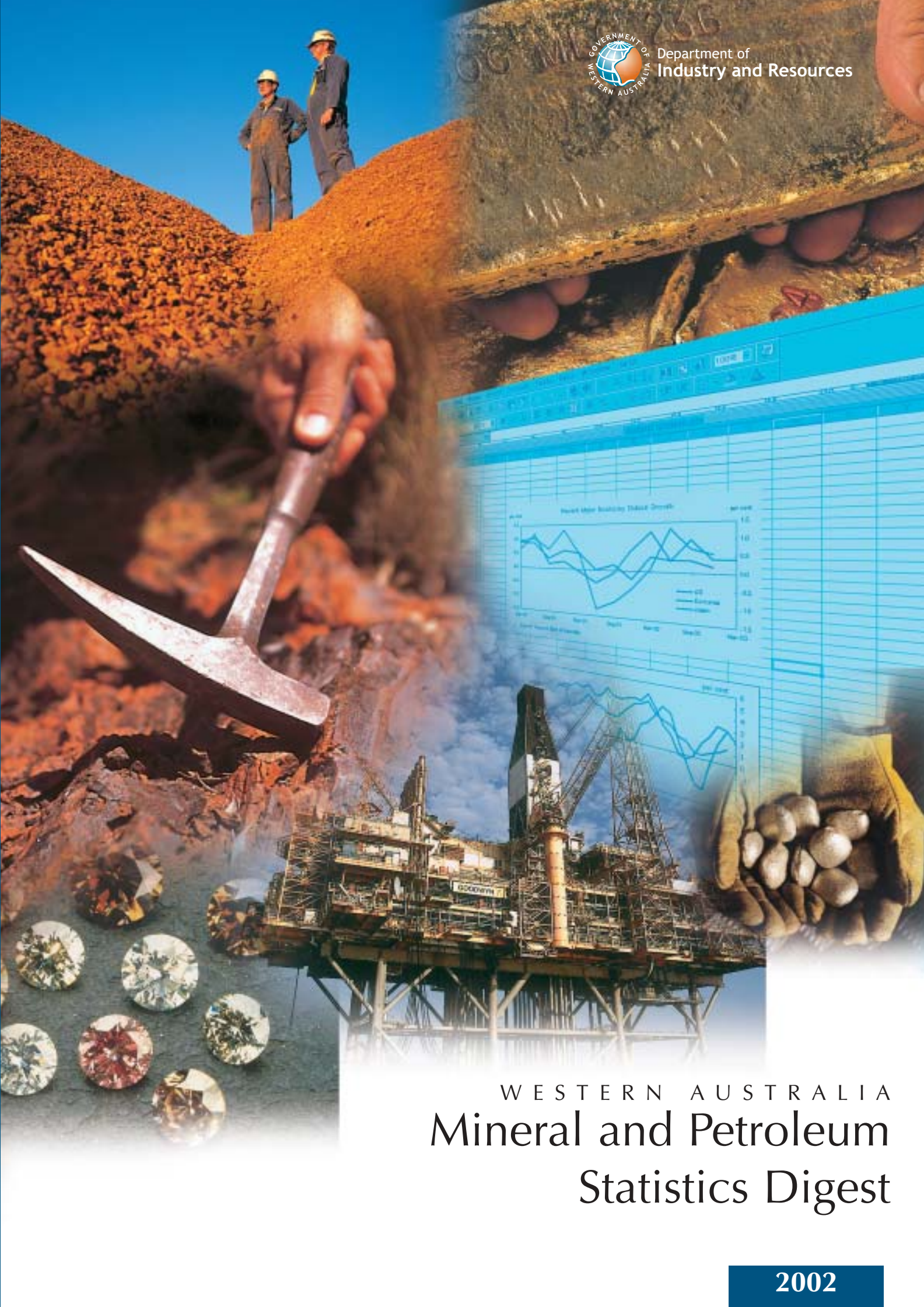




Department of
Industry and Resources



WESTERN AUSTRALIA
Mineral and Petroleum
Statistics Digest

2002

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Jim Limerick
Director General

Welcome to the Department of Industry and Resources' 2002 Statistics Digest. This publication contains the most comprehensive statistical information available on the Western Australian mineral and petroleum industry.

The Digest provides detailed quantity and value data, by commodity and industry sector in addition to figures on employment, royalty receipts, exploration, investment and principal producers. Incorporated with this data is an analysis explaining the performance of the various mineral and petroleum sectors. Numerous facets of the State's resource sector, including commodity price trends and Western Australia's position as a resource exporter, are also covered.

In 2002, Western Australia's resource sector achieved record-breaking production volumes in some mineral and petroleum commodities including oil, alumina, nickel and iron ore. However, due to adverse global commodity price conditions and an appreciation in the Australian dollar, growth in the value of Western Australia's mineral and petroleum industry remained at \$27 billion, the same value as in the previous year.

With the exception of gold, nickel and to a lesser extent oil, world events and lethargic world economic conditions saw a decrease in global prices for most commodities during 2002. Coupled with this, Australia's relatively high interest rates and a weaker US dollar played a part in forcing up the average value of the Australian dollar during the year. With most mineral and petroleum sales denominated in US dollars, the appreciation of the Australian dollar compounded the lower returns received from depressed prices.

This outcome needs to be seen though, in not just the context of global conditions, but also the industry's extraordinarily high growth rates of the previous two years.

Furthermore, despite the check on growth, it is noteworthy that the State's value of mineral and petroleum production has more than doubled in the last ten years. It has demonstrated a solid average annual growth rate of 8.5% per annum since 1992, far outstripping growth of the economy in general.

In releasing the Western Australian Minerals and Petroleum Statistics Digest for 2002 I would like express my appreciation to the many individuals and companies who have contributed to the preparation of this report, including the Australian Bureau of Agricultural and Resource Economics (ABARE), the Australian Bureau of Statistics (ABS) and the Western Australian Treasury Department.

A handwritten signature in black ink that reads "J. Limerick". The signature is written in a cursive style with a large, decorative initial "J".

1. ECONOMIC AND SOCIAL ENVIRONMENT

1.1 Global Economy

The global economy saw a period of slower growth towards the end of last year that has persisted into 2003. The slowdown has been pervasive across the key industrial economies, the US, Europe and Japan. Contrasting with this disappointing performance has been the non-Japan Asian region where performance has generally remained strong, particularly in China and South Korea. Australia and New Zealand have also performed well relative to most economies.

While recent events saw the dissipation of two risks to global growth, a prolonged Iraq war and an associated jump in oil prices, other risks have either continued or new ones arisen. These include uncertainties about the impact of the SARS virus in the Asian region, financial risks around the stability of Japanese and European financial systems, potential for a sharp fall in the US dollar and continued geopolitical risk in the Middle East and the Korean Peninsula.

United States

Global economic growth in the past eighteen months has had an unhealthy heavy dependence on the US economy. There is a risk that the US economy's ability to stabilise world activity is weakening. Over the past six months, the US recovery has failed to become self-sustaining with a softening in private consumption which has been the driving force of the recovery to date. As yet, there is little sign of the crucial element of a sustainable recovery, a pick-up in business investment.

In the March quarter of 2003, US GDP rose by a modest 0.4%, translating to an annual rate of 2.1%. The housing sector remained robust but consumption growth continued to weaken in the March quarter. Softer consumption reflects rising unemployment and low stock prices, which have eroded incomes and

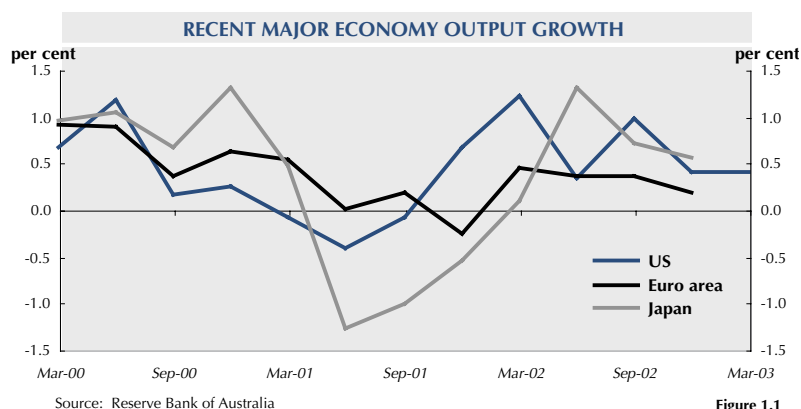


Figure 1.1

MAJOR ECONOMY OUTPUT GROWTH 2001 – 2004				
	Actual 2001	2002	Forecasts 2003	2004
World	2.3	3	3.2	4.1
United States	0.3	2.4	2.2	3.6
Japan	0.4	0.3	0.8	1
European Union	1.4	0.8	1.1	2.3
Germany	0.6	0.2	0.5	1.9
Non-Japan Asia	5	6.3	6	6.3
China	7.3	8	7.5	7.5
Newly Industrialised Asia	0.8	4.6	4.1	4.5

Annual percentage changes.

Source: IMF World Economic Outlook April 2003

For classification of countries see page 59.

Figure 1.2

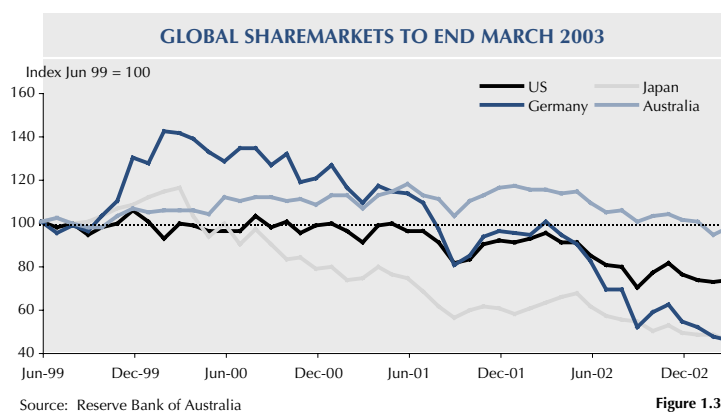


Figure 1.3

consumer wealth perceptions. Compounding overall weakness in the US economy, business investment fell in the March quarter, to be 1.3% lower than at the same time in 2002. Weak domestic demand in other economies also meant that net exports made a significant deduction from US growth over the year to March 2003.

The outlook is unclear in terms of whether there will be a pick-up in investment and self-sustaining growth in the short term.

On the positive side, the medium-term fundamentals, notably US productivity, are sound. Monetary policy

stimulus is still in the pipeline following the cut in the official interest rate to 1.25% in November 2002 and fiscal policy will see a large shift into deficit as a result of spending increases and tax cuts. The housing sector remains strong and new orders for capital goods rose in the early months of 2003. Another positive development is that the uncertainty associated with the potential for a prolonged conflict in Iraq has dissipated.

However, there are constraints on near-term growth. Household consumption is unlikely to provide the stimulus that it did in the 2002 recovery. Household debt is now high and falling stock prices have reduced household net wealth. Critically, the labour market is likely to remain soft.

Investment also remains constrained by excess capacity in the IT and manufacturing sector, low profitability levels, high levels of corporate debt and a lack of venture finance.

In addition, the US' current account deficit is now expected to reach over 5% of GDP in 2003 and related to this, the US has seen a significant deterioration in the long-term fiscal position. There is some risk that financial markets will respond to these issues by triggering a sharp decline in the value of the US\$. This would not only destabilise the US economy, but also reduce the export competitiveness of Japan and Europe, constraining the strongest recent source of growth in these economies.

The Federal Reserve has also raised the risk, though emphasised it as a 'minor' one, that the US economy may suffer deflation. The impact of deflation on the US economy would be uncertain and depend on the extent and persistence of price declines, whether consumers delayed spending to take advantage of lower prices and the extent to which rising unemployment offset the rises in real incomes caused by lower prices.

Japan

The Japanese economic recovery that began in the first half of 2002 has also faltered, as domestic demand remained weak and stronger exports to China were offset by weaker exports to the slowing US economy. Industrial production remained flat in line with exports growth.

With increased orders for machinery and improving profitability, some signs of recovery in manufacturing

have emerged, but other sectors have not improved significantly.

Deflation remains entrenched. Prices of goods and services have fallen for the past four years and declines have gained pace recently, causing deferrals in spending, rising real debt levels and limits on the effectiveness of Japanese monetary policy in boosting growth. Deflationary expectations appear to be worsening, holding out the risk that the economy will continue to soften as consumers and investors cut back further on spending plans. Illustrating this, growth slowed in the fourth quarter of 2002 due to a sharp decline in consumption growth and falling inventory levels.

The outlook remains for, at best, modest growth. Significant excess capacity, notably in manufacturing, is putting off a sustained recovery in investment. Domestic demand is likely to remain weak as record levels of unemployment continue to sap consumer confidence.

A key downside risk to the Japanese economy is a worsening of the banking sector prompted by further declines in equities or attempts to solve the sector's bad debt problems without adequate measures to build up bank capital. On the positive side, the swift conclusion of hostilities in Iraq means that the potential for sharply higher oil prices have receded for the moment as have further shocks to consumer and investor confidence and Japanese equity prices.

Europe

Growth in Europe has been minimal since mid-2002, with GDP expanding negligibly in the December quarter of 2002. Industrial production remains flat with flagging manufacturing, construction and business confidence. Germany remains one of the weakest economies in the Euro region.

On the positive side, in the Euro area household consumption has continued to grow relatively robustly despite unemployment continuing to rise to 8.7% in March 2003 from its most recent trough of 8% in late 2001. Consumer confidence in the economic outlook has fallen, however, recently reaching nine-year lows.

In a response to falling inflation, the European Central Bank (ECB), cut Europe's official interest rate by 25 basis points to 2.5% in March 2003. However, the euro's

sharp appreciation against the US\$ has significantly offset easier monetary policy, with estimates that its appreciation is equivalent to up to a 100 basis points increase in the official interest rate.

While growth remains moribund in Germany, France and Italy, the UK economy has been a little stronger. However, even here, the first quarter of 2003 saw a softening in the economy, with services sector output weaker and retail trade slowing to a crawl. A recent sharp fall in the sterling should provide some assistance to the manufacturing sector, though its potential inflationary impact may deter the Bank of England from further reducing interest rates.

Non-Japan Asia

Growth in the Asian-Pacific region (excluding Japan) softened a little in the first months of 2003 following strong GDP growth of 6.3% in 2002. Growth remains resilient however, with the International Monetary Fund (IMF) forecasting growth of 6.0% in 2003.

In contrast with the major economies, the region has seen growth based on both domestic and external demand. This growth has been particularly impressive because it has occurred at a time when global trade, particularly in electronics, has been soft. In part, this performance reflects supportive macroeconomic policies and the impact of ongoing economic reforms in China and elsewhere in the region. There has also been further confirmation during the recent cycle that demand in China is now a key component of growth in the east-Asian economies.

Notwithstanding recent performance however, global trade remains a key underpinning for domestic demand in the region's economies that have large traded goods sectors.

Any further softening in world growth is a significant risk to the growth outlook for the region. The region's export earnings are a key driver of investment. In addition, the emergence of China as a growing market for exports of other regional economies is a double-edged sword. A vital risk facing China's economy and therefore resilience of the region's growth prospects is the extent of the impact of the SARS virus.

There has been some divergence in regional performance over the past year, largely reflecting trade performance. Growth in Indonesia has slowed due to a sharp fall in tourism in the wake of the Bali bomb

attack, while Hong Kong's growth rose following a sharp pick-up in tourism. The SARS virus is likely to have some ongoing impact on the region through its impact on tourism and confidence more generally.

The Global Outlook

Indicating its expectation that the recent slowdown may be temporary, the IMF has forecast that 2003 will see a modest improvement in global growth, up to 3.2% from a weak 3.0% in 2002. This should reflect a slowing in the United States being offset by slight (and lower than previously forecast) improvements in the still fragile and vulnerable recoveries of Japan and Europe. The non-Japan Asian economies should see resilient growth, though there is some uncertainty as to the impact of the SARS virus in the region. Global growth is expected to return to its long-term trend, around 4%, in 2004 as growth picks up in most economies.

1.2 National and Western Australian Economic Context

The national economy continued to grow over the past year, by 3.0% in the year to the December quarter 2002. While this represents a slowing of the strong growth of a year ago, the drought's negative impact on farm output was a key factor. Abstracting from the drought's impact, the non-farm sector continued to grow at close to 4% during the year to December 2002.

Domestic demand grew by 7% during 2002 with moderating consumption growth boosted by robust housing activity and an upswing in business investment.

Domestic demand should moderate from its 2002 level, as the housing cycle passes its peak. Continued employment growth should support consumption growth, while business investment provides the driving force for sustained recovery. If the world economy continues its modest recovery and the drought breaks, exports should provide some stimulus to growth. A continuation of the A\$'s sharp increase against the US\$ would however, temper any contribution from this area. Deterioration in global economic conditions is the major risk to the outlook for the national economy.

The Western Australian economy performed better than expected in 2002-03 despite the reduction of agricultural output caused by the drought. State final demand grew strongly and the State Treasury expects it to grow by

6¼% in 2003. Business investment has been a key driver of growth reflecting new resource projects and commercial sector construction. The housing sector has proved more resilient than expected, underpinned by low interest rates which have also supported robust growth in private consumption.

State Treasury expects Gross State Product (GSP) to grow strongly in 2003-04, forecasting it to rise by 4.5%, with recovery in agricultural production a key driver. Domestic demand however is expected to soften, reflecting a contracting dwelling sector and softer private consumption. Business investment though is expected to remain strong while net exports detract from growth, reflecting stronger investment-linked imports and still modest global trade conditions.

Exchange Rate

The Australian dollar continued to appreciate over the past year and a half, though its record against different currencies has varied. Against the US dollar it has risen by over 27%, from around US51 cents at the end of 2001 to over US64 cents in mid-May 2003. To a large extent the Australian dollar's rise has reflected a decline in the US dollar as capital has shifted from that slowing economy to other regions and currencies. The Australian dollar's performance against other currencies has been varied, depreciating by 2.7% against the strengthening euro and appreciating 13.1% against the yen, it has also appreciated against the Asian currencies. Net of these movements it has risen a substantial 14.6% against the trade weighted index.

The Australian dollar's appreciation is due to a number of factors. These have included a significant official interest rate differential with the US Federal Funds rate and the potential that this may widen given the softness in the US economy relative to that of Australia. In addition, strong international demand for Australian dollar bonds, reflecting the overall strength in the Australian economy and interest rate differentials, has provided support. Upgrade of Australia's foreign currency debt rating by Standard and Poor's in February and higher gold prices have also underpinned demand for the local currency.

