been to facilitate investment and, where electricity provision was a State Government role, to provide power. The latter role has been steadily decreasing as the various State Governments have corporatised and privatised their electricity generation and transmission functions.

In recent years, the Government has announced the provision of over $100m in investment incentives for Comalco's alumina project. Comalco has announced Gladstone as its preferred site but it has not given the go ahead for the project.

In addition, the Automotive Competitiveness and Investment Scheme commences on 1 January 2001, and will encourage investment and innovation in the Australian automotive industry. Development of light metal automotive components will be rewarded under this scheme, and there may be some scope for benefits to flow down the light metal supply chain through joint development projects between suppliers and manufacturers.

OPPORTUNITIES

Opportunities for increasing the adding of value in the Australian aluminium industry include the following types of activities:

- Greenfield alumina refineries.
- Brownfield expansions of existing alumina refineries.
- Greenfield aluminium smelters.
- Brownfield expansions of existing aluminium smelters.
- Diecasting of automotive parts.

Investment projects from the first three categories are presently under consideration and are listed in Table 4. Investment projects in the last two categories are certainly possible but there are no specific projects in the public domain at the time of writing.

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[2] Mr David Coutts, Executive Director, Australian Aluminium Council address to the 31 May - 1 June 2000 Aluminium and Alumina Summit.

[3] Mr Tracy Stevenson noted at the 31 May - 1 June 2000 Aluminium and Alumina Summit

The development of greenfield bauxite mines is possible but is considered unlikely given the high cost of developing new mines in remote areas and the ease with which existing mines could be expanded. Similarly, any major expansion in aluminium rolling in Australia appears to be remote given the new capacity added in other parts of the world and the poor profitability of existing rolling mills. Indeed, Capral will close one of their rolling mills at the end of 2000.

KEY ISSUES

Greenhouse

The Australian aluminium industry has a vital interest in the greenhouse debate, particularly given the industry's heavy reliance on energy, and any moves to limit greenhouse emissions in Australia could have a significant impact on the industry if not handled carefully. Whilst developing countries remain outside of the Kyoto protocol, severe greenhouse restrictions could see capacity move offshore and this paradoxically could lead to a worse greenhouse outcome on a global basis, since Australia is amongst the most energy efficient producers.

Activities of Foreign Governments

Recent and proposed new smelter capacity in South Africa, Mozambique, China and the Middle East may have benefited from government support to the detriment of potential investments in Australia.

Coastal Shipping

Over six million tonnes of Weipa bauxite are transported by coastal shipping each year for refining at Gladstone. In addition, a total of 2.5 million tonnes of alumina per annum are transported by coastal shipping from Kwinana, Bunbury, Gove and Gladstone to smelters at Newcastle, Bell Bay, Portland and Geelong. The high cost of Australian coastal shipping can make this transport more expensive than transport of Australian bauxite or alumina to foreign refineries and smelters.

Energy Infrastructure

A major factor in Comalco's deliberations over the site of its proposed new alumina refinery was the availability of gas at Gladstone. Similarly, we understand that availability of competitively priced electricity is the major obstacle for the proposed greenfield aluminium smelter for Lithgow.

Technology

CSIRO has developed a carbothermic process for smelting aluminium which may have the potential to reduce energy consumption by 10-15% with corresponding reduction in carbon dioxide emissions. The process also eliminates fluorides and does not generate spent pot linings.

CSIRO is also involved in alloy development, high pressure diecasting, light metal design and prototyping, low pressure and gravity diecasting, magnesium technology, rapid product development, squeeze casting and modelling, and tooling. The Organisation has a long history of research and collaboration with the die casting industry which has enabled the development of high level skills in foundry technology. It has participated in the aXcessaustralia Low Emission Vehicle project since June 1999, designing and manufacturing several light metal components through the Light Metal Design and Prototyping project.

MAGNESIUM

This paper focuses only on magnesium metal. Magnesia and magnesium chemicals are also value added products produced from magnesite or sea water but they are not considered in the paper.

INTRODUCTION

Australia currently does not produce magnesium metal in commercial quantities.