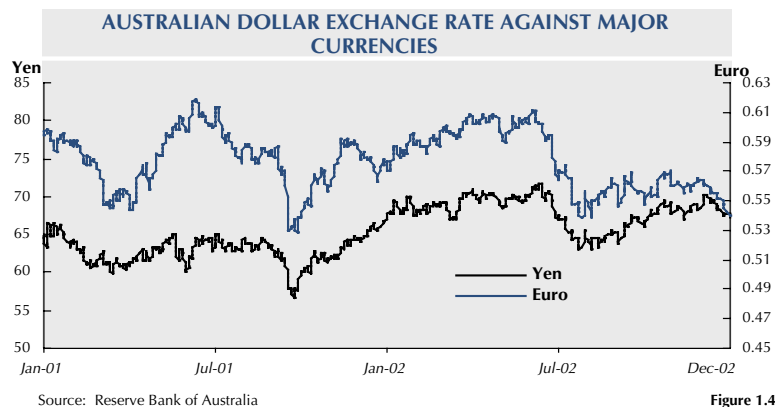


Figure 1.4

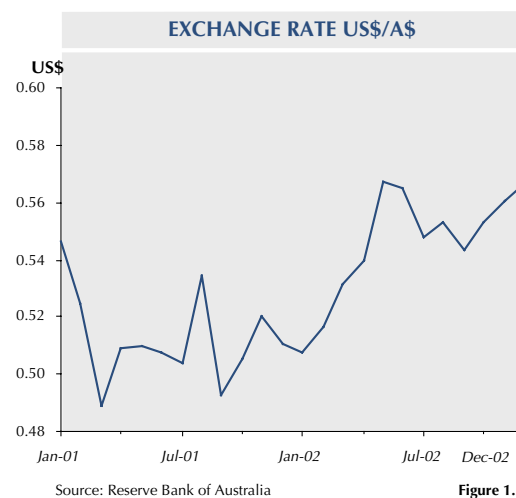


Figure 1.5

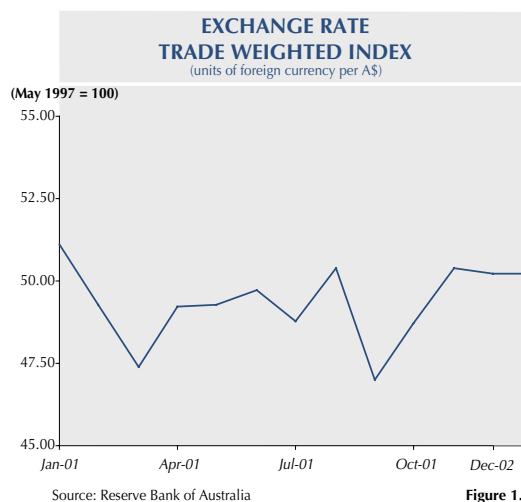


Figure 1.6

1.3 Policy Issues Affecting the Mining Industry

Electricity Reform

The process of reforming the Western Australian electricity supply industry has moved into the design and implementation phase with the formation of the Electricity Reform Steering Committee by the Office of Energy. The Steering Committee, supported by the Electricity Reform Implementation Unit, was established in January 2003 to implement the recommendations of the Electricity Reform Task Force (ERTF).

The ERTF released its report on the future structure of the electricity supply industry in Western Australia in October 2002. The ERTF was established by the Minister for Energy in August 2001 and was charged with making recommendations on disaggregating Western Power, establishing full retail contestability, establishing an electricity market and developing an electricity code.

The main objective of the reform program is to remove impediments to competition and to achieve sustainable lower electricity prices for all customers while maintaining a uniform tariff for residential and small business customers. This is to be done without compromising the reliability, security, quality and safety of electricity supply.

The main elements of the program are:

- Split-up of Western Power into four separate State-owned corporations comprising a State Generation business, consisting of all Western Power's South-West Interconnected System (SWIS); a State Retail business; a State Networks corporation, which would own the SWIS transmission and distribution infrastructure; and a Regional Power Corporation, which would own the North-West Interconnected System (NWIS) and isolated regional distribution systems.
- Full retail contestability should be established after the completion of disaggregation and the establishment of an electricity market, targeted for 2006 with a commencement of the lowering of the contestability threshold on 1 January 2005.
- Establishment of an electricity market, with large volumes of electricity traded through bilateral

contracts, supplemented and balanced by short-term bids traded through the Residual Trading Market (RTM).

- Development of an Electricity Code and regulation of the industry by the new Economic Regulation Authority.

A cost-benefit analysis concluded that competition facilitated by the report's recommendations could bring major cost reductions to consumers.

The Electricity Reform Implementation Unit's website is: www.eri.energy.wa.gov.au.

Sustainability

Sustainability has been recognised as a major issue for the resource industry. It has been instrumental in advancing the agenda through forums such as the Global Mining Initiative, International Council on Mining and Metals and participation in the 2002 Johannesburg World Summit on Sustainable Development.

In Western Australia, a major undertaking by the Government to produce a State Sustainability Strategy is underway. A public consultation draft of the Strategy was released by the Department of The Premier and Cabinet in September 2002 and the comment period closed in February 2003. This strategy encompasses a broad range of policy areas, aiming to identify:

- Critical sustainability issues for Western Australia;
- Barriers to achieving sustainability and how these will be overcome;
- Actions to promote and encourage long-term progress towards sustainability, including new initiatives, policy and legislative change and institutional reform;
- Short-, medium- and long-term goals for sustainability across regions and sectors;
- Research and development required to help solve long-term problems for sustainability;
- Examples of best-practice sustainability in different sectors in Western Australia; and
- Means of securing ongoing commitment to sustainability by Government, business and community.

In regard to the mining and petroleum industries, the draft strategy includes recommendations that:

- All major projects be assessed using sustainability criteria;
- A set of sustainability operating principles be developed for the mining sector, building on the work of the Global Mining Initiative; and
- Transparent processes be established to improve community awareness of the regulatory system for mining and mineral production.

Keating Review of the Project Approvals System

The Keating Review, which produced its final report recently, looked at Western Australia's Project Development Approvals Process. The main recommendations of the review were:

- Reducing the jurisdiction of the Wardens Court with a commensurate expansion of the role of the EPA;
- Greater use of timelines to improve levels of certainty and predictability, with a stop-the-clock mechanism to ensure that project approvals facing deadlines are not penalised for events beyond their control;
- Allowing the State to undertake environmental assessments on behalf of the Commonwealth; and
- An integrated approval system for projects of 'State significance'.

In sum, more than 50 recommendations have been made to better integrate State and Commonwealth agencies, improve cohesion in the approval system and remove overlaps and other inefficiencies. The resulting changes will affect large and small project proposals and create a more efficient, effective, certain and accommodating system that facilitates sustainable resource development.

The Ministerial Steering Committee (MSC) overseeing the recommendations of the report met in October 2002 and endorsed:

- Progressive implementation of recommendations by interagency working groups;
- Working groups producing implementation plans for non-contentious recommendations;
- Preparation of position papers by working groups

on contentious recommendations for MSC consideration; and

- Deferring action on recommendations regarding the proposed integrated approvals system.

The MSC resolutions were endorsed by Cabinet on 7 April 2003.

Greenhouse

Greenhouse gas emissions control is still a source of uncertainty for the mining and petroleum industries, although the Commonwealth Government has stated that it will not sign the Kyoto Protocol unless the United States also signs and developing countries commit to greenhouse gas reductions. Canada and Russia have indicated their intention to ratify the Kyoto Protocol, giving it enough signatories to come into force. In February 2002, the Commonwealth Government signed the joint Australia-US Climate Action Partnership to collaborate on research into climate change and in July 2002 announced 19 joint projects under its auspices.

The Commonwealth and State Governments are tackling greenhouse gas emissions through the National Greenhouse Strategy and are aiming to meet Australia's commitment under the Kyoto Protocol to reduce greenhouse gas emissions to 108% of 1990 levels by 2010, even if the Protocol is not ratified.

The State Government is also developing its approach to greenhouse gas abatement through the State Sustainability Strategy and Greenhouse Strategy. Approaches already being implemented include:

- carbon rights legislation;
- establishment of a Sustainable Energy Development Office;
- mandatory energy efficiency improvements for Government agencies; and
- improving the carbon efficiency of the Western Power network.

The Greenhouse Task Force has released an issues paper which can be downloaded at www.greenhouse.wa.gov.au/

Native Title

One of the major developments in native title in 2002 was the resolution of the Ward High Court decision, in which the Court found that the Miriuwung Gajerrong

people had significant native title rights over a large area of land in the East Kimberley. The Court found that native title did not entail any rights over minerals or petroleum under the ground where native title may apply. This has positive implications for current methods of collecting royalty payments on minerals and petroleum. The Court also found that the grant of a mining title did not wholly extinguish native title, but did extinguish the right to be asked permission or to have access in relation to the whole of the area of the lease.

A State Government initiative to improve the fairness and workability of the native title regime was the Wand Review of the State Government's General Guidelines for Native Title Determinations and Agreements. The review was released in November 2001. Among its key recommendations were:

- A summit of Government, the Federal Court, peak bodies and claimants to coordinate the resolution of native title applications;
- Rigorous assessment of evidence of connection to the country;
- Enhanced access to Government records that could assist claimants in compiling evidence in support of their application;
- An overhaul of State land-use and management laws to integrate processes for the recognition of native title and other rights of traditional owners; and
- A public education campaign to encourage agreement-making.

Progress is being made on implementing the recommendations of the Review and evidence guidelines for native title claimants were released by the Deputy Premier on 8 October 2002.

In another significant native title development, in December 2002 the High Court dismissed the native title appeal by eight members of the Yorta Yorta people of north-east Victoria. In a five-to-two majority, the court upheld an earlier Federal Court decision that the forebears of the Yorta Yorta claimants had ceased to occupy their land in accordance with traditional laws and customs. The court found the claimants had not established that they had continued to acknowledge and observe those laws and customs.

Following the High Court's decision against the claimants in the Yorta Yorta native title case, the State Government is also pursuing alternative means to native title to deliver land justice for displaced indigenous people in the southwest of Western Australia.

Removing the Backlog of Mineral Tenement Application

In April 2001, the Government established a Technical Taskforce to assess how mineral, petroleum and land title applications can be dealt with more efficiently, while recognising and protecting the native title rights of indigenous people.

The Taskforce released a discussion paper in early August 2001, which set out options for reducing the current backlog of some 11 000 tenement applications and preventing a backlog developing in the future. The Taskforce also provided its preferred option for dealing

Tenements in Force 1978 Act

	1996-97		1997-98		1998-99		1999-00		2000-01		2000-02	
	Number	000 ha	Number	000 ha	Number	000 ha	Number	000 ha	Number	000 ha	Number	000 ha
Prospecting Licences	8,212	1,100	7,525	992	6,242	809	5,827	745	5,512	711	4,964	634
Exploration Licences	4,718	38,279	4,505	35,993	3,463	23,732	3,394	20,687	3,162	18,152	2,899	18,556
Mining Leases	5,180	2,047	6,690	2,031	7,555*	2,263	4,865	1,829	4,841	1,803	4,820	1,774
Other	1,537	89	1,584	205			2,001	468	3,625	2,840	3,618	3,002
Mineral Claims & Other 1904 Act	310	34	309	34	307	34	194	22	186	21	186	22
Total	19,647	41,515	19,029	39,255	17,567	26,838	16,280	23,751	17,326	23,829	16,487	23,988

* Includes Other

Source: DoIR
Figure 1.7

with exploration and mining title applications. The final report of the Taskforce was released by the Government in December 2001.

One of the key recommendations of the taskforce was the introduction of extended exploration licences to mitigate the need for explorers to take out mining leases, with the consequent deferral of native title processes until productive mining is to take place.

Key actions underway on the Taskforce's recommendations are:

- A Heritage Protection Working Group is working to develop a protocol for heritage surveys preceding ground-disturbing exploration activities;
- Work is proceeding on draft transitional amendments to the *Mining Act 1978* to allow existing applicants for mining leases to apply for new exploration/prospecting leases; and
- A Mining Title Recommendation Working Group is considering long-term Mining Act amendments to prevent the backlog from recurring.

Bowler Inquiry

In April 2002, the Government announced a 'Ministerial Inquiry into Greenfields Exploration' to be carried out by Mr John Bowler, MLA, Member for Eyre.

The inquiry was tasked with investigating the reasons for the reduced levels of private investment in greenfields mineral exploration in Western Australia. It was also asked to recommend actions that State and Federal Governments could undertake to achieve levels of expenditure necessary for a sustainable future for this sector of the Western Australian economy.

Following extensive public consultation, the Bowler Inquiry submitted its report to the Minister for State Development in November 2002. The report's recommendations focused on tackling the decline in exploration activity through:

- Reducing the backlog of unprocessed mining title applications in line with addressing the issue of native title, as a pivotal measure to restore the industry;
- Increased provision of regional geoscientific data;
- Changes to the heritage protection procedures and support for native title bodies to expedite access to land;

- Establishment of a greenfields exploration title; and
- The introduction of investment incentives for smaller exploration companies such as flow-through share schemes.

The report was released for public comment in January 2003, and the results of that consultation have been compiled. A second report will be released in the near future.

Prosser Review and Mining Action Agenda

On 24 May 2002, the Commonwealth Minister for Industry, Tourism and Resources, the Hon. Ian Macfarlane MP, advised that the Standing Committee on Industry and Resources (chaired by The Hon. Geoff Prosser, MP) would inquire into and report on any impediments to increasing investment in mineral and petroleum exploration in Australia, including:

- An assessment of Australia's resource endowment and the rates at which it is being drawn down;
- The structure of the industry and role of small companies in resource exploration in Australia;
- Impediments to accessing capital, particularly by small companies;
- Access to land including Native Title and Cultural Heritage issues;
- Environmental and other approval processes, including across jurisdictions;
- Public provision of geoscientific data;
- Relationships with Indigenous communities; and
- Contributions to regional development.

Public submissions to the inquiry have been sought, and the Committee is currently holding public hearings to collect further information. The State Government is providing input into the inquiry through submissions drawn from the expertise gathered by the Bowler Inquiry.

On 12 September 2002 the Commonwealth announced a new Mineral Exploration Action Agenda, and in November 2002 a Strategic Leaders Group was formed to drive the process. The Action Agenda will address issues such as investment incentives, native title rulings, land access and environmental regulation to develop a set of strategies for the industry to encourage further investment.

2. EXPLORATION AND INVESTMENT

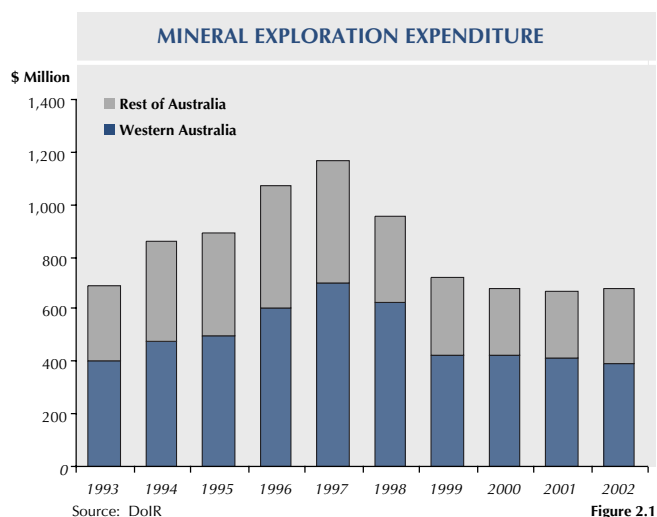
2.1 Mineral Exploration

In 2002, the level of mineral exploration expenditure in Western Australia was \$396 million. This was down by \$13 million or 3% on the previous year. Expenditure on mineral exploration in Western Australia nevertheless represented 58% of the national total (\$678 million).

Mineral exploration in Western Australia has now fallen in every year since 1997 and is now at levels slightly lower than the recessionary years of the early 1990s.

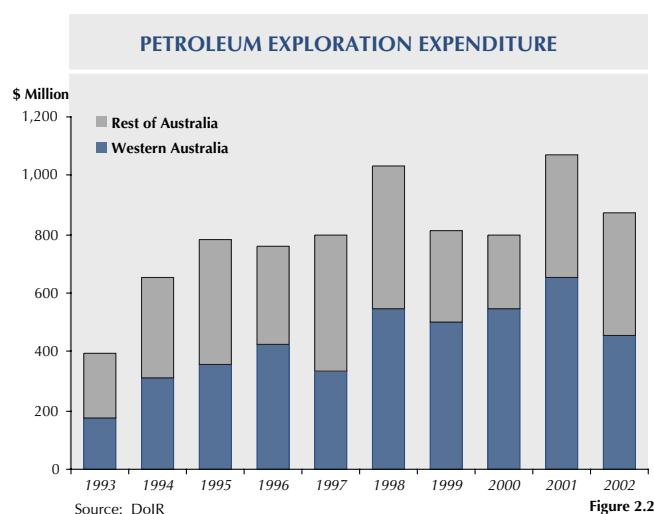
The fall in mineral exploration activity in Western Australia during 2002 was led by continued weakness in the gold sector, with gold exploration falling by \$8 million or 3%. The five-year decline in gold exploration expenditure since 1997 is already having an impact on gold production in Western Australia. Falls in exploration expenditure for base metals and diamonds were also significant.

Overall, mineral exploration in both Australia and Western Australia may still be described as fluctuating along the bottom of a trough with no definitive sign of recovery. These trends reinforce the importance of the steps being taken to bolster mineral exploration in the State.



2.2 Petroleum Exploration

Petroleum exploration expenditure in Western Australia had been at very high levels during the late 1990s. However, during 2002 Western Australia experienced a dramatic slow-down in both onshore and offshore petroleum exploration. Substantial falls in petroleum



exploration expenditure in both Australia and Western Australia were reported for 2002. ABS data showed that petroleum exploration expenditure in Western Australia in 2002 declined by 30% (\$193 million) to \$457 million.

In addition, the proportion of Australian petroleum exploration spent in Western Australia has fallen from around 70% to 52% in only two years. Significantly, the proportion of petroleum exploration expenditure directed offshore remains at high levels, averaging around 75% for calendar 2002.

In terms of actual drilling activity, only 51 wells were drilled during the year, compared with 75 in 2001. Of the 51 wells drilled in Western Australia, 25 were new field wildcats (down from 44 in 2001), 18 were extension wells and eight were development wells. The majority of drilling occurred in the offshore Northern Carnarvon Basin where 22 exploration, 13 extension and five development wells were drilled. Within the Perth Basin, an additional two exploration and five extension wells were drilled.

Offshore seismic 2D activity during 2002 also dropped significantly from levels in 2001. A total of 11 322 line km of new 2D seismic data was acquired in 2002, compared to 39 785 line km in 2001. 3D seismic activity also followed this trend and decreased to 2 177 sq km from 8 186 sq km in the previous year.

The potential discovery rate in 2002 was 28% and seven oil discoveries were made from the 25 new field wildcats drilled.

Positively though, industry expectations of petroleum exploration expenditure in Australia during the first half of 2003 are for significant increases – with increases of 37% for offshore and 26% for onshore areas.

2.3 Investment

ABS private new capital expenditure statistics for 2002 indicate that mining accounted for around 50% of Western Australia’s total investment, compared to around 54% in 2001. The total value of State investment rose by 5.9% from around \$5.97 billion in 2001 to \$6.32 billion in 2002. In terms of Western Australian mining investment, it fell slightly by around 2.2% from \$3.24 billion in 2001 to \$3.17 billion in 2002.

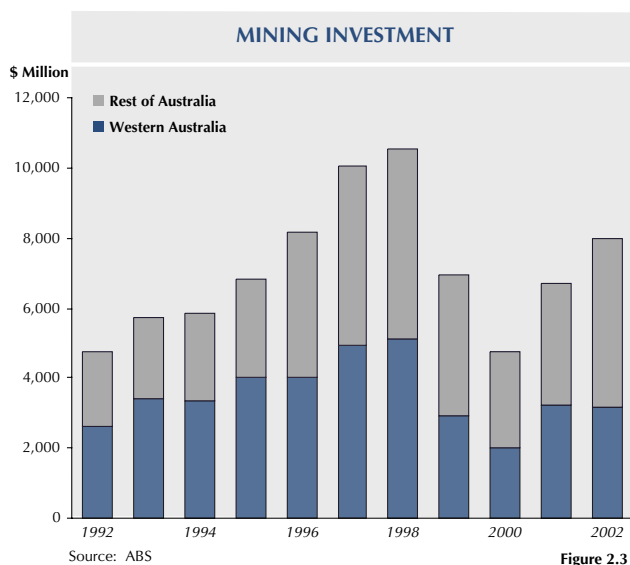


Figure 2.3

Total national mining investment in 2002 was \$8.0 billion for which Western Australia accounted for around 40%. It is important to note that these figures do not capture all mining investment because the ABS uses classifications specified in the 1993 edition of the Australian and New Zealand Standard Industrial Classification (ANZSIC) (ABS Catalogue number 1292.0). Accordingly, mining is broadly defined as the extraction of minerals occurring naturally as solids such as coal and ores, liquids such as crude petroleum and natural gas. Downstream mining activities such as smelting of minerals or ores (other than preliminary smelting of gold) or refining are classified as manufacturing activities under the ANZSIC. Products such as coke and alumina are also included in the ANZSIC manufacturing category.

The ABS released a paper that addressed some of the above classification issues relating to the Western Australian resource sector in June 2002 (as a feature article in ABS Catalogue number 1367.5). However, the resulting investment data covered only the State economy not national, and did not include data for the financial years 2000–01 and 2001–02.

Some notable Western Australian mining sector projects currently under construction or committed include:

- Burrup Fertilisers’ ammonia plant on the Burrup Peninsula;
- BHP Iron Ore’s iron ore mine – Mining Area C;
- Hismelt’s pig iron plant in Kwinana; and
- Newcrest Mining’s Telfer Deeps gold mine expansion.

3.1 Overview and Outlook

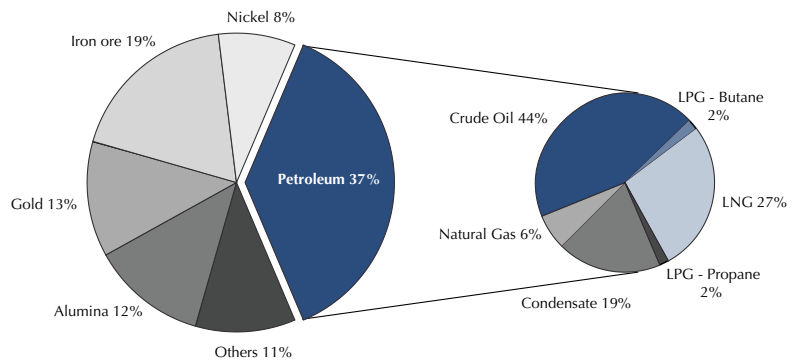
In 2002, due to adverse global commodity price conditions and an appreciation in the Australian dollar, growth in the value of Western Australia's mineral and petroleum industry stabilised at \$27 345 million. This was almost the same value as in the previous year of \$27 368 million, but follows two years of record growth. The outcome needs to be seen in the context of subdued world commodity prices in 2002, an increase in the value of the Australian dollar against the US currency and the industry's previous extraordinarily high growth rates.

With the exception of gold, nickel and to a lesser extent oil, world events and lethargic world economic conditions saw a decrease in global prices for most commodities during 2002. Coupled with this, Australia's relatively high interest rates and a weaker US dollar played a part in forcing up, by 5%, the average value of the Australian dollar during the year.

Physical sales volumes for most of the State's mineral and petroleum commodities actually increased during the year, to record-breaking levels for many sectors including oil, alumina, nickel and iron ore. However, most sales are denominated in US dollars and the appreciation of the Australian dollar compounded the lower returns received from depressed prices.

Alumina, Western Australia's third-largest resource sector, for example, experienced a 4% sales increase to a record 11.1 Mt. But depressed prices and a stronger

SALES BY COMMODITY

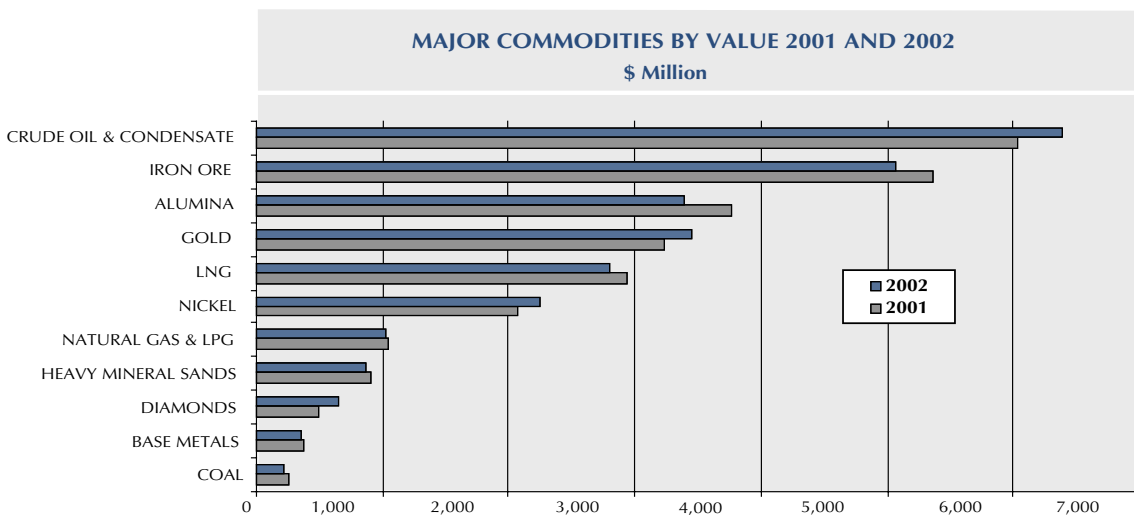


Source: DoIR

Figure 3.2

Australian dollar translated to the value of these sales dropping by \$366 million or 10%. Similarly, the State's burgeoning iron ore industry attained another record with sales output climbing to 172 Mt, but last year's price cuts and climbing Australian dollar meant that the value of sales suffered a \$310 million drop to \$5.1 billion. Likewise, while the volume of liquefied natural gas (LNG) sales increased slightly, the stronger Australian dollar caused the value of sales to drop by \$156 million.

Counteracting such drops in value, a 10% increase in the State's crude oil and condensate production to a record 139 million barrels and a 59% increase in diamond sales helped boost the value of resource sales by \$363 million. A substantial increase in world gold and nickel prices in 2002 also played a key role in helping to at least maintain the State's overall value of resource sales.



Source: DoIR

Figure 3.1

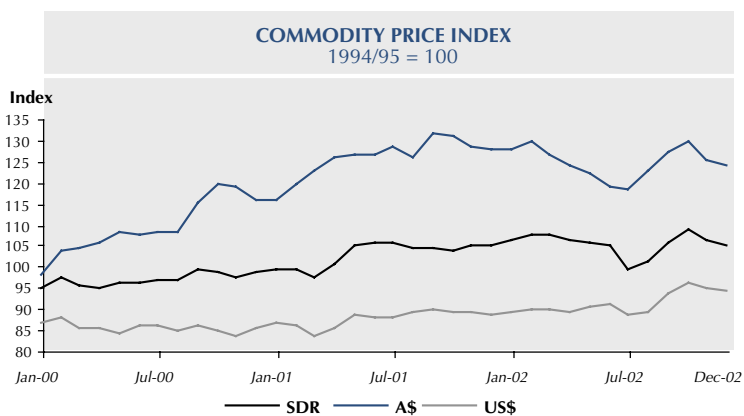
Despite the check on growth in the Western Australian mineral and petroleum industry during 2002, it is noteworthy that the value of mineral and petroleum production has more than doubled in the last ten years ago. It has demonstrated a solid average annual growth rate of 8.5% per annum since 1992, far outstripping growth of the economy in general.

base metals component of the index, the non-rural commodity price index fell by only 1% on the previous year. The small decrease in the non-rural commodity price index during 2002 can be explained by the significant price increase in gold and to a lesser extent oil, which offset the 5% appreciation of the Australian dollar relative to the US currency in 2002.

3.2 Commodity Price Index

The Reserve Bank of Australia (RBA) produces a monthly commodity price index comprising non-rural commodity prices. Commodities included in the index are both steaming and coking coal, LNG, gold, iron ore and base metals consisting of aluminium, copper, nickel, zinc and lead. The RBA also produces a separate index comprising just the latter group of base metals.

In 2002, in Australian currency terms, despite a 9% fall in the average price level for the



Source: Reserve Bank of Australia

Figure 3.3

Reserve Bank of Australia (RBA) Commodity Price Index

The Reserve Bank of Australia Commodity Price Index is based on the price of 17 major commodities exported by Australia. These commodities collectively account for around two-thirds of total commodity exports. The index is apportioned into three sections – rural, non-rural and base metals.

The non-rural index comprises base metals (which consists of aluminium, copper, nickel, zinc and lead), gold, coking coal, steaming coal, iron ore and LNG. The index is compiled monthly and is expressed in US dollars, Australian dollars and Special Drawing Rights (SDR).

The RBA's index, expressed in US dollar terms is useful because most commodities are traded in world markets in US dollars. However such an index is subject to changes in the US dollar exchange rate (as it is based on spot prices). In this respect, the SDR index is a better indication of underlying supply and demand for commodities than the US dollar index.

SDR is a unit of account used by the International Monetary Fund (IMF). Its value is based on a basket of currencies comprising the euro, Japanese yen, English pound and US dollar. Weights are assigned to each of these currencies to reflect their relative importance in world terms. The RBA expresses the SDR component of its index in US dollar terms, with commodity prices derived from the London Metal Exchange and Bloomberg and converted to monthly averages of daily data.

Alternatively, the Australian dollar index is useful for gauging the domestic currency price received by Australian commodity exporters as it reflects the interrelation between world commodity prices and the Australian exchange rate. For example, if prices in foreign currency terms remain unchanged but the Australian dollar depreciates, this will be recorded as a favourable upward shift in the index, which would not be evident in either the SDR or US dollar, indexes.

The RBA index is a fixed-weight Laspeyres index, using 1994-95 as the base year and excludes crude oil. The index is re-based every five years in order to make long-run reliable comparisons, unlike the national accounts that are re-based annually to track short-run movements. Base-period weights indicate the relative importance given to individual commodities. They are based on gross exports thus explaining the omission of crude oil (for which Australia is a net importer) and correspond to the export value of each commodity as a share of total exports. These weights change over time to reflect changes in the composition of commodity exports. Movements in the index from one period to the next reflect underlying price movements and do not take into account changes in volumes.

3.3 Petroleum

In 2002 world oil prices increased from under US\$20/bbl in January 2002 (average of Brent, Tapis and WTI prices over the course of the month) to nearly US\$30/bbl at the end of the year. Overall, in 2002 prices averaged around US\$25.50/bbl which was 2% up on the previous year's average of US\$25/bbl. Also, the Australian dollar, at US54.39 cents during 2002, was 5% up on 2001 when the average was US51.74 cents.

Firmer oil prices and a stronger Australian dollar saw the sales volume of condensate and crude oil in Western Australia grow faster than the value of sales in 2002. Western Australia's condensate and crude oil sales increased by 14% and 8% to record levels of 43 and 96 MMbbl, respectively. However, reflecting the appreciation in the value of the Australian dollar against its US counterpart, the value of condensate and crude oil sales increased by a lower rate in 2002 — condensate up 8% to \$1 929 million and crude oil up 5% to \$4 457 million.

Western Australia's liquefied natural gas (LNG) sales in 2002 were marginally up by 1% to 7.6 Mt. Due to the stronger Australian dollar however, LNG sales value suffered a 5% drop to \$2 791 million.

The decrease in the value of LNG sales combined with a near 10% fall in LPG sales negated much of the increases attained by crude oil and condensate. As a result, the overall value of Western Australia's petroleum sales increased by only 2% in 2002 to \$10 200 million, despite total sales of petroleum (by volume in terms of oil equivalent) in 2002 increasing by 6.5%. This result is still impressive given the higher sales value base the industry has been operating from since the 106% increase in sales value achieved in 2000.

The petroleum sector retained its dominant position in the Western Australian economy in 2002. The share in the State's total value of mineral and petroleum sales accounted for by the petroleum sector remained static in 2002 at 37%. Crude oil is the major petroleum product, accounting for 44% of total petroleum sales, followed by LNG (27%) and condensate (19%).

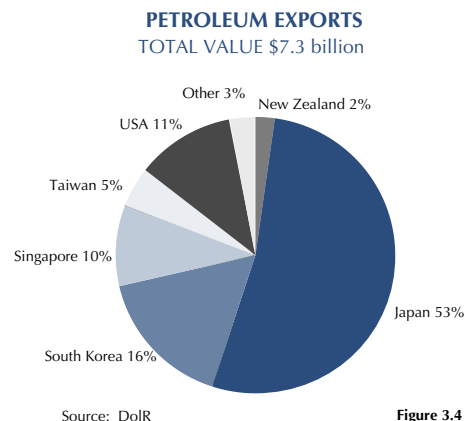


Figure 3.4

Crude Oil

Western Australia's crude oil sales reached a new high of 96 MMbbl in 2002, up by 8% on the previous year. This was largely due to a full year of production from the Legendre oil field, increased output from Wanaea and commencement of production from other new fields. World oil prices rose towards the end of 2002 and on average, over the course of the year, were 2% higher compared to 2001. The price increase was negated however by a 5% appreciation in the exchange rate of the Australian dollar relative to the US dollar. Consequently, the value of Western Australia's crude oil sales increased by 5% in 2002 to \$4 457 million.

Crude oil reinforced its dominant position in the petroleum industry in 2002. The share of total petroleum sales in Western Australia accounted for by crude oil increased by one percentage point to 44% from 43% in 2001.

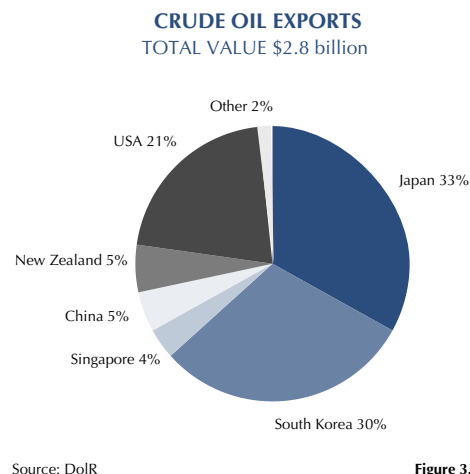


Figure 3.5

Crude oil exports from Western Australia were up by 5% to \$2 838 million in 2002. Major overseas markets for Western Australia's crude oil in 2002 included Japan (absorbing 33%), South Korea (30%) and the United States (21%). Compared to 2001, crude oil exports to Japan increased significantly at the expense of Singapore, China and other countries.

Oil was produced from 39 fields in Western Australia in 2002. The largest oil producing field is Wanaea. During 2002, the Wanaea field alone produced 28.7 MMbbl, accounting for nearly 30% of the State's total. Other fields with an output exceeding 1 MMbbl in 2002 included:

- Legendre North (9.2 MMbbl);
- Griffin (8.0 MMbbl);
- Cossack (6.4 MMbbl);
- Hermes (5.6 MMbbl);
- Stag (5.3 MMbbl);
- Chinook–Scindian (5.1 MMbbl);
- Buffalo (4.7 MMbbl);
- Wandoo (4.3 MMbbl);
- Barrow Island (3.6 MMbbl);
- Simpson (3.1 MMbbl);
- Lambert (3.0 MMbbl);
- Legendre South (2.1 MMbbl);
- Laminaria East (1.6 MMbbl);
- Roller (1.4 MMbbl); and
- Saladin (1.1 MMbbl).

To deal with the rapid decline in production from the Laminaria field, Woodside Energy Ltd and its joint venture partners completed the \$123 million Laminaria phase II development consisting of two additional infill production wells in June 2002. Initial production from these wells increased the combined field production from 75 000 to 140 000 bbl/d.

A number of new fields commenced oil production in Western Australia in 2002. These included Gibson, South Plato, Little Sandy, Victoria and Pedirka in the offshore Carnarvon Basin and Hovea in the onshore Perth Basin. The Harriet Joint Venture, comprising Apache Northwest, Kufpec Australia Pty and Tap

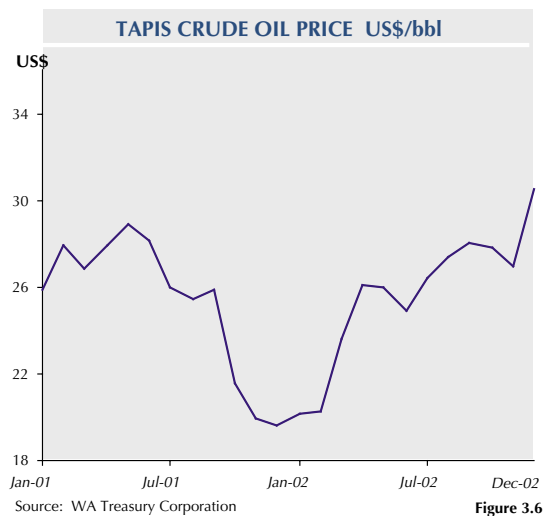


Figure 3.6

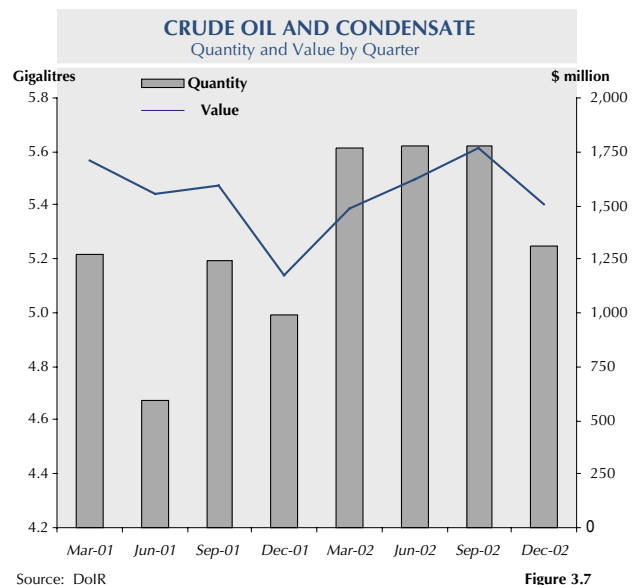
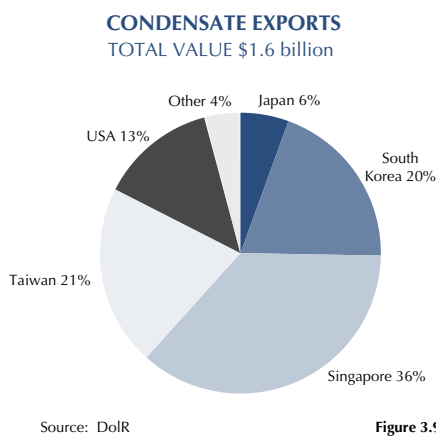
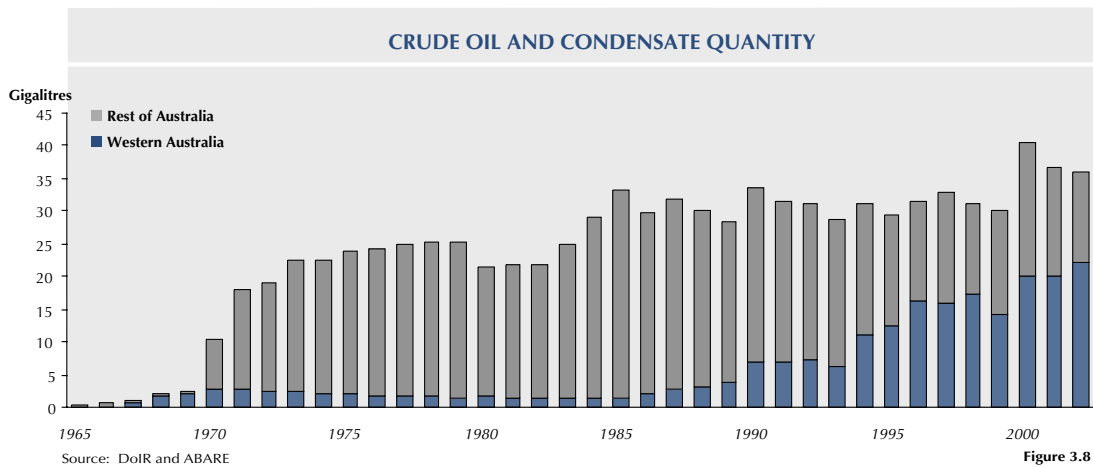


Figure 3.7

brought new wells in the Simpson field and the nearby Gibson–South Plato oil field into production in late 2002. ARC Energy and its joint venture partner Origin Energy concentrated their activity on the development of the Hovea oil field in 2002. The Hovea development is the first commercial oil discovery in the Perth Basin since 1966 and the first onshore oil field in Western Australia brought into commercial production in the past 20 years. Total output from these new fields in 2002 was about 1.65 MMbbl.