The world market for magnesium is around 450 thousand tonnes a year, making magnesium a minor metal. Major uses of magnesium are aluminium alloys (44%), diecasting (28%) and steel desulphurisation (14%). The amount of magnesium used in diecast automotive parts is estimated at 22% of magnesium use but this sector is growing fastest - at about 15% per annum.

Table 5 shows world production of magnesium metal by country. As can been seen, world production has grown strongly in the 1990s. Production has grown in China, Canada, Norway and Israel. In the US, which has dominated world production until recently, production fell in 1998 and again in 1999 to an estimated 90 thousand tonnes following the closure of Dow's 65,000 tonne plant in December 1998. The Dow closure leaves two US magnesium producers, Magcorp and North West Alloys (owned by Alcoa) which each have 40 thousand tonnes of capacity.

TABLE 5: WORLD PRODUCTION OF MAGNESIUM METAL BY COUNTRY

Country	Plants	Production (thousand tonnes)						
	1998	1992	1993	1994	1995	1996	1997	1998
China	200	6	11	11	60	56	92	120
US	3	137	132	128	142	143	140	117
Canada	2	26	26	29	42	52	54	57
Norway	1	30	27	28	35	38	52	49
Russia	2	40	30	25	35	28	35	35
Israel	1	0	0	0	0	0	7	25
France	1	12	9	9	10	11	16	16
Kazakhstan	1	20	20	0	0	0	1	10
Ukraine	1	10	9	7	13	10	10	10
Brazil	1	7	10	10	10	11	9	9
Serbia	1	3	0	1	1	2	3	3
India	2	1	1	1	1	1	1	1
Japan	0	7	3	0	0	0	0	0
Italy	0	1	0	0	0	0	0	0
Total	216	300	278	264	349	352	433	452

Source: Mining Annual Review 1999 and previous editions published by Mining Journal Ltd London.

A chicken and egg situation has existed between the magnesium industry and the automotive industry. The automotive industry has been reluctant to embrace the large scale use of magnesium because the world supply has been too small and the price too high. At the same time, the metal industry has been reluctant to install major new capacity without commitments from the automotive manufacturers. This impasse appears to have been broken in recent years with fuel economy legislation leading to the development of business partnerships between automotive companies and magnesium producers. At the same time China has become a major supplier of low cost metal.

Over the next decade, the global magnesium industry may emerge from being a minor metal into the ranks of the major metals. According to one analyst, rising demand for light weight automotive components could see world magnesium production increase from its current level of 450 thousand tonnes to 1 million tonnes by 2010 - comparable to current world production of nickel and lead.

RAW MATERIALS

Magnesium is the eighth most abundant element in the Earth's crust and the third most plentiful element dissolved in seawater. Magnesium is recovered from seawater and brines as well as minerals such as dolomite, magnesite and carnallite.

Resources from which magnesium may be recovered range from large to virtually unlimited and are globally widespread. Resources of magnesium bearing minerals are enormous and magnesium bearing brines are estimated to constitute a resource in billions of tonnes.[4]

In Australia, the AGSO report *Australia's Identified Mineral Resources 1998* refers to deposits of magnesite at Kunwarara (Qld), Arthur River (Tas), Thuddungra (NSW), Yaamba/Herbert Creek (Qld) and Myrtle Springs (SA). Three of these deposits, those at Kunwarara, Thuddungra and Myrtle Springs, have been mined in recent years but the Thuddungra mine near Young ceased production a few years ago.

Queensland Metals Corporation's (QMC) Kunwarara, Queensland, deposit has the largest Economic Demonstrated Resource of magnesite in Australia. It is also the world's largest known resource of cryptocrystalline, nodular magnesite, a high quality ore by world standards.

The Kunwarara mine provides the raw material for QMC's refractory magnesia plant at Rockhampton. In 1999 QMC mined 2.4 million tonnes of raw magnesite and produced 280 thousand tonnes of beneficiated magnesite which was converted into 147 thousand tonnes of refractory magnesia. Exports of refractory magnesia in 1999 were 123 thousand tonnes valued at $41m. This same deposit would supply raw material for the Australian Magnesium Corporation (AMC) magnesium metal project.