Condensate

Sales volumes of condensate in Western Australia increased by 14% to a record high 43 MMbbl in 2002. This was largely due to a full year's production from the Athena and Echo–Yodel fields. Again however,



appreciation of the Australian dollar eroded the value of this increase with condensate sales rising by 8% to \$1,929 million.

Condensate is a by-product from offshore gas fields. There were 27 fields producing condensate in Western Australia in 2002. The Goodwyn field remained the largest condensate contributor in the State. In 2002, it produced 19.1 MMbbl of condensate, accounting for about 43% of the State's total. Nevertheless, the Goodwyn field's share in total production has shrunk significantly compared to 66% in 2001. Echo-Yodel which commenced production in late 2001 became the second largest condensate field, producing 12.5 MMbbl of condensate or 28% of the State's total in 2002, surpassing the Perseus-Athena field (7.6 MMbbl or 17%).

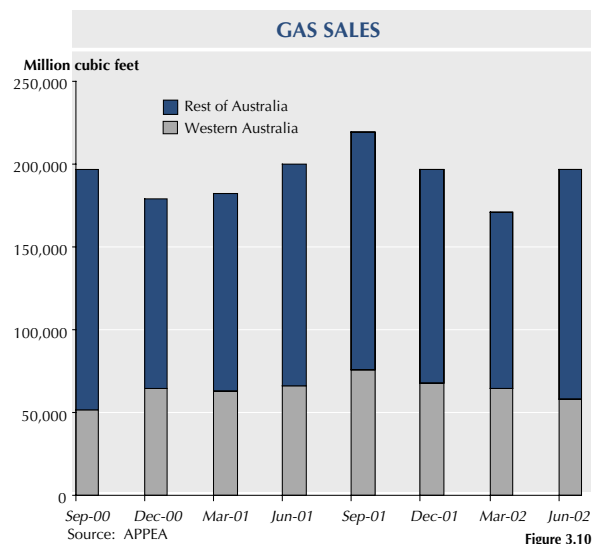
In 2002, \$1.6 billion (or 36%) of Western Australia's condensate was exported. This was down by 6% on the previous year's \$1.7 billion. Singapore surpassed

Taiwan in 2002 and became the largest condensate export market, accounting for 36% of the State's total exports. Condensate to Taiwan fell significantly from \$626 million in 2001 to \$339 million in 2002, resulting in Taiwan's share decreasing from 36% to 21%. Other major condensate export destinations were South Korea (20%) and the United States (13%).

Liquefied Natural Gas (LNG)

LNG is Western Australia's most valuable petroleum product. In 2002, sales were marginally up by 1% to 7.6 Mt. Due to price lags and contractual arrangements which characterised the State's LNG sales, the value of LNG shipments did not fully benefit from the slightly higher oil prices. This, in combination with the stronger Australian dollar translated to a 5% drop in sales value to \$2 791 million.

LNG has been the second-largest sector within Western Australia's petroleum industry since 2000. In 2002, LNG accounted for 27% of the State's total petroleum



sales, down slightly on the previous year's 29%.

The North West Shelf Gas Project is the only LNG project in Australia. Japanese power utilities have been the principal purchasers of Western Australia's LNG since 1989. In 2002, the North West Shelf Venture (NWSV), consisting of Woodside Energy, BP, ChevronTexaco, BHP Billiton, Shell and Japan Australia LNG (MIMI), delivered 127 cargoes of LNG to Japanese customers. In addition to the contract sales, three spot cargoes were sold to Korea Gas Corporation and one cargo to BP Gas Marketing in 2002.

The \$2.4-billion expansion of the NWSV's gas processing facilities remained a major focus of development efforts by the LNG industry in 2002. Construction of the fourth LNG processing train commenced in September 2001 and was 60% complete by the end of 2002. This facility will have the capacity to process 4.2 Mt/a of LNG. First LNG production from the fourth train is expected in mid-2004. Work on the second trunkline, which started in June 2002, was more than 30% complete by December. The trunkline will provide additional capacity to meet expected demand from gas-related industries on the Burrup Peninsula and overseas customers.

To support the expansion, an LNG ship at an approved capital investment of \$300 million and a capacity of 137 500 m³ is being built in South Korea with the first steel being cut in September 2002. Delivery of the new ship is expected in early 2004.

In 2002, the Western Australian LNG producer continued to successfully market LNG into the north Asian region. With the announcement in August 2002 that Australia LNG (the NWSV's marketing agency outside of Japan) had been selected as the preferred supplier to China's first LNG project in the Guangdong Province in southern China, the Western Australian LNG industry broadened its customer base beyond its long-standing relationships with Japanese customers. Sales and Purchase Agreements were signed in October 2002 for the supply of approximately 3.3 Mt/a of LNG for 25 years, starting in 2006. The \$25-billion contract is the biggest export deal with a single customer in Australian history. It will further strengthen LNG's role in Western Australia's petroleum industry in the future.

Natural Gas

In addition to gas used as feedstock for LNG production,

Western Australia also produces natural gas for domestic State consumption in industry and households. Natural gas sales accounted for about 7% of the State's total petroleum sales. In 2002, natural gas sales in Western Australia increased marginally (1%) to 7.9 billion m³. The sales value of natural gas increased by 2% to \$660 million.

The largest five gas fields in Western Australia in 2002 were Goodwyn, Perseus-Athena, North Rankin, Echo-Yodel and East Spar. Production from these five fields accounted for about 88% of the State's total.

Liquefied Petroleum Gas (LPG)

LPG accounts for 4% of the State's total petroleum sales. 2002 was not a favourable year for Western Australia's LPG industry. LPG sales (including both butane and propane) amounted to 815 566 tonnes which was down by 5% on the previous year. As LPG produced in the State is mainly for overseas markets, the appreciation of the Australian dollar exacerbated the tonnage deterioration, resulting in a 10% fall in the value of LPG sales to \$363 million.

The outlook for the Western Australian petroleum industry

A record level of crude oil and condensate production combined with winning the \$25-billion contract to export LNG to China made 2002 an impressive year for the State's petroleum industry.

Looking into the short to medium term, the outlook for the oil and gas industry in Western Australia remains extremely positive. Significant additional oil and gas production for the State will emanate from proposed development of new fields. Upstream oil and gas projects which have been committed or anticipated to be committed during 2002-2004 totalled \$5.23 billion. Of these projects, the Double Island-Simpson North and Hovea fields are under development, and the Woollybutt project began production in May 2003.

A positive development for the Western Australian gas industry in 2002 was the increased momentum of initiatives which add value to the vast gas reserves in the north of the State. Between 2002 and 2004, total capital expenditure for gas-based downstream projects which are committed or expected to be committed amounts to more than \$10 billion. These include the NWSV's LNG expansion, ChevronTexaco's Gorgon

LNG onshore project and several substantial Gas to Liquids (GTL) projects proposed for the Burrup Peninsula.

Six GTL projects are currently at the committed or proposed stage of development. One of these, the Burrup Fertiliser project, commenced construction in May 2003. Another, the Methanex project, has been granted environmental clearance. The initial plant considered by Methanex had a capacity of up to 5 Mt/a of methanol. However, the company announced in March 2003 that it would suspend development pending a review of construction costs and its initial level of capital commitment to the project. An option under review involves a two-stage development comprising a smaller capacity plant (1 Mt/a) with capital costs of US\$500 million to be built in the first stage, which is to be operational in 2006. In the second stage, another 1 Mt/a production capacity would be built up in 2009.

The gas that would be required for the six GTL projects is estimated to be at least double that of Western Australia's total domestic consumption. The proposed full 3-phase development of Sasol Chevron's project would be significant, representing the largest resource project since the North West Shelf was brought into production. The proposed project involves the expenditure of up to \$2.2 billion during the first stage of development. With an estimated gas intake of 20 trillion cubic feet over the 25-year life of the project, only the Carnarvon Basin or the North West Shelf has the capacity to meet the plant's gas needs. The project would potentially initially aim to produce 45 000 bbl/d of synthetic diesel, building up to 200 000 bbl/d at some point. The plant would operate for around 25 years and potentially coincide with the development of the expansive gas reserves in the Gorgon area.

In contrast to the promising outlook for the petroleum industry in Western Australia, there continues to be uncertainty surrounding the outlook for the global oil market as well as the world economy. Although oil prices eased from a 12-year high of US\$40/bbl after the war in Iraq, prices remained very volatile. On the demand side, growth in the US remains weak and Asian economies, already struggling to boost business and consumer confidence, have felt the effects from the outbreak of Severe Acute Respiratory Syndrome (SARS).

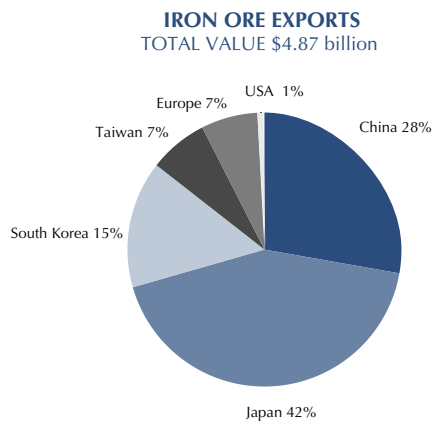
On the supply side, the war in Iraq ended quicker than expected and the damage to oil infrastructure in Iraq appears limited so far. Although OPEC has decided to cut production levels recently, other countries have increased production markedly in recent months. As a result, the international oil market could well be faced with a situation of excess supply and even larger decline in prices once inventories have been replenished. However, continuing geopolitical tensions around the world (including post-war Iraq) and lingering terrorist threats are still imposing considerable risk to the world oil market.

Nevertheless, increasing development activities in both upstream and downstream sectors in Western Australia highlight the State's attraction as a place to invest in petroleum production. With abundant petroleum resources, a highly skilled workforce, well established financial and physical infrastructure, geological proximity to burgeoning Asian markets, and supportive and efficient public services, Western Australia is a key location for a growing petroleum industry.

3.4 Iron Ore

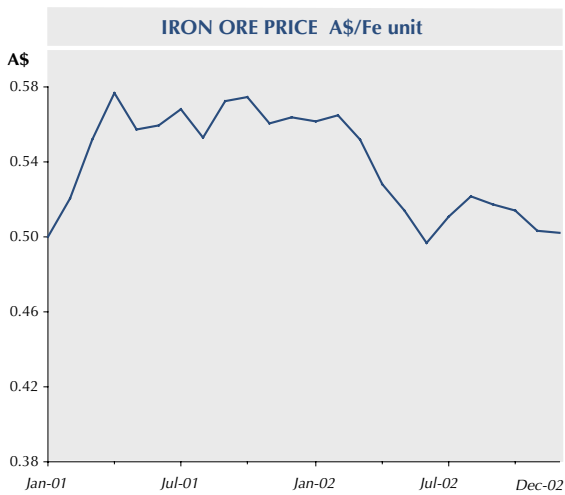
A slowdown in the world economy, large inventories and a fall of around 30% in the price of steel products all resulted in price cuts of around 5–6% for iron ore producers in 2002.

However, lower prices did not prevent the Western Australian iron ore industry from continuously growing. Achieving a new record of 172 Mt in 2002, the volume of iron ore sales in Western Australia was up by 3.4% in 2002 compared to the previous year. Unfortunately, due to lower prices from the previous round of negotiations and appreciation of the Australian dollar,



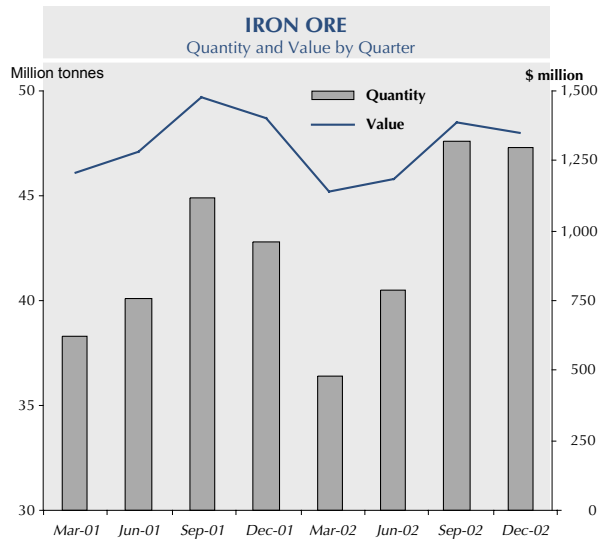
Source: DoIR

Figure 3.11



Source: Tex Report, High Grade Fine Ore Prices

Figure 3.12



Source: DoIR

Figure 3.13

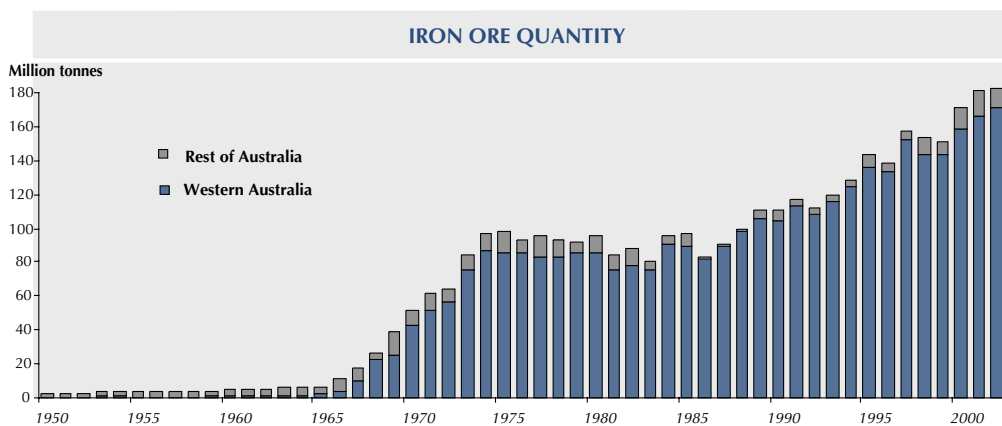
the value of these sales was down by 6% to \$5 060 million. Surpassed only by the petroleum industry, the iron ore industry remained the second-largest commodity sector in Western Australia, accounting for 19% of the State's total minerals and petroleum sales.

Western Australia is one of the major iron ore producers in the world. During 2002, the State accounted for more than 16% of the world's iron ore production. Western Australia has also been the dominant iron ore state in Australia since 1967. In 2002, 97% of Australia's iron ore was produced in Western Australia.

Western Australia's iron ore industry is highly export oriented. In 2002, 96% (or \$4.87 billion) of iron ore

produced in the State was sold to overseas markets. The major consumers are Japanese steel mills, accounting for 43% of the State's total iron ore exports. The rest was exported to China (28%), South Korea (15%), Taiwan (7%), Europe (7%) and The United States (1%).

The year 2002 was good for the Western Australian iron ore industry in terms of physical demand. Although the European market continued to be flat, demand for iron ore is booming in major Asian markets as steel production grows, particularly in China which has the largest iron and steel industry in the world in terms of output. AME Mineral Economics' report shows that China's iron ore imports in 2002 smashed the previous year's record by around 20 Mt. Despite its flagging



Source: DoIR and ABARE

Figure 3.14

economy, Japan also increased its imports by almost 3 Mt, posting its second-highest import level in well over a decade at 129 Mt.

Increasing Chinese demand for iron ore was largely due to strong growth in Chinese blast-furnace-based steel output, deregulation of iron ore import arrangements and rationalisation within the domestic iron ore industry. Rationalisation has been based on closure of a large number of small, low iron content, relatively inefficient Chinese mines. One of the inefficiencies includes high internal transport costs due to the poor location of the mines relative to the industrialised steel producing centres on the coast. Imported, efficiently produced, quality iron ore has therefore become more attractive to Chinese steel manufacturers.

Australia is the largest supplier of iron ore to China with a 41% share of the market in 2001. Historically, Western Australia's high share of the Chinese iron ore market has been attributed to competitive transport costs due to Australia's proximity. The State's competitiveness in the Chinese market has now also been further enhanced by the greater production efficiency of Western Australian iron ore producers. For example, Western Australian iron ore miners continue to set world standards for production efficiency with unit costs falling from US\$9.71 per tonne in 1997 to US\$7.08 per tonne in 2001-02.

Strong demand for iron ore in the international markets, driven by China's thriving steel industry, has forced iron ore producers to increase output. To take maximum advantage of further export opportunities over the next ten years, principally in the East Asian region, Western Australia's established and potential new suppliers continue to develop and assess the feasibility of a number of new iron ore projects.

In August 2002, the formal opening of the \$450 million Robe River Iron Associates' West Angelas mine not only signified the arrival of Western Australia's newest Pilbara mine, but also a new generation of projects from which Marra Mamba-type ores will be extracted and processed. It is estimated that the mine will process a total 440 Mt of Marra Mamba reserves, commencing at a rate of 7 Mt/a and rising to 20 Mt/a by 2006. Located 110 km west of Newman in the East Pilbara, ore is transported by rail to the newly expanded port facilities at Cape Lambert. The new ore, which is higher in

calcined iron and has lower levels of impurities, is to be supplied to six Japanese steel mills, comprising Nippon Steel, NKK Corporation, Kawasaki Steel, Sumitomo Metal Industries, Kobe Steel and Nisshin Steel.

Another major project aiming to exploit Pilbara-based Marra Mamba-type ores is BHP Billiton's Mining Area C (MAC), located 110 km north of Newman. In 2002, development continued on finalising the details of this project, which is an addition to the company's existing Yandi mine. The \$350-million project will supply 15 Mt/a to the world iron ore market, with a minimum of three million tonnes per annum of this production to be supplied to Korean steel conglomerate Pohang Iron and Steel Company Ltd (POSCO). The supply to South Korea represents part of the development agreement for the project, which ensures a supply deal between POSCO and BHP Billiton, involving a direct stake in the ore body by POSCO.

MAC contains 890 Mt of Marra Mamba ore, the largest undeveloped resource of its kind in the Pilbara. The project is to include a mine and processing facility as well as a range of infrastructure including a rail spur to link MAC to the original Yandi Mine, power, water, airstrip and roads. The MAC development will be completed at the end of 2003. About 500 people are involved in construction, reducing to a permanent workforce of about 100 when operation starts.

Elsewhere in the State, the smaller iron ore producer Portman Mining Limited proposed production increases from its Koolyanobbing mine, located 50 km northeast of Southern Cross, through the development of deposits at Mt Jackson and Windarling Range. With the bulk of the expansion focusing on these northern tenements, the securing of a key Native Title Agreement in 2002 opens the way for the expansion. The Western Australian Environmental Protection Authority also gave conditional approval to the project in April 2003. The expansion will require the construction of a new railway to connect the expansion area to the Koolyanobbing project site. The capacity of the Koolyanobbing operation is expected to increase from 4.4 Mt/a to about 8 Mt/a after the expansion.

Portman has also announced the resumption of mining on Cockatoo Island in conjunction with Henry Walker Eltin. Located 140 km north of Derby, the mine will produce 4 Mt of iron ore over four years.

Other expansions in the industry include Hamersley's Yandicoogina mine, which will see production, expand from 15 Mt/a to 18 Mt/a.

A major new project intending to exploit Marra Mamba-type ore is the Hope Downs project, a joint effort between Hancock Prospecting and South Africa's Kumba Resources. The joint venture aims to develop 400 Mt of ore reserve 75 km northwest of Newman. The \$1.4-billion project will include a new \$300-million railway, following the Western Australian Supreme Court rejection of the joint venture's attempts to access BHP Billiton's Newman railway line. Despite the setback, it is expected that the mine could be in production by 2005-06 with ramp-up production levels of around 5 Mt/a building up to 25 Mt/a.

In other developments, Mount Gibson Iron Ltd continued to consider the development of its magnetite-rich iron ore deposit at Mount Gibson, located 330 km southeast of Geraldton. In April 2002, Mount Gibson Iron agreed to purchase Kingstream Steel's Tallering Peak iron ore deposits in mid-west Western Australia. The acquisition was completed in August 2002. The Tallering Peak purchase entitles Mount Gibson Iron Ltd to an extra 40 Mt of hematite and 48 Mt of magnetite ore.

It is possible that the Tallering Peak deposits may be mined before the Mount Gibson deposit due to Tallering Peak's closer location to the port of Geraldton. Mount Gibson Iron Ltd and the Geraldton Port Authority signed a contract to export 1.5 Mt of iron ore from the Geraldton Port to China in July 2002.

It was also announced in April 2002 that the Swiss commodities giant, Glencore, had signed an initial five-year offtake agreement with Mount Gibson Iron Ltd, commencing in 2003 with an option to extend the contract for a further five years. Later, in May 2002, Mount Gibson Iron Ltd announced that it had entered into an agreement with Ausmelt to investigate the production of pig iron in Western Australia using Mount Gibson iron ore resources, locally sourced coal and Ausmelt's AusIron technology.

In other developments during 2002, Hamersley Iron and China's Shanghai Baosteel Group Corporation agreed to form a joint venture which guarantees Baosteel 200 Mt of iron ore products over the next twenty years. The joint venture aims to develop a new mine in the Pilbara

region, 10 km east of the existing Paraburdoo mine, which will be built and operated by Hamersley which has a 54% share in the venture. Hamersley also intends to develop its Nammuldi iron ore deposits near its current Brockman No 2 iron ore mine, 55 km northwest of Tom Price. The project will produce Marra Mamba lump and fine ores at around 20 Mt/a.

In terms of iron ore processing, one of the highlights in 2002 was final environmental approval for Rio Tinto's Hismelt project at Kwinana, a key component in the commercialisation of Marra Mamba fines. Commercialising 20 years of Australian research and development, the new Hismelt technology is the world's most advanced method of direct pig iron smelting through conversion of iron ore to liquid pig iron by the injection of non-coking coal and fine iron ore into a molten bath. The project is a joint venture with Nucor (25%), Mitsubishi (10%) and Shougang (5%). The \$400-million plant has secured \$50 million in Federal Government funding and State Government assistance in the form of land and port access to the value of \$30 million. The project's aim is to produce pig iron at an annual capacity of up to 820 000 tonnes in its first phase and increasing to 1.64 Mt/a in phase-two by 2006. Construction of the plant commenced in May 2003 employing 230 people, while full commissioning is set for late 2004 with an estimated 65 full-time positions required for the operational phase.

Western Australia's export capacity is to be boosted by a number of primarily iron ore-driven port facility upgrades throughout the State as part of the Government's \$225-million port enhancement program. Esperance Port is set for a \$54-million upgrade which includes dredging to create the deepest port facility in southern Australia. Other work will include a new berth and loading facility, construction of a 300 000 tonne iron ore storage facility and reclamation of 23 hectares of land to build a seawall. On completion of the upgrade, Esperance Port will have the capacity to accommodate cape class vessels and increased export flows of at least 6 Mt by 2004, up from 3 Mt in 2001. The expansion has been facilitated by the involvement of Portman, which agreed to underwrite the development.

Similarly, Geraldton Port is to undergo a \$100-million enhancement which includes plans to deepen the

harbour by an extra 12 m. On a smaller scale, BHP Billiton intends to increase its export capacity by developing a new stockpile area and upgraded berth-handling capacity to accommodate 25 000 t ships at its Finucane Island Port Facility. The company also intends to up grade its harbour tunnel in Port Hedland.

New developments undertaken by Western Australia's iron ore miners in combination with strong market conditions indicate a bright prospect for the State's iron ore industry. Iron ore price negotiations for the Japanese fiscal year in 2003 between Australian iron ore producers and Japanese steel makers were again very prolonged. However, despite being deadlocked for months since December 2002, an increase of 9% was achieved by Western Australian iron ore producers following the Brazilian Companhia Vale do Rio (CVRD), the world's largest producer, striking a 9% price increase with European steel maker Arcelor in May 2002. According to Rio Tinto and BHP Billiton, fine ore prices will increase by 9% to US30.83 cents per long dry ton unit, lump ore by 8.9% to US39.35 cents and Yandi ore by 9% to US29.98 cents for the Japanese financial year that began on 1 April 2003.

Booming Chinese demand is likely to change the market structure for Western Australia's iron ore exporters in the future. Although Japan remains the dominant destination for Western Australia's iron ore exports, China has been increasing its iron ore imports from the State over the last five years, with its share in the State's total iron ore exports rising from 21% in 1998 to 28% in 2002. By contrast, the proportion accounted for by Japanese importers has been falling in recent years, from 53% in 1999 to 43% in 2002.

Many industry analysts recognise that the expansion of China's steel industry holds the key to prospects for the iron ore sector in the region and for major raw material suppliers like Western Australia. According to AME Mineral Economics, owing to its burgeoning steel industry, China's iron ore imports will continue to surge and China is forecast to become the world's largest iron ore importer in 2003. Accordingly, iron ore trade between China and Western Australia is expected to grow in the future.

However, there are increasing challenges to Western Australia's iron ore exports to China given the fierce competition between international iron producers.

Brazil's CVRD for example, continues an aggressive approach to secure a greater share of the Chinese market. CVRD's share of the world market has already increased over the last three years from 12% to 18%. The Western Australian Chamber of Minerals and Energy estimates that Western Australia's share of the Chinese market is down four percentage points in 2002 compared to 2001, while CVRD's share has actually increased by the same amount. Meanwhile, India's share of the market has also jumped an extraordinary 17 percentage points. CVRD plans to construct a 450 000 t bulk carrier in partnership with its Chinese customers. The resultant reduction in iron ore transport costs could squeeze Western Australia's competitive advantage in transport and potentially further erode the State's Chinese market share.

3.5 Alumina

In terms of sales value, alumina is Western Australia's fourth-largest resource sector, accounting for 12% of total mineral and petroleum sales in 2002. The State has four refineries, comprising Worsley's Collie alumina refinery and Alcoa's Kwinana, Pinjarra and Wagerup operations. Total production capacity of the four refineries is 9.8 Mt/a.

Western Australia's refineries set the global standard for operating costs and efficiency. Ongoing world-class technical research is largely responsible for annual production cost gains estimated at 3% per annum. According to AME Mineral Economics, Worsley, Pinjarra and Wagerup refineries make up three of the world's five top rating refineries in terms of lowest production costs per tonne. Overall, Australia is ranked as the second-lowest-cost country, only slightly more expensive than Venezuela.

In 2002, Western Australia's alumina output continued to grow, experiencing a 4% increase to a record 11.1 Mt. Worsley's alumina production, increasing to maximum capacity following its refinery expansion, contributed to this growth. In terms of sales value however, sales dropped by \$366 million or 10% to \$3.4 billion compared with 2001. This was mainly caused by depressed prices and an appreciating Australian dollar. Although China's demand for alumina was strong, the world alumina market remained quiet in

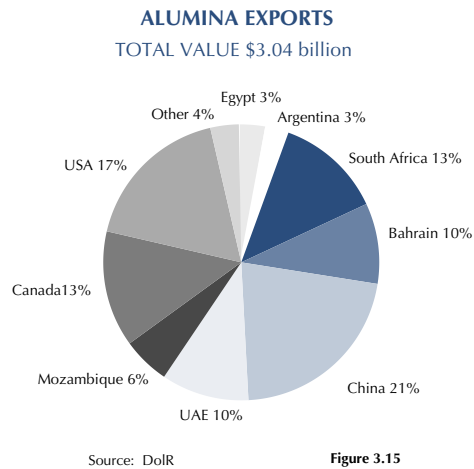


Figure 3.15

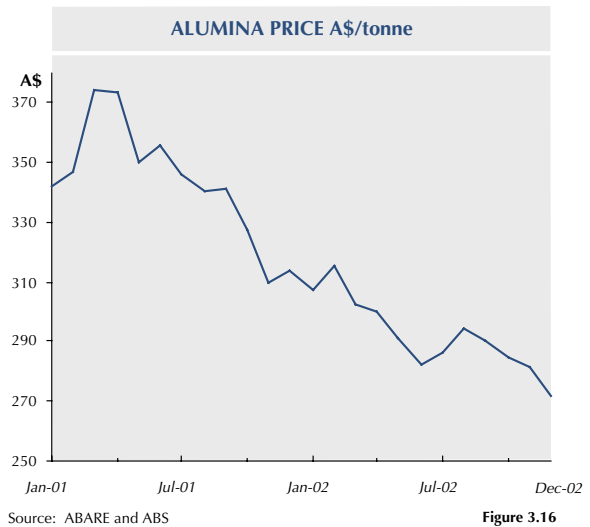


Figure 3.16

2002. As a result of weak demand for aluminium primarily attributable to the slow global economy and sluggish automotive and aviation sectors, alumina prices fell by nearly 15% on 2001.

Australia is the world's largest alumina producer and within this, Western Australia plays a prominent role, accounting for almost 20% of the world's alumina output in 2002. Nationally, the State's share of Australia's total alumina has been gradually increasing, from 62% in 1999 to 68% in 2002.

Nearly 90% (or \$3.04 billion) of the State's alumina was exported in 2002. China comprised the largest share of the State's exports by value, at 22%, followed by the US which accounted for 18% of the State's alumina exports. Other significant export destinations were Canada (14%), South Africa (13%), United Arab Emirates (10%) and Bahrain (10%).

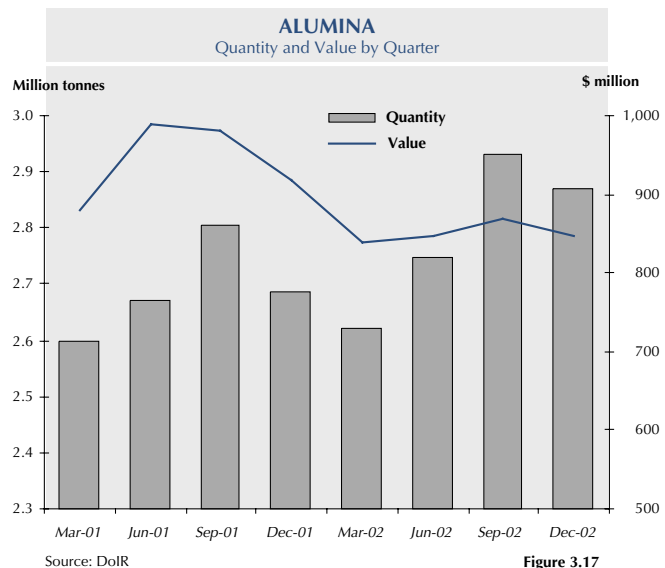


Figure 3.17

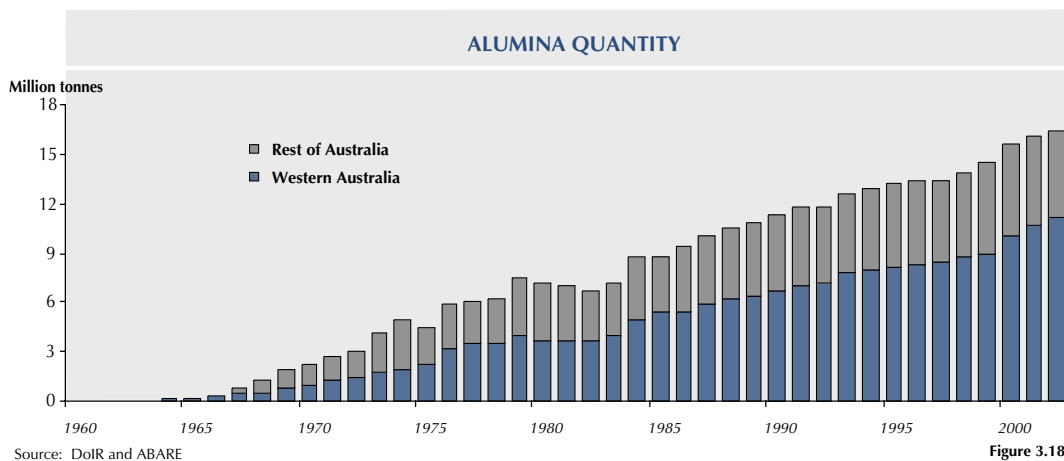


Figure 3.18

Compared to 2001, Western Australia's alumina exports to all non-China markets fell in 2002. The decreases range from 7% (the United States) to 35% (Egypt). Total exports were down by 12%. However, the State's exports to China increased by more than 12% to \$589 million.

These export results are a reflection of the mixed picture in the global aluminium markets in the past year. More than 90% of the world's alumina is used in aluminium production, so alumina trends are strongly tied to events in the aluminium industry. Weak demand, oversupply and a contradictory mix of production cutbacks, shutdowns and restarts characterised the aluminium industry throughout 2002. Weak demand for aluminium was primarily attributed to the slow global economy and sluggish automotive and aviation sectors. While capacity expansions and re-starts of idle production in some regions contributed to the general oversupply conditions in the aluminium market. China is viewed as the main driver for the global aluminium oversupply with booming production levels moving the country from a net importer to a net exporter in 2001. In 2002 alone, China commissioned 560 000 tonnes of new aluminium smelting capacity. The expansion of China's aluminium smelting capacity had kept demand for alumina healthy, despite market conditions in many other regions remaining weak throughout the year.

According to Metal Bulletin Research, the world alumina market recorded a deficit of around 300 000 t in the fourth quarter of 2002. This was due mainly to high Chinese demand. In January 2003, China reduced its import duty on alumina from 12% to 10%, which supported the market. China's seemingly insatiable demand for alumina has driven up alumina prices since January 2003 with average LME alumina prices increasing by more than 10% over the first four months of the year.

Improvements in alumina prices are likely to rejuvenate Western Australia's alumina projects. In July 2003, Alcoa unveiled a two-year capital invest-plan for its Pinjarra refinery worth \$600 million. This expansion would boost the refinery's capacity by an estimated 18%. However, approval for the expansion to proceed is dependent on environmental approvals and market

conditions. These factors figured prominently in July 2002 when Alcoa decided to hold off on plans to expand its Wagerup refinery. The planned Wagerup expansion would have lifted annual production at the operation to between 3.5 and 4 Mt/a from the existing 2.3 Mt/a, making it the world's biggest alumina refinery. Apart from environmental concerns, weak alumina prices were another major factor in stalling the \$1-billion expansion. With prices recovering, it may instead though lead to the Pinjarra expansion going ahead on condition that community environmental concerns are properly addressed.

Meanwhile, since the completion in September 2000 of the Worsley refinery expansion, Worsley's output has increased to maximum capacity of 3.1 Mt/a. BHP Billiton is now considering a further expansion which could see output creep up by a further 16% to 3.7 Mt/a.

Environmental concerns have been a significant factor in the operation of Western Australia's alumina refineries. In addition to their impact on the expansion of the Wagerup refinery, Worsley's liquor burner was shut down in May 2002 in response to health concerns raised by the community which began in late 2001. Other environmental matters concerning the industry included ground water pollution arising from Alcoa's operations at Kwinana, Pinjarra and Wagerup.

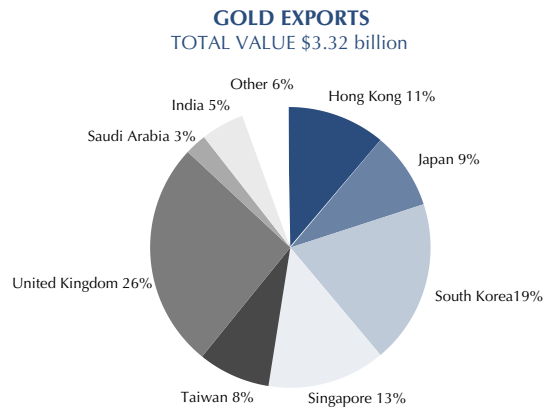
In other parts of Australia, work has commenced in Chadstone, Queensland, on Comalco's 1.4-Mt/a smelter grade alumina refinery. The wholly-owned Rio Tinto subsidiary estimates that the refinery will come on-stream by 2005. The State and Federal Governments have made funding and infrastructure commitments to the project which will include wharf facilities, conveyers, grinding mills, storage silos, coal handling and a rail delivery system, gas and electricity distribution systems, a steam generation plant and associated plant buildings. Initial production levels will be 1.4 Mt/a with expansion allowing for production of up to 4 Mt/a. The existing alumina industry in the area was a drawback for the attraction of the new refinery with bauxite and all other inputs, except caustic soda, being sourced locally.

3.6 Gold

The gold industry was the third-largest commodity sector in Western Australia, accounting for 13% of the State's total mineral and petroleum sales in 2002. On a national scale, Western Australia accounted for 69% of Australia's gold production in 2002.