Only about one thousand tonnes of magnesite per annum is produced at the Myrtle Springs (SA) mine. However, there are extensive deposits of magnesite in the region north of Leigh Creek in South Australia and these have given rise to the South Australian Magnesium (SAMAG) Project.

The Arthur River an Lyons River deposits about 50km SW of Burnie in Tasmania would provide the raw material for the Crest magnesium project. In the same region of Tasmania there are two other deposits of magnesite being considered for producing magnesium metal. Bass Resources is considering using the Main Creek deposits or alternatively the company could purchase magnesite from Goldamere which trades as Australian Bulk Minerals and which owns and operates the Savage River magnetite mine. This magnetite is a form of iron ore and is used in steelmaking. However, magnesite occurs alongside the magnetite and it could be recovered if economic.

Other deposits of magnesite being considered in magnesium metal projects are at Murrin Murrin in Western Australia and at Batchelor in the Northern Territory. Other projects propose to recover magnesium from the asbestos tailings at Woodsreef (Northern NSW), from brines which

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[4] US Geological Survey Mineral Commodity Summaries February 2000 available on the Internet at http://minerals.usgs.gov/minerals/pubs/commodity/magnesium/400300.pdf.

are associated with salt production near Dampier in Western Australia and from power station fly ash at the Hazelwood power station in Victoria's Latrobe Valley.

TECHNOLOGY

Magnesium metal can be produced either by thermal or electrolytic processes. The electrolytic route lends itself to large-scale plants with high capital costs and low operating costs (provided power costs are competitive) and involves three key stages: preparation and purification of magnesium chloride, dehydration and electrolysis. The thermal route conventionally uses silicon or ferrosilicon as reductant and involves small plants with low capital costs but higher operating costs.

AUSTRALIAN PROJECTS

There are nine magnesium metal projects under consideration for Australia. Their location is shown in Figure 2 and their details are summarised in Table 6. Further details are provided in the text below.