The gold sector is also a significant employer, accounting for about 30% of total employment in the petroleum and mineral sectors in Western Australia. The number of people employed within the gold industry in 2002 was more than 12 600, up by 6% on 2001.

During 2002, gold regained some its safe-haven status as prices continued to increase in an environment of nervousness surrounding instability in the Middle East, a US-led war with Iraq, a volatile global equity market, an uncertain world economic environment and a weakened US dollar. In December 2002, the price of



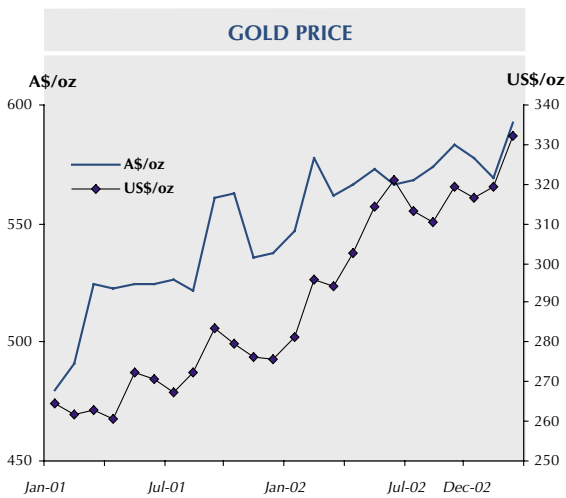
Source: DoIR

Figure 3.21

gold hit \$618.50/oz which was its highest Australian dollar price in nearly 15 years. The average price of gold was US\$310/oz in 2002, up by nearly 15% on the previous year.

However, compared with 2001, Western Australian gold sales in 2002 dropped 2% to 6.1 million ounces (188.8 t). A lack of exploration leading to new mining operations contributed to this fifth successive year of decreasing output since the 1997 record of 240.2 t. This is in line with the national production results with Australia's total gold production in 2002 falling 4% to 8.8 million ounces (273 t). Despite the decline in production on an annual basis, the downward trend has been levelling off with signs of recovery in the late quarter 2002. State gold output for the December quarter was 48.3 t, up by 2% on the previous corresponding period and the highest for four quarters. This was largely due to new mines coming on-stream in the State, such as the Thunderbox project owned by Lionore Mining International Ltd and Dalrymple Resources NL and Equigold NL's Kirkalocka

operation. Despite the dip in annual output, the value of gold sales in Western Australia was up by nearly 7% to \$3.5 billion in 2002 owing to higher prices. Western Australia exported 182.5 t of gold worth \$3 323 million in 2002. Both volume and value of



Source: Perth Mint and London Fix

Figure 3.19

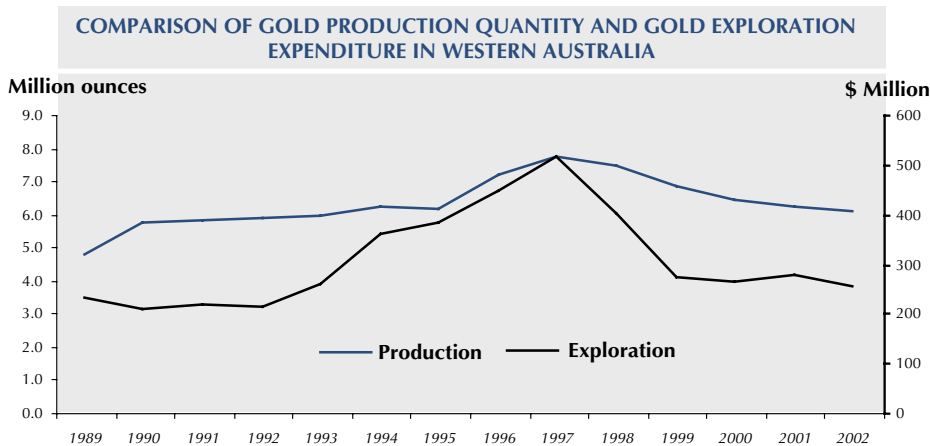
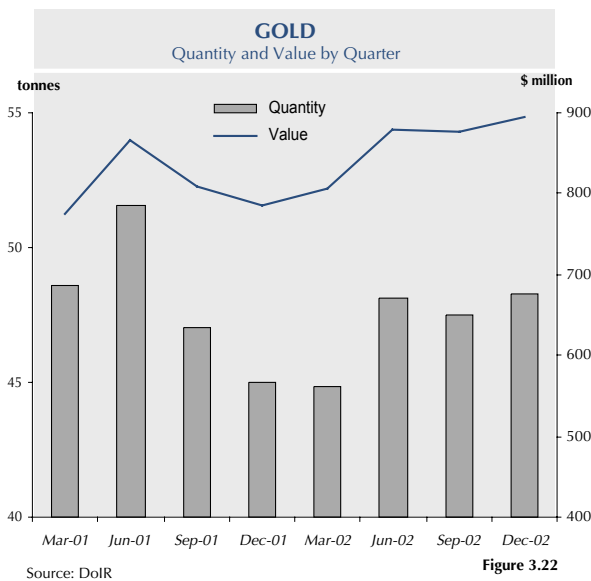


Figure 3.20



exports were up by 7% and 17%, respectively, on the previous period. The top four export destinations were the United Kingdom (accounting for 26% of Western Australia's exports), South Korea (19%), Singapore (14%) and Hong Kong (11%).

Driven by cost reduction the incentives of, and the increased likelihood of, attracting institutional investment, the consolidation trend in Australia's gold industry continued in 2002. Following the merger of Barrick Gold Corporation with Homestake Mining Company and the merger of Goldfields Limited with Delta Gold Limited in December 2001, 2002 saw the merger of Croesus Mining NL with Central Norseman Gold Corporation Ltd.

Take-overs during the period were equally on a large scale with the loss of Australia's Normandy Mining

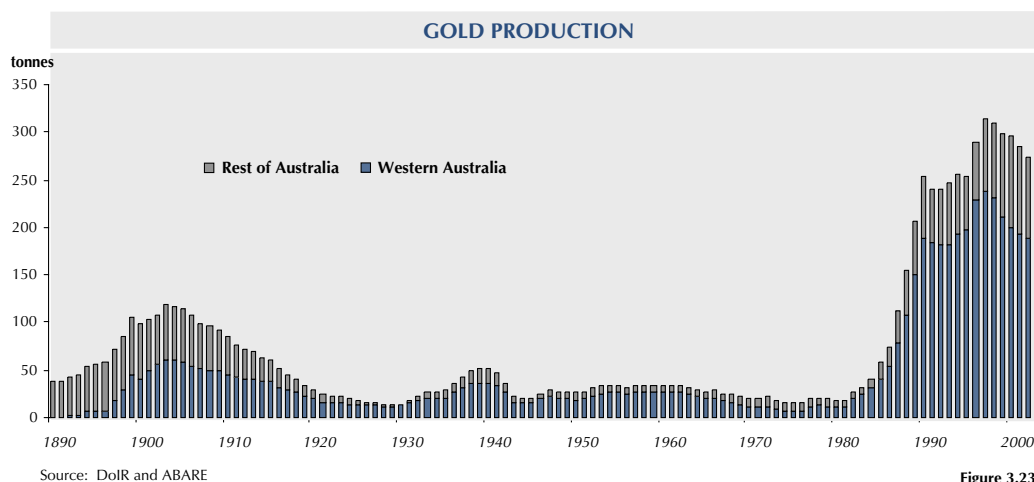
(December 2001) and Canada's Franco-Nevada Gold (February 2002) to Newmont Mining to create the world's largest gold producer. Also Perth-based Hill 50 was lost to South Africa's Harmony Gold (June 2002). By the end of 2002, Canada's Placer Dome also completed its take-over of Sydney-based AurionGold Limited.

Some of Western Australia's larger gold mining projects have been included in these consolidations. For example, the Harmony Gold take-over included the acquisition of the Mt Magnet and New Celebration mines, which together produce 4% of the State's total output. Barrick Gold Corporation also acquired a share of Western Australia's largest mine, the Kalgoorlie Superpit, when it merged with Homestake Mining Company. Also, the AurionGold acquisition increased Placer's interest in the Granny Smith mine in Western Australia from 60% to 100% and added to Placer's stake three new mines in the Kalgoorlie region.

Western Australia's ten largest projects accounted for more than 60% of the State's gold output in 2002.

These projects comprised:

- Golden Mile (KCGM – Newmont Australia Ltd, Barrick Gold Corp.) – 22.2 t
- St Ives (Gold Fields Ltd (South Africa)) – 17.0 t
- Granny Smith (Placer Dome Inc) – 14.9 t
- Sunrise Dam (AngloGold Ltd) – 11.5 t
- Jundee–Nimary (Newmont Australia Ltd) – 10.0 t
- Plutonic (Barrick Gold Corp.) - 9.7 t
- Paddington – Mt Pleasant (Placer Dome Inc) – 8.5 t



- Bronzewing–Mt McClure (Newmont Australia Ltd) – 8.4 t
- Kanowna Belle (Placer Dome Inc) – 8.2 t
- Hill 50–Mt Magnet (Harmony Gold (Australia) Pty Ltd) – 6.0 t

In terms of the State's gold production outlook, the continuously falling rate of gold exploration since 1997 is placing pressure on the level of economically demonstrated resources. Therefore, the State's gold production is forecast by ABARE to continue to decrease, primarily as a result of older mines coming to the end of their mine life, such as, for example, the Dalgaranga mine which ceased operations in June 2002.

There are however, some significant new gold projects which should at least ameliorate the declining rate of production. These include:

- LionOre–Dalrymple Resources' Thunderbox gold project. This project commenced production in 2002. Total recovered gold is expected to be 800 000 ounces for the initial five-year open pit mine life;
- Newcrest's resurrection of the Telfer gold mine. Newcrest Mining is investing \$1.2 billion into re-starting the Telfer gold and copper project in Western Australia's Pilbara region. This mine will provide the biggest and most dramatic boost to the State's gold production. It is estimated that it will produce around 800 000 ounces per annum for 24 years. The Telfer operation, which has reserves of 19 million ounces, is expected to topple the Super Pit as Australia's largest gold mine when it resumes production early in 2005. The project will include completion of development of the existing mine with both open pit and underground mines. Power for the project is to be supplied from gas-fired turbines supplied from the North West Shelf.
- Expansion of the Wandoo underground operations at Boddington. The Wandoo expansion, if completed, is estimated to would produce around 680 000 oz/a. It is subject to negotiations regarding the proportion of stakes held by the three owners – AngloGold (33%), Newmont Mining (44%) and Newcrest Mining (22%).

Other projects, which will supplement the State's future gold output, include Gindalbie Gold's Minjar project near Yalgoo and Aurion Gold's White Foil project. In addition, both the Granny Smith Wallaby mine and the Sunrise Dam mine are set for extension.

While the level to which the Australian dollar is supporting gold prices denominated in local currency terms has to some degree fallen, favourable cash margins still exist for most Australian producers. As foreseen by ABARE, these cash margins are expected to be sufficient for gold producers to outweigh the impact of any appreciation of the Australian dollar over the outlook period. Cost-related closures of mines are thus not expected over the outlook period, with the exception perhaps of some smaller mines with unprofitable hedge books.

3.7 Nickel

International nickel prices performed strongly in 2002. Compared with 2001, the price of nickel rose 14%, averaging at US\$6,793/t for 2002. As a result of this significant turnaround for nickel, the State's nickel industry experienced an 8% increase in its total sales value to \$2 242 million. This was on the back of total sales volume, which remained almost static, increasing by just 1% to 183 182 t in 2002.

There are 11 nickel operations in Western Australia, accounting for all of Australia's nickel production and 18% of world nickel production. In 2002, the five largest nickel operations accounting for more than 85% of Western Australia's output were:

1. Western Mining Corporation (Mount Keith–Leinster–Kambalda) – 91 343 t
2. Anaconda Nickel Ltd–Glencore (Murrin Murrin) – 25 290 t
3. Black Swan Nickel Pty Ltd (Outokumpu)–MPI Mines Ltd (Black Swan) – 20 979 t
4. Mincor Operations Pty Ltd (Mittel) – 12 596 t
5. Sir Samuel Mines NL (Cosmos) – 7 643 t

In 2002, 96% of the State's total nickel sales, worth \$2 143 million, was exported. Major destinations were Europe and Japan. The primary importing countries include Finland (accounting for 24% of the State's total nickel exports), Japan (15%) and Netherlands (15%).

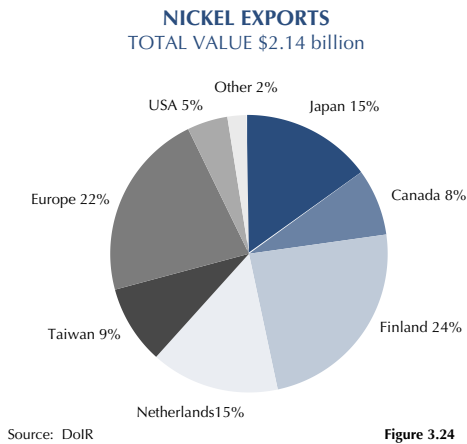


Figure 3.24

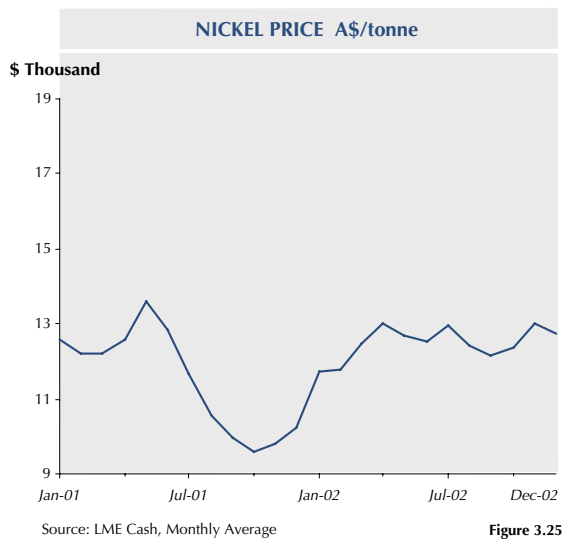


Figure 3.25

The nickel industry has undergone diversification, chiefly attributable to the divestiture by Western Mining Corporation (WMC). For example, the Long Nickel Mine was purchased by Perth-based Independence Gold. Other WMC interests in the area which have been taken up by smaller operators include the

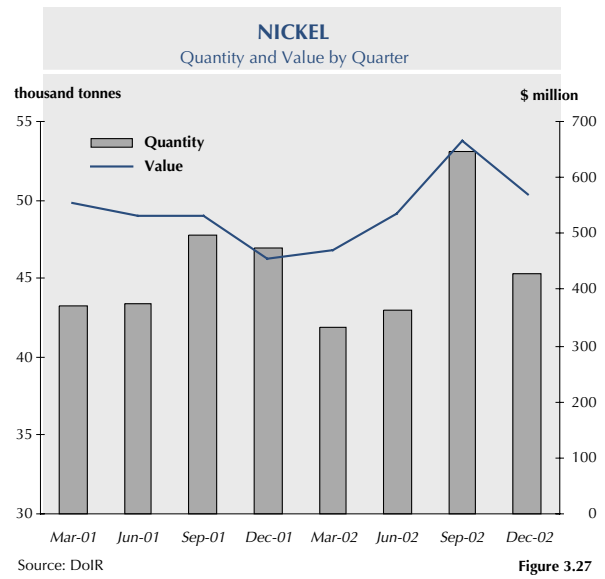


Figure 3.27

purchase of the north Widgiemooltha exploration block by Titan Resources; the Miitel, Redross, Wannaway and Mariners deposits by the Miitel Joint Venture; and the leasing of the Otter Juan and Coronet North tenements by Goldfields Mine Management.

3.8 Mineral Sands

Production from the Western Australian heavy minerals sands industry comprises titanium and non-titanium minerals. Titanium minerals include ilmenite, rutile, leucoxene and synthetic rutile. These minerals are feedstock for the production of titanium dioxide pigment and titanium metal. Non-titanium minerals derived from the industry comprise zircon, garnet, staurolite and monazite.

In terms of sales value, synthetic rutile, or sometimes referred to as upgraded ilmenite, dominates Western Australia's mineral sands industry. It

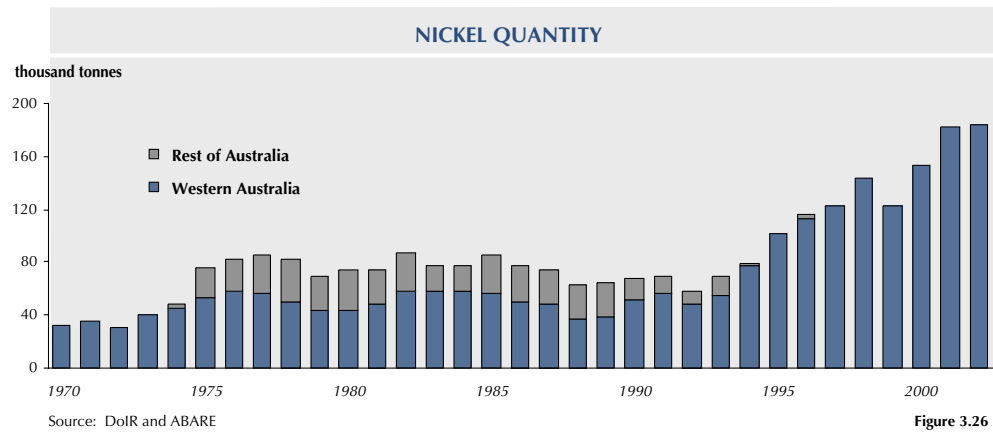
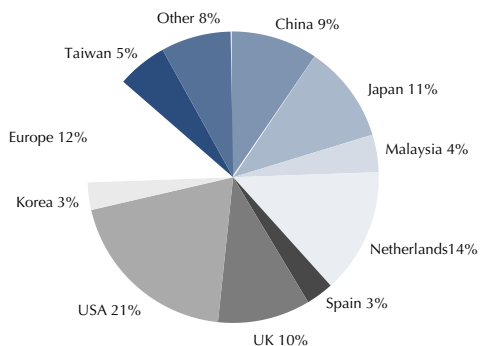


Figure 3.26

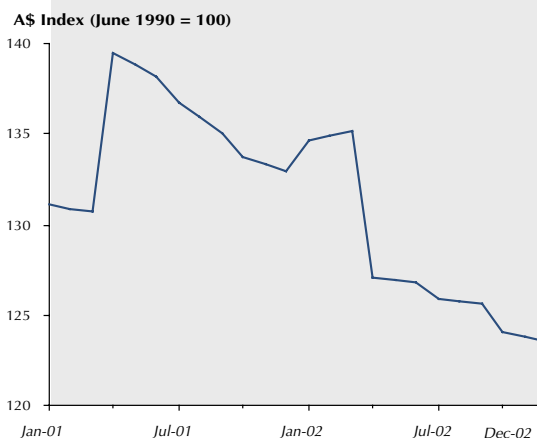
HEAVY MINERAL SANDS EXPORTS
TOTAL VALUE \$746.03 million



Source: DoIR

Figure 3.28

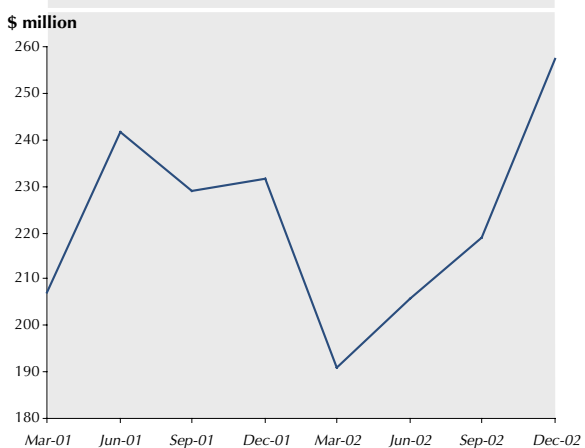
HEAVY MINERAL SANDS PRICE INDEX



Source: WA Treasury

Figure 3.30

HEAVY MINERAL SANDS
Value by Quarter



Source: DoIR

Figure 3.29

constituted 42% of total sales in 2002. Other major heavy mineral sands products include zircon (28%), ilmenite (15%) and rutile (12%).