FIGURE 2: MAP OF AUSTRALIAN MAGNESIUM PROJECTS

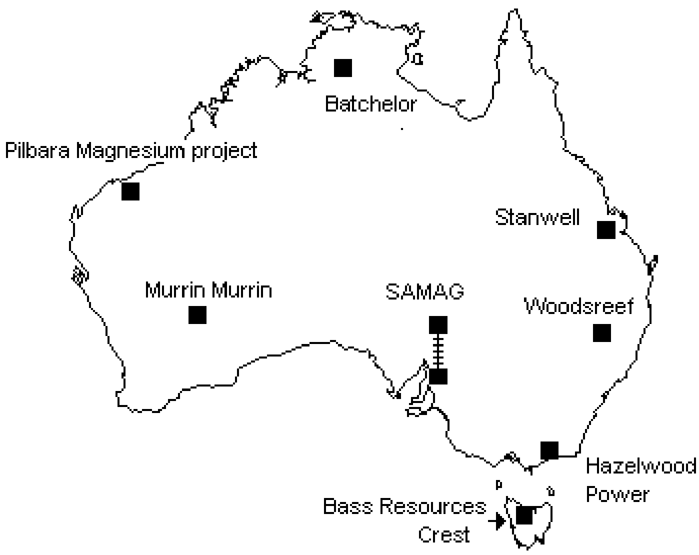

TABLE 6: PROPOSED MAGNESIUM METAL PROJECTS FOR AUSTRALIA

Proponent	Proposed facilities & location	Cost ($m)	Capacity (kt)	Status
AMC	Mine – Kunwarara, Qld Smelter – Stanwell, Qld Own technology proven in pilot plant	1130	96	Feasibility study complete; offtake agreements in place
Anaconda	Mine - Murrin Murrin, WA Smelter - undecided	1000	100	Possible
Bass Resources	Mine - Main Creek or Savage River. Smelter - Bell Bay, Tas Technology unknown	800	80	In discussion with Pasminco over mine leases.
Crest	Mine – Arthur/Lyons River, Tas Smelter – Bell Bay, Tas Russian/Ukrainian technology	950	95	Project setback following loss of Multiplex as partner; energy price still unknown
Golden Triangle	Mine – Woodsreef tailings, NSW Smelter - Woodsreef Own technology being developed with Russia and Israel	700	80	Feasibility study
Hazelwood Power	Use of fly ash waste from power station	270	34	Pre-feasibility
HCC	Smelter in Pilbara region of WA based on brines as feedstock Ukrainian technology	700	50	Pre-feasibility study
Mt Grace	Mine – Batchelor, NT Smelter - Batchelor? Heggie thermal technology	120	50	Feasibility study
SAMAG (Pima)	Mine – Leigh Ck, SA Smelter - Port Pirie, SA Dow technology	650	52	Feasibility study
TOTAL		6320	617	

Source: ISR database complied from published information. Note: Projects are arranged alphabetically.

AMC Project - Queensland

The AMC project involves the construction of a $1.13 billion magnesium smelter at Stanwell in central Queensland. The project is planned to produce 96 000 tonnes of metal a year and is forecast to produce magnesium at less than US64c a pound, making it one of the world's lowest cost producers.

The major proponent is Queensland Metals Corporation (QMC) which has net assets of around $102m and has a successful track record in bringing projects to fruition. QMC has successfully developed a refractory magnesia project and a business based on environmental applications of magnesia.

The magnesium metal project had its origins in the late 1980s following the discovery of the Kunwarara magnesite deposit. In 1990, QMC was not able to purchase suitable technology and together with CSIRO developed its own electrolytic process with $20m of Commonwealth funding. The resulting Australian Magnesium process (or AM process) involves novel chlorination and dehydration steps followed by conventional electrolysis. AMC has spent $160m over 10 years developing the AM process which has been demonstrated in a 1 500 tonne pa pilot plant at Gladstone.

A considerable body of expertise and know how has been built up through CSIRO, the CRC for Alloy Solidification Technology and other technological infrastructure in Queensland.

The major partner in the AMC project, Queensland Metals Limited (QMC), released in April 2000 the results of its feasibility study into a commercial plant. The study confirmed the economic and technical viability of the project. QMC is aiming to finalise the funding for the $1.13 billion commercial plant by the third quarter of 2000.

Ownership is currently being restructured after Normandy's announcement that it will exit the project. Normandy proposes to concentrate on the gold sector and its exit from the project is not expected to be a hindrance to the project.

Underpinning the viability of the AMC project is a long-term take-or-pay offtake agreement with Ford Motor Company covering 45 000 tonnes of magnesium metal a year, while talks with other potential customers are under way.

The major task facing AMC is to secure financing.

SAMAG Project - South Australia

The South Australian Magnesium Project (SAMAG) involves a magnesite mine north of Leigh Creek and a 52 500 tonne magnesium smelter near Port Pirie.

The project proponent is Pima, a junior exploration company with net assets of around $3.8m.

The SAMAG project has purchased the rights to Dow technology. This is well proven technology but the recent closure of Dow's plant in Texas, the only plant which used the technology, has led to some doubts about the competitiveness of the technology. Pima claims that the high costs of the former Dow plant in Texas were site specific and would not apply to a modern plant in Australia. The company has employed some ex-Dow personnel.

Energy prices have been a major concern but the company announced on 19 May 2000 the signing of a MOU with the SA Government over the supply of Victorian gas to Port Pirie. The additional competition in the supply of gas could lead to lower gas prices in SA. This in turn could overcome the high cost of power in SA, which has been one of the project's major hurdles. SAMAG are investigating the prospect of a third party constructing a gas fired power station for the Port Pirie region.

Besides the need for low cost energy, other hurdles are thought to be the need for an offtake agreement with an Automotive company and securing the necessary finance. The company advises that it has made "significant progress toward securing suitable offtake arrangements". SAMAG expects financial closure by February 2001.

Batchelor Magnesium Project - Northern Territory

Mt Grace Resources' Batchelor Magnesium Project has the advantage of low capital costs as the project could start with a $30m plant producing 5 000 tonnes with more capacity added incrementally. The project also has the advantage of the financial involvement of a substantial Australian company, Multiplex.