Compared with 2001, average prices for zircon rose by 8% to US\$449/t and rutile remained static at US\$501/t in 2002. Average ilmenite prices however, decreased slightly by 1% to US\$80/t. However, a stronger Australian dollar eroded much of the price rise, resulting in prices expressed in A\$ terms increasing by only 3% for zircon and dropping by 5% and 6% for rutile and ilmenite, respectively. Reflecting the negating effect of an appreciating Australian dollar, the average heavy mineral sands price index in 2002 fell by 5% compared to the previous year.

During 2002, the physical sales volumes for zircon and rutile increased by 4% and 11%, respectively. The volume of ilmenite sold remained static and the volume

of upgraded ilmenite sales dropped by 9%. Upgraded ilmenite accounted for more than 40% of heavy mineral sands sales. Therefore, the significant drop in upgraded ilmenite sales, in combination with a rising Australian dollar resulted in the total sales value of the State's heavy mineral sands industry decreasing by 4% to \$873 million in 2002.

Western Australia exported heavy mineral sands to the value of \$746 million during 2002, amounting to 85% of the State's total sales. In terms of destination, the State's heavy mineral sands are shipped to a variety of countries around the globe, with the US accounting for the largest proportion. In 2002, the US imported \$146 million worth of Western Australia's heavy mineral sands, accounting for nearly 20% of total heavy mineral sands exports from the State. Collectively, European customers comprise 40% of Western Australia's total heavy mineral sands exports, with the Netherlands (14%) and the UK (11%) being the next largest countries after the US in terms of export sales.

The State's heavy mineral sands industry is concentrated in the South West and is the seventh-largest resource sector by value in the State. On a national scale, Western Australia's heavy mineral sands production accounts for about 90% of Australia's output.

Similar to the global industry, the heavy mineral sands industry in Western Australia is highly consolidated, with five companies controlling more than 75% of current world production capacity. The four major entities dominating the State's mineral sands industry

comprise Iluka Resources, created from the merger of RGC and Westralian Sands in late 1998 (thereby forming the world's second-largest producer of mineral sands); Cable Sands (WA); The Tiwest Joint Venture, jointly owned by Ticor and Kerr McGee Chemical Corporation; and Millennium Chemicals.

Iluka produce mineral sands from two main regions in the State, Eneabba (Mid West) and Capel (South West) while Cable Sands operates exclusively in the region around Bunbury. The Tiwest Joint Venture has mining operations approximately 170 km north of Perth at its Cooljarloo mine and processing operations at its Chandala synthetic rutile plant near Muchea, about 60 km north of Perth. Some synthetic rutile from the Chandala processing site is railed to its Pigment Plant in Kwinana. Millennium Chemicals manufactures titanium dioxide (TiO₂) pigment from synthetic rutile at Kemerton near Bunbury.

During 2002, about 93% of world titanium feedstocks (or 4.3 million TiO₂ units) were consumed by the TiO₂ pigment industry. The remainder was consumed by the titanium metal and other industries such as welding electrodes. As the dominant user of titanium feedstocks, the TiO₂ pigment industry had a major influence on world titanium feedstock markets. Despite several attempts by pigment manufacturers to raise prices throughout the year, annual average TiO₂ pigment price was down nearly 15% on 2001 to \$2995/t. Nevertheless, improved pigment demand in the second half of 2002 was evident with increased sales volumes for key producers. For the year as a whole, the pigment sector reported higher sales volumes, with increases in sales volumes ranging from 6% to 17%. Higher demand was attributed to improved global business conditions, healthy demand from coatings manufacturers, customer restocking in advance of anticipated price increases and seasonal effects. The second half of 2002 also saw TiO₂ pigment prices begin to pick up.

North America and Europe are the major titanium pigment consuming regions where consumption underpins world demand. China, as with many other commodities, has become an increasingly important source of growth for titanium pigment producers. Driven by the country's coatings and plastics markets underpinned by the burgeoning vehicle and building industries, Chinese pigment consumption has grown strongly in recent years, with imports of titanium dioxide pigment increasing by an estimated 18% in 2002.

Unlike the titanium dioxide pigment market, demand for titanium metals remained weak throughout 2002. The aerospace industry accounts for approximately 40% of titanium metal demand. Although demand for titanium metal for military use increased substantially during 2002, commercial aircraft production decreased by about 20% since 11 September 2001. The outbreak of SARS also added a blow to the world aerospace industry. With lingering terrorist threats and the sluggish global economy, expectations are that a difficult business environment for titanium metal producers will persist in 2003.

Worldwide feedstock prices fell in the early stages of 2002 in response to low demand and corresponding production cutbacks in the US. By June 2002 however, a clear increase in feedstock demand was becoming evident. This resulted in the re-start of the Tiwest North Cooljarloo mine (which had stopped operations in January 2002 to reduce stockpiles). Similarly, the Chandala synthetic rutile plant near Muchea, which receives production from the Tiwest north and south Cooljarloo mines, returned to full operating capacity after functioning at 80% capacity since October 2001. The demand improvements are viewed as a moderate turning point in an otherwise depressed feedstock market.

Despite signs of strengthening prices in the second half of 2002, the outlook for the titanium feedstock group

One TiO₂ unit is equal to one tonne of contained TiO₂. TiO₂ units are used in order to overcome the problem of combining consumption of titanium products with a variety of TiO₂ levels. For instance, for an ilmenite product with a TiO₂ content of 50%, one TiO₂ unit would be equal to two tonnes of ilmenite. For a rutile production with 95% TiO₂, one TiO₂ unit would be equal to 1.05 tonnes of rutile. Not only do ilmenite and rutile contain different TiO₂ contents, but also individual ilmenite products have a spectrum of TiO₂ contents. Because the TiO₂ pigment industry is essentially buying contained TiO₂, it is more useful to consider demand for titanium in TiO₂ units.

of minerals remains subdued in the short to medium term. On the demand side, although strong growth in Chinese TiO₂ pigment consumption is expected to continue in 2003, the prospect for demand growth for titanium pigment in North America and Europe remains moderate as economies in these regions struggle to recover. According to AME Mineral Economics, demand for titanium pigment in North America and Europe is forecast to rise by 1–1.5% in 2003.

Over the past two decades, there has been a declining trend in real TiO₂ pigment prices, but a generally increasing trend in real prices for feedstock used in the pigment industry. The continuing low level of profitability in the pigment industry has forced pigment producers to focus their efforts for cost improvements, including reduction in the cost of the actual TiO₂ units purchased. On the supply side, the titanium feedstock market remained in oversupply in 2002 with the overall surplus amounting to 86 000 TiO₂ units. With the large number of potential titanium-based mineral sand projects currently vying for development, the surplus supply situation for both high TiO₂ feedstocks and ilmenite is likely to continue. According to TZ Minerals International Ltd (TZMI), world titanium feedstock demand is forecast to increase by 2% to 4.7 million TiO₂ units in 2003 and by 3% to 4.8 million TiO₂ units in 2004. While in the equivalent period, world titanium feedstock supply is projected to grow by 3% and 7%, respectively, resulting in a surplus of 254 000 TiO₂ units in 2004.

Within an environment featuring sluggish demand and surplus supply, market analysts foresee continuing shift in the balance of power from feedstock producers to pigment producers. Accordingly, pigment feedstock

prices are expected to be under increasing pressure. In the period to 2006, the outlook is for downward movement of upgraded slag (UGS), average chloride slag and sulphate slag price and downward pressure on chloride and sulphate ilmenite prices for the whole period. Rutile prices are also expected to be under pressure, though with some recovery possible from 2005.

By contrast the zircon market is likely to remain tight due to its low availability. Zircon prices remained remarkably strong following buoyant demand in China, averaging US\$449/t during 2002, up by 8% on the previous year. The outlook is for the upward trend in zircon prices to continue in the short to medium term as a result of the declining zircon/TiO₂ ratio. This is causing a relative decrease in zircon production while demand from China continues to be strong.

According to Industrial Minerals Information Ltd (UK) zircon demand is heavily linked to the ceramics industry, accounting for approximately 55% of demand. Europe is the most important market for zircon followed closely by Asia including China, with China comprising approximately 60% of Asian zircon demand. Chinese ceramics production has boomed in recent years and is expected to increase further in tandem with increased demand for zircon in the production of television picture-tube glass and zirconium metals production. China is now estimated to account for more than 18% of the world's consumption of zircon. Demand in China has grown on average at 12% per year over the past decade.

In 2002 Western Australian zircon sales amounted to 366 452 tonnes, valued at \$245 million. In 2002, zircon accounted for 28% of the total sales value of

the State's heavy mineral sands industry. While New South Wales, Victoria and Queensland also produce zircon, Western Australia dominates national production, accounting for nearly 90% of the nation's total. Overall, Australia is the world's largest zircon producer, with South Africa recently closing the gap.

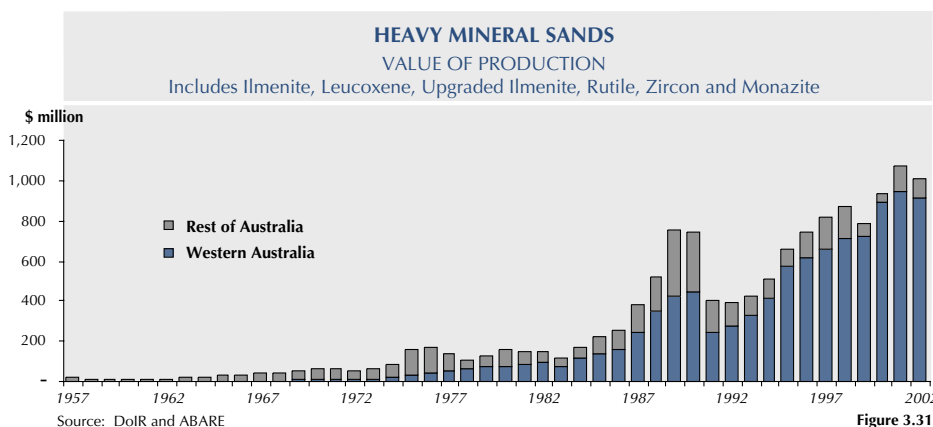


Figure 3.31

Iluka Resources, Cable Sands and the Tiwest Joint Venture are the main producers of zircon. In addition to its classification as a gemstone, zircon also has a variety of industrial applications such as in glassmaking, ceramics, electronics and specialty optical glasses including television picture-tube glass.

Despite the sombre state of affairs for the duration of 2002 in the heavy mineral sands industry, with only leucoxene and zircon recording increases in sales value, the industry still experienced a number of new developments during 2002.

In terms of new mining activity, the commencement of operations at the new \$30-million Doral Dardanup mineral sands mine in the latter half of 2002 marked a significant event in the industry. The project, which includes a refurbishment of the dry processing plant near Picton, is expected to operate for ten years, producing 120 000 t/a of titanium-based minerals and 10 000 t/a of zircon. Officially opening in October 2003, the mine is the first major greenfields mining project by a new player in the region in recent years. Other developments included the application by Cable Sands (WA) to re-mine the titanium minerals ore body adjacent to D'Entrecasteaux National Park at the Jangardup South Mineral Sands Mine. The application is subject to environmental approval.

Also, exploration by Magnetic Minerals in the Dongara area has resulted in the discovery of significant mineral sands resources. Located 35 km north of Iluka Resources' Eneabba Mine, Magnetic is looking to develop the resources under joint venture, acquisition or merger arrangements.

In expansion news, Millennium Chemicals announced plans to expand its Kemerton TiO₂ pigment plant. Millennium has valued the planned expansion at \$470 million, although further progress on the proposal will depend upon market conditions. If the expansion takes place, production at the plant would increase to 190 000 t/a. The project has been given environmental approval and is now on hold pending favourable markets. In other expansions, Tiwest Joint Venture received environmental approval for the expansion of its Kwinana TiO₂ pigment plant.

In other potential expansion developments, Iluka Resources and Outokumpu-Lurgi Metallurgie

announced the intention to develop the first synthetic rutile plant based on a new process allowing the production of synthetic rutile from a wider array of ilmenite feedstocks. Termed NewGen SR this new process allows for low value ilmenite, such as that found in the Murray Basin, to be upgraded into premium synthetic rutile using a low temperature hydrogen-based reduction technique. The process includes the removal of manganese, magnesium and chromium. Iluka and Outokumpu have signed an exclusive agreement to construct a new synthetic rutile plant, which shall incorporate NewGen SR. It is hoped the new plant will be in production by 2006 with the joint venture currently devoting 12 months to establishing the engineering requirements of the plant.

However, on the contractionary side, Iluka decided to cease plans to expand its operations in Capel. Valued at \$50 million, the expansion would have increased production levels by 50 000 t/a. The expansion was to focus on the refurbishment of an old kiln to bring it back into production. However the age and condition of the plant, in conjunction with the estimated cost of the refurbishment, deemed the proposal unfeasible. Iluka's preference is to increase output at its existing southwest leaching plant by undertaking a \$2-million upgrade which will facilitate extra synthetic rutile production of around 12 000 t/a. Iluka is also investigating the possibility of increasing output and production efficiency through new processing technologies such as NewGen SR described above.

In the face of tough market conditions with no immediate prospect of a recovery in demand, titanium minerals producers have been endeavouring to cut production costs. According to AME Mineral Economics, average cash cost of production of titanium minerals over a three-year period from 1999-2002 fell by more than 40%.

Tough market conditions also tend to trigger rationalisation of ownership aiming at achieving economies of scale. The heavy mineral sands industry within Australia underwent moderate ownership shifts during 2002. At a corporate level, the Tiwest Joint Venture underwent a slight change of influence following Anglo American's strengthened position in the iron ore industry through acquisition of a 10% stake in Kumba Resources. Kumba Resources owns almost 50%

of Ticor, which in turn has a 50% share in the Tiwest Joint Venture. Meanwhile, in April of 2002, Japan's Itochu Corporation and Tochu Corporation acquired a 70% share in the Kemerton silica sands project from Sons of Gwalia following Gwalia's divestiture of non-core assets.

Iluka Resources also completed its takeover bid for Basin Minerals in November of 2002. In doing so Iluka became a significant player in the emerging Murray Basin Mineral Sands province through the development of the Douglas and KWR mines. The Murray Basin straddles Victoria, New South Wales and South Australia over an area of 300 000 km and at this stage is believed to contain over 80 million tonnes of rutile, zircon, ilmenite and leucosene. Aside from Iluka, these resources are predominantly controlled by BeMax Resources NL (Gingko deposit), Southern Titanium NL (Mindarie) and Murray Basin Titanium (Wemen and Birthday Gift) – a joint venture between Sons of Gwalia and RZM.

3.9 Diamonds

Western Australia is a prominent diamond producer on a global scale. Since the mid-eighties, the Argyle diamond mine has been the world's largest diamond producer by volume, accounting for around 22% of the world's total mine production. After a considerable fall in both sales volume and value in 2001, the Western Australian diamond industry recouped much of its losses in 2002. The quantity sold in 2002 increased substantially by 59% to 34.4 million carats. The value of sales also rose by a significant 31% to \$652 million despite an appreciating Australian dollar.

Western Australia's economic diamond resources are based on very large, low-gem-quality diamonds as extracted by the Argyle operation. Located near Kununurra, the Argyle diamond mine traditionally accounts for about 90% of Australia's diamond production. Only about 5% of Argyle diamonds are gem quality, with 40% near-gem quality and the remaining 55% industrial quality diamonds. This compares with overall global production proportions comprising about 10% gem, 55% near-gem quality and the remaining 35% industrial quality. Subsequently, by value, Australia is ranked seventh in the world for diamond production, yet produces the largest volume

of diamonds. Higher gem quality diamonds are also extracted from the Merlin mine in the Northern Territory.

A large proportion of Western Australia's uncut diamonds (some 90% of Argyle's rough diamond production) are ultimately destined for the Indian diamond manufacturing industry which occupies the top position in the world's small and low quality diamonds cutting and polishing output. It is estimated that Argyle production represents approximately 10% of all Indian diamond imports. In terms of end-user markets, US demand conditions have a significant flow-on effect for the State's industry. About half of the global trade in gem quality diamonds is destined for the supply of US customers and 35% of diamond exports from the Indian cutting and polishing industry are destined for the US.

In 2002, performance of the world diamond industry improved. Rough sales, rough imports, polished imports and retail diamond jewellery sales, in general, showed healthy growth. For example, rough imports by Israel and India were up by 30% and 49%, respectively compared to 2001. Despite an unfavourable environment of threats of war and recession, falling stock market and plummeting consumer confidence, the world retail diamond jewellery sales also increased by about 3%. The US market, which accounts for 50% of the world's US\$56-billion diamond jewellery retail market was particularly resilient. After falling as much as 20% in the second half of 2001, open market prices for rough diamonds in many of the small and medium gem-quality size ranges recovered strongly in early 2002. Christmas season, diamond jewellery sales were particularly strong. However, prices softened again in the second half of 2002, despite prices for some categories, such as large white stones, remaining strong throughout the year.

In 2002, a highlight of the Western Australian diamond industry was the opening of stage 1 of the new Ellendale diamond mine near Broome in the Kimberley region. The commencement of production at the Ellendale mine marks the end of Argyle's 20-year role as the State's sole diamond producer. The commencement of operations followed amendment of legislation to excise the Ellendale Diamond Lease from the *Diamond (Argyle Diamond Mines Joint Venture) Agreement Act 1981-83*, facilitating the transfer of the tenement from its former Argyle owners to Perth based Kimberley Diamond Company. The new lease extends over 117 sq km of the West Kimberley and includes 13 diamondiferous pipes.

Full-scale mining operations commenced at Ellendale in July 2003. Total sales for the first year of operation by June 2003 amounted to 47 931 carats, representing more than 110 000 diamonds valued at \$12.2 million. Average sale prices were US\$159 per carat for the 10 sales completed to date. According to Kimberley Diamond Company NL, mining and processing operations at Ellendale are currently approaching the annualised rate of 600 000 t/a of ore for Stage 1 of the project. However, in the long-term, treatment rates of between 2 and 4 Mt/a are expected. Stage 1 of the Ellendale project is focused on the Ellendale Pipe 9 comprising rich near-surface resources. After 12 to 15 months the project will shift its focus to the near surface zone of Ellendale 4. Off-site construction work is currently underway on a new 2.2 Mt/a production plant which will be located adjacent to current operations at Ellendale Pipe 9 as part of the Stage 2A expansion program. On-site construction is scheduled to commence in August 2003, with the new plant expected to be fully operational by 1 December 2003.