Mt Grace Resources is a junior exploration company (net assets $4.6m) whilst Multiplex is a large Australian construction company.

The Mt Grace project is the only Australian project proposing to use thermal technology. Which typically has lower capital costs but higher operating costs than electrolytic processes. However, conventional proven technology will not be used but the unproven Heggie thermal technology has been chosen. The Heggie process has been demonstrated at a scale of 200 tonnes per annum. Mt Grace and Multiplex propose to build a 1 000 tonne per annum pilot plant whilst a commercial plant will have a capacity of 5 000 tonnes per annum. The technology, which has been developed in Australia, uses aluminium scrap as the reductant and a plasma arc furnace in place of a conventional furnace.

The project's disadvantages include the commercially unproven nature of the Australian developed Heggie thermal technology and the high cost of power in the NT. In addition, it will be necessary to import aluminium scrap or transport it from southern and eastern Australia and no offtake agreement has been negotiated.

Woodsreef Project - New South Wales

Golden Triangle Resources' Woodsreef project in NSW proposes to produce magnesium from asbestos tailings. This type of process has been demonstrated by Canada's Noranda which is building its own A$750m, 63 thousand tonne per annum magnesium project in Canada. However, Golden Triangle is developing its own technology in conjunction with the joint Israeli-Russian Laboratory for Energy Research in Israel.

Golden Triangle is a junior exploration company with net assets of $5.1m. Golden Triangle was also considering a project based on the Main Creek magnesite deposit in Tasmania. However, the company has abandoned this project in favour of the Woodsreef project.

The smelter location is yet to be determined. Options include the Hunter Valley or adjacent to the mine site.

Project impediments include the need to prove up the technology and to negotiate a product offtake agreement.

Crest Resources - Tasmanian Magnesium Project - Tasmania

This project envisages a mine at the Arthur-Lyons River magnesite deposit and a smelter at Bell Bay. The existing Bell Bay power station would be converted to gas firing with gas being supplied from Bass Strait via a gas pipeline from Longford in Victoria.

Crest Resources is a junior exploration company with net assets of $12.1m.

The Crest project proposes to use the Russian UTI/VAMI route which is used by Israel's Dead Sea Magnesium project. The Crest project has been setback by the withdrawal of Multiplex from the project. In addition, the Tasmanian Government has had difficulties in quoting an electricity price because of uncertainties associated with the projects to bring power and gas across Bass Strait.

The company announced in May 2000 that it would seek to raise $9.3m through a share issue in order to progress the project. The company has also announced that it has secured a new Managing Director for the project. However, the company has not released the new Managing Director's name.

Bass Resources - Tasmania

Bass Resources is discussing with Pasminco the possible purchase of the Main Creek magnesite leases relinquished by Golden Triangle Resources. Alternatively, the company could purchase magnesite from the Savage River iron ore mine where magnesite deposits exist. Bell Bay is being considered as a smelter location. Bass Resources is a junior exploration company.

Hazelwood Power Station - Victoria

Hazelwood Power Station at Morwell in Victoria proposes to extract magnesium metal from its power station fly ash. A $270m project producing 34 thousand tonnes of magnesium is under consideration.

HCC - Pilbara Magnesium Project - Western Australia

The project is a joint venture between HCC, a private Perth based company, and Multiplex. The project envisages the production of magnesium from bitterns which are a waste product from salt production at Dampier.

Anaconda Nickel - Murrin Murrin Western Australia

Anaconda Nickel (net assets $203m) has discovered a magnesite deposit 40km from its Murrin Murrin nickel project. Preliminary studies for a magnesium metal project are underway.

ROLE OF GOVERNMENT

The Federal Government became involved in the development of the Australian magnesium industry in the late 1980s when QMC was considering a magnesium metal project based on the Kunwarara magnesite deposit. QMC was unable to negotiate access to magnesium metal production technology from existing foreign owned companies and furthermore the company was unable to utilise the R&D assistance programmes that existed at that time. In 1991, the Government provided a $20m loan towards a $50m R&D program involving a pilot plant.

The project was delayed over the need to find suitable partners and it was 1999 before the pilot plant was commissioned and successfully produced its first metal. The proponents recently completed a full feasibility study which found that a commercial scale plant would be viable.

From an early stage it was recognised that the development of a new industry in Australia required more than just a smelter proposal. The Queensland Government, in addition to contributing $5m towards the R&D project, was also instrumental in getting the CRC for Alloy Solidification Technology (CAST) established at Pinjarra Hills. This has allowed the development of “know how” in casting magnesium in ingots and in casting automotive parts.

In parallel with the Queensland initiatives, the Commonwealth established a Light Metals Strategy in the early 1990s:

- to promote the use of magnesium to the Australian diecasting industry
- to produce information booklets on the use of magnesium in automotive components
- to run seminars promoting the use of the metal in the Australian diecasting industry
- to promote investment in magnesium auto-parts manufacture in Australia.

The Light Metals Strategy does not have its own funding but has made use of funds available in other portfolio programs, particularly in the areas of Technology Diffusion, the Automotive Action Agenda and Invest Australia. In 1999, the Department issued a report entitled *Magnesium Opportunities in Australia* and the March 2000 edition of the Department’s Ascent magazine ran several feature articles on Australia’s magnesium future.

KEY ISSUES

Finance

From the above brief analysis, it will be noted that all of the project proponents other than QMC and Anaconda Nickel have net assets of less than $20m. Furthermore, only QMC and Anaconda Nickel have a track record in developing projects. The absence of large Australian or overseas resource companies is a notable feature of the projects.

Underpinning the viability of the QMC project is a long-term take-or-pay offtake agreement with Ford Motor Company covering 45,000 tonnes of magnesium metal a year. None of the other projects have announced offtake agreements.

Technology

Access to technology is critical to the success of a magnesium project. AMC have proved their technology in a pilot plant. SAMAG, Crest and HCC propose to use existing proven technology. Grace Resources and Golden Triangle propose to prove up new technology. The other projects have not disclosed or decided on which technology they propose to use.

Tariff Barriers

The US has a 8% tariff on magnesium and 6.5% on magnesium alloy; the EU has tariffs of 5.3% for pure magnesium and 4.3% for magnesium alloys. Two of the major magnesium producing countries, Canada and Israel, have preferential access to the US market. These tariffs will give Australian producers a significant disadvantage against competitors.

Activities of Foreign Governments

Exports of magnesium from China and the former Soviet Union have increased from nil in 1990 to some 100,000 tonnes per annum now. This is despite the imposition of import restrictions in both the US and EU. China is estimated to have some 200 magnesium production facilities, many of which are thought to have been built with government assistance. The average production per Chinese smelter was only 600 tonnes in 1998 compared to 33 000 tonnes in the western world. Given their small scale and the high cost thermal technology they use, it is difficult to see how such producers could survive in a market economy.

Greenhouse

There are two greenhouse issues associated with magnesium production. Firstly, significant carbon dioxide is generated in the production of magnesium. Carbon dioxide is released as a result of the conversion of magnesite (magnesium carbonate) into magnesia (magnesium oxide) or magnesium chloride and carbon dioxide is generated through the energy used in the process (mostly electricity). The second issue is that sulphur hexafluoride, commonly used as an inert gas to prevent hot metal from oxidising, is a greenhouse gas. The Australian Greenhouse Office April 2000 publication *Synthetic Gas Use in Non-Montreal Protocol Industries* goes into some detail about magnesium and sulphur hexafluoride. The publication is available on the Internet at: http://www.greenhouse.gov.au/pubs/ngs/synthetic_gas.pdf.

Counterbalancing the greenhouse gasses emitted in magnesium production is the greenhouse gas savings that result from the use of magnesium in automotive applications. The light weight of magnesium reduces fuel consumption and hence reduces greenhouse emissions. The industry claims that a life cycle analysis shows that magnesium has a net positive benefit in terms of greenhouse. However, a problem for potential Australian producers, who will export most of their production, will be that the emissions will occur in Australia and the savings in other countries.