Western Australia's Kimberley region has been experiencing a renaissance. Renewed interest in the area is evident in the opening of the Ellendale mine as well as a series of new joint ventures and exploration activities.

An agreement was announced in March 2002 between Striker Resources NL and joint venture partner AKD Limited to explore for diamonds at the Seppelt Range diamond prospect in the Kimberley. The joint venture has returned good initial results with the Seppelt 2 kimberlite pipe producing initial findings comprising 2.25 carats per tonne, a result, which potentially signifies a world-class grade. Striker Resources is the largest holder of ground in the north Kimberley, with tenements covering an area of 9 000 sq km.

Flinders Diamond Limited has indicated that it plans to explore in an area 200 km southwest of the Argyle Diamond mine known as Skeleton Flat. The company is also hoping to open South Australia's first diamond mine either at its Springfield or Adelaide Hills projects. Exploration in the Kimberley region has also attracted explorers including Thundelarra Exploration and Diamond Rose NL.

In other more global developments, in 2002, the United Nations regulatory initiative known as the Kimberley

Process gained considerable momentum. The process is an international monitoring system which is designed to stem the trade of 'conflict diamonds' – defined as those rough diamonds used by rebel movements or their allies to finance weapons, fuels and other material used to undermine legitimate governments. This issue is particularly pertinent in certain areas of Africa such as Angola, the Democratic Republic of Congo and Sierra Leone where atrocities against humanity have been funded by the illicit trade in conflict diamonds. It is estimated that conflict diamonds account for about 4% of the world diamond market.

The Kimberley Process includes the signing of the Conflict Diamonds Treaty by all nations producing, trading and manufacturing rough diamonds. Under the Kimberley Process, a system of import and export controls has been introduced. Signatory nations will be required not to accept imports from, nor allow exports to, other nations that have not signed the treaty. In addition, an international certification scheme comprising Kimberley Process Certificates (KPCs) will accompany all rough diamond shipments.

In July 2002, the World Diamond Congress resolved to implement the process. On 1 January 2003, the Kimberley Process came into effect. About 45 countries have implemented the Kimberley Process. Since then, all exports of rough diamonds from the participating countries must be shipped in sealed containers and must be accompanied by a Kimberley certificate. All invoices for sales within the trade must contain a warranty signed by the seller stating that the diamonds have been purchased from legitimate sources not involved in funding conflict and in compliance with UN resolutions.

At a State level, a new Western Australian Police Service Unit, named the Diamond and Pearl Investigation Unit, has been formed to focus on investigating crime and identifying security issues specific to the diamond and pearling industries. The Unit will specifically target systematic and organised theft as well as offer support to companies to resolve security problems.

3.10 Base Metals

Base metal production in Western Australia is limited in scope and not of a scale comparable with the larger operations in the East of Australia. In 2002, Western

Australia sold \$354 million worth of base metals, accounting for about 1% of the State's total mineral and petroleum sales.

Zinc is the primary product in the State's base metal sector, accounting for 49% of the total sales by the sector followed by copper with a share of 42%. The rest (9%) was accounted for by lead.

In Western Australia, zinc is mined at two operations being Newmont Mining's (through Murchison Zinc Company) Golden Grove operation, 225 km east of Geraldton and Western Metals' Lennard Shelf operations, 40 km south of Fitzroy Crossing in the Kimberley.

The chief copper producers in Western Australia, accounting for more than 80% of the State's output are Straits Resources' Nifty project in the Pilbara which produces cathode-grade metal and the aforementioned Murchison Zinc's Golden Grove operation. Remaining copper is sourced as by-product from a range of nickel projects.

Like zinc, Western Australian lead production comes from only two sources, namely Murchison Zinc's Golden Grove operation and Western Metals' Lennard Shelf operations.

A large proportion of base metals produced in Western Australia are exported, with export shares ranging from 42% (copper) to 75% (lead). In 2002, China was the largest export market for Western Australia's copper and lead, accounting for 77% and 66%, respectively, of the State's total exports. Japan is the second largest importer of Western Australia's copper while South Korea is the second largest importer of Western Australia's lead. In 2002, 21% of the State's copper exports were delivered to Japan and 32% of the State's lead exports were shipped to South Korea. Zinc exports are more evenly distributed, with Japan accounting for 27% of the State's total, Thailand 20%, Belgium 16%, the US 12% and China 8%.

Although 2002 saw the volume of Western Australian copper and zinc sold rise by 33% and 4% respectively, the value of these sales was lower compared with 2001 due to the sluggish market conditions. Driven by hedge funds aiming to position themselves in the base metal markets prior to a resumption in global growth, base metal prices strengthened in the first half of 2002

and again in late 2002. However, with a continuing decline in the fortunes of the global economy, these rallies eventually failed and base metal prices as a whole were down in 2002 compared to the previous year. The average zinc price of US\$779/t in 2002 was 12% below its equivalent price in 2001. Lead prices slipped on average 5% lower to average at US\$453/t in 2002. At around US\$1560/t, copper prices also remained relatively lacklustre in 2002 and little changed from the previous year. The fall in base metal prices was exacerbated by a stronger Australian dollar. Consequently, the Western Australian base metals industry suffered a 5% drop in sales value compared with 2001.

The most significant contributor to the fall in sales value was zinc. Despite a 4% increase in sales volumes, the substantial fall in world zinc prices in combination with a stronger Australian dollar resulted in the sales value of the State's zinc industry falling by 17% to \$173 million. Given the dominant share of zinc in the State's base metal sales, the significant contraction in the sales value of zinc had a much larger negative impact on the performance of the base metal sector than lead, which also experienced a 27% fall in the sales value.

The long-term fortunes of base metals will in general depend on the cycle of the world economy, in particular the US economy and fundamental changes in intensity of metal usage. However, as demand and supply conditions are different, the outlook for each individual metal is likely to vary in the short term. The copper price has been on an upward path since October last year, when smelters began to feel the effects of mine production cutbacks. Although copper demand in the Western world continues to be weak, demand in other regions, particularly China, remains strong. As reported by The Mining Journal, China became the world's largest copper consumer in 2002, with its demand surpassing that of the US by 10%. According to Bloomsbury Mineral Economics, 2003 may see Chinese copper demand reach 3.25 Mt, exceeding forecast US consumption by 25%. The strong growth of Chinese demand will be an important supportive factor for copper prices. But any easing in supply-side discipline aiming to capitalise on rising prices will dampen the price improvement. Lead and zinc are also likely to benefit from buoyed demand in China. According to the International Lead & Zinc Study Group (ILZSG), despite a forecast 2% fall in the US demand due to continuing sluggish conditions in

the industrial battery sector, strong growth in China will more than offset the fall in the US and world refined lead demand is anticipated to rise by 2% in 2003. For zinc, world demand is forecast to rise by 4% in 2003, again with the strongest growth of 6% in China. Demand in the US and Europe is also projected to grow modestly at 3% and 2%, respectively. On balance, ILZSG forecasts a deficit for lead but a surplus for zinc in 2003.

3.11 Other minerals

Coal

Western Australia has two coal producers, Wesfarmers and Griffin. They are located in the south-west of the State and all of the State's coal supplies are sold on the domestic market. The majority is used by Western Power for electricity generation. The quantity of coal sales were only marginally higher by 1% in 2002 to reach 6.3 Mt. The value of these sales was up by 3% to \$266 million.

Salt

In 2002 the quantity of salt sales increased by 7% to 9.2 Mt. Due to the appreciation of local currency, the value of Western Australian salt sales increased by 2% only to \$255 million.

The major salt producer in Western Australia is Dampier Salt, a majority-owned company of Rio Tinto which originally established the Dampier salt field in 1972 and purchased the Lake MacLeod operation in 1978. Dampier Salt also has a gypsum operation at Lake MacLeod. After the acquisition of Cargill's Port Hedland salt operation in July 2001, Dampier Salt's production capacity has been significantly expanded to nearly 9 Mt to become the world's largest salt exporter.

Dampier Salt's production is exported, principally to Asia, with its largest customers in the chemical industry in Japan, South Korea, Taiwan and Indonesia. A proportion of output is used for food processing and domestic consumption in Malaysia and the Philippines.

Onslow Salt has also played an important role in boosting the State's salt production during 2002. The Onslow Salt project began harvesting in April 2001 with first shipments being made in the latter half of 2001. The Onslow salt project is now the seventh solar salt field in Western Australia.

Tin-Tantalum-Lithium

In the Tin-Tantalum-Lithium group, although the sales of spodumene and tin metal suffered in 2002 due to weak prices, the Western Australian tantalum sector's production expanded. The sales volume of tantalum increased by 22% while the sales value increased by 12%. The increase in tantalum's sales has more than offset the fall in spodumene and tin metal, resulting in the sales value of the Tin-Tantalum-Lithium group as a whole rising by 8% on 2001 to \$222 million.

Tantalum is a rare, grey-blue metal. It is chiefly used in the electronics industry for manufacturing capacitors, with the electronics industry accounting for approximately 60% of total global demand. Another fast growing application for tantalum is as an alloy in the manufacture of turbine blades for power stations and jet engines, as tantalum improves structural integrity of the blades, enabling the turbines to operate at higher temperatures.

Western Australia is the sole source of tantalum production in Australia, with output of tantalum concentrate (30% Ta₂O₅) chiefly emanating from Sons of Gwalia's (SOG) operations in Greenbushes and Wodgina. Significantly, Greenbushes and Wodgina are the world's largest and second-largest tantalum mines, respectively and the two mines together constitute about half of the world's defined tantalum resources. In total, output from these operations currently accounts for 45% of world supply.

Dramatic increases in tantalum sale volumes during 2002 were mainly attributable to expansion of SOG's operations. Additional output also came from a new producer, Haddington International Resources which commenced mining operations in May-July 2001 at Bald Hill, in the Eastern Goldfields region. In addition to the Haddington operation commencing, the second half of 2002 also saw Australasian Gold Mines NL commence mining operations at Dalgaranga in the Murchison.

Cobalt

The growing nickel industry in Western Australia and burgeoning prominence of nickel laterite projects has seen the State exhibit a commensurately significant increase in its output of cobalt as a nickel by-product. Ten years ago the volume of the State's cobalt sales was less than 500 tonnes, valued at little over \$6 million. In 2002, the volume was 4 855 t, with a sales value of \$122 million.

Compared with 2001, the sales volume increased by 14%, which was in keeping with the growing nickel sales output. However, cobalt prices fell by 33% due to sluggish world economic growth and worldwide over-supply of cobalt, averaging US\$7.20/lb during the year, compared to US\$10.80/lb in 2001. This dramatic fall in prices translated to the value of Western Australian cobalt sales dropping by 17% in 2002.

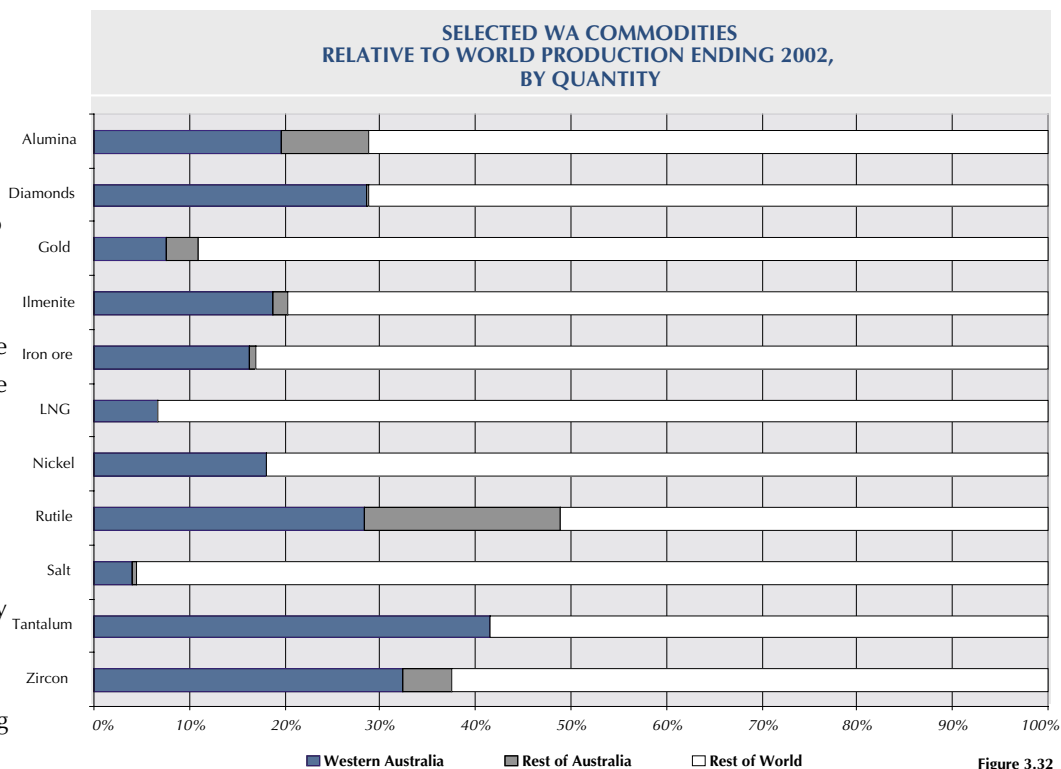
Since sliding to multi-year lows at under US\$6/lb in October 2002, cobalt prices have been recovering. The average price in June 2003 was US\$11.40/lb, up by 66% compared to US\$6.80/lb in December 2002. Production cuts and rising demand are primary factors underlying the rise. According to the Mining Journal, in North America, the OM Group Inc. announced in 2002 that it would cut its cobalt output to 7 200 t/a in 2003, representing a 28% cut of its worldwide cobalt refining capacity of 10 000 t/a. In addition, Canmine Resources Corp. in Ontario has been placed in liquidation and its cobalt refinery placed on care-and-maintenance. Significant cutbacks have also been conducted by African producers. Along with the supply-side cutbacks, rising demand primarily from within the lithium ion rechargeable battery industry that uses cobalt in the form of lithium cobalt dioxide, has contributed to the strengthening of cobalt prices.

In the face of extensive idle capacities, total sustainable recovery of the cobalt market in the medium to longer term depends on strong and sustainable recovery of the global economy. This particularly applies to the aerospace sector which has been struggling under continuing terrorist threats since 11 September 2001.

Manganese

In Western Australia manganese is produced by Consolidated Minerals from its Woodie Woodie operation in the Pilbara. The company re-commenced mining operations at Woodie Woodie in May 1999. Following industry consolidation, the Company is the only independent supplier of high-grade manganese ore in the Asian region.

A key milestone was celebrated in March 2002 with the shipment of the millionth tonne of high-grade manganese ore from the Woodie Woodie Manganese Mine. In 2002, Consolidated Minerals sold 578 t of manganese, up 16% on the previous year. However, due to weaker prices and a stronger Australian dollar, the sales value remained virtually unchanged, amounting to \$76 million. Manganese produced in the State was mainly for export. Major overseas markets in 2002 comprised China (41%), Ukraine (41%) and South Korea (14%).



Source: DoIR, ABARE and USGS

The latest comparable data show that the Western Australian share (by quantity) of the world's output of the following products was: alumina 20%, gold 8%, ilmenite 19%, iron ore 16%, LNG (sea borne trade) 7%, nickel 18%, rutile 28%, salt 4%, tantalum 42%, zircon 32% and 29% of diamonds (mainly industrial grade)

TABLE 1 QUANTITY AND VALUE OF MINERALS AND PETROLEUM					
COMMODITY	UNIT	2001		2002	
		QUANTITY	VALUE	QUANTITY	VALUE
ALUMINA	t	10,748,039	3,766,551,734	11,166,119	3,400,602,886
BASE METALS					
Copper Metal	t	50,236 (r)	120,710,541 (r)	66,761	148,593,748
Lead Metal	t	91,383	44,902,919 (r)	70,397	32,690,023
Zinc Metal	t	210,837 (r)	208,717,514 (r)	218,803	173,064,117
TOTAL BASE METALS			374,330,974 (r)		354,347,888
CHROMITE	t	6,087	996,294	22,668	3,948,138
CLAYS					
Attapulgite	t	13,194	1,377,850	11,926	1,245,433
Clay Shale	t	7,194	71,940	15,822	158,220
Fire Clay	t	29,371	56,215	2,470	55,104
Kaolin	t	480	50,618	377	36,155
Saponite	t	1,659	125,641	1,191	75,940
TOTAL CLAYS			1,682,264		1,570,852
COAL	t	6,204,695	258,211,794	6,262,538	266,402,673
CONSTRUCTION MATERIALS					
Aggregate	t	519,620	4,190,023	589,339	5,726,287
Gravel	t	177,397 (r)	1,177,292 (r)	340,808	1,269,255
Rock	t	252,791	1,944,452	352,261	3,543,190
Sand	t	1,175,565 (r)	5,756,683 (r)	1,644,511	7,642,108
Sandstone	t	0	0	868	47,740
TOTAL CONSTRUCTION MATERIALS			13,068,450 (r)		18,228,580
DIAMONDS	ct	21,679,930	499,534,159	34,367,807	652,459,470
DIMENSION STONE					
Granite	t	928 (r)	208,436 (r)	639	171,900
Marble	t	227	80,620	515	183,099
Other	t	0	0	435	226,690
TOTAL DIMENSION STONE			289,056 (r)		581,689
GEM & SEMI-PRECIOUS STONES	kg	148,787	135,243	506,929	441,431
GOLD	kg	192,204 (r)	3,236,195,818 (r)	188,757 (e)	3,457,230,086
GYPSUM	t	1,092,060 (r)	23,070,405 (r)	1,502,432	25,062,941
HEAVY MINERAL SANDS					
Garnet	t	108,698	n/a	101,845	n/a
Ilmenite	t	834,385 (r)	137,315,560	837,525	128,823,975
Upgraded Ilmenite (a)	t	646,459	418,660,055	586,993	364,811,013
Leucoxene	t	24,792	12,149,759	43,750	21,205,504
Rutile	t	112,927	99,085,695	125,411	102,663,206
Staurolite	t	1,021	169,505	2,120	330,906
Zircon	t	353,169	229,999,326	366,452	244,554,353
TOTAL HEAVY MINERAL SANDS			897,379,900		862,388,957
INDUSTRIAL PEGMATITE MINERALS					
Feldspar	t	29,733	1,494,518	61,828	3,082,424
IRON ORE					
Domestic	t	7,282,826	235,698,057	6,599,275	192,414,071
Exported	t	158,731,693 (r)	5,134,014,112 (r)	165,165,180	4,872,460,443
TOTAL IRON ORE		166,014,519 (r)	5,369,712,169 (r)	171,764,455	5,064,874,514
LIMESAND-LIMESTONE-DOLOMITE					
Dolomite	t	10,221 (r)	164,408 (r)	17,449	324,278
Limesand-Limestone	t	3,511,669 (r)	15,444,737 (r)	3,596,373	15,177,942
TOTAL LIMESAND-LIMESTONE-DOLOMITE			15,609,145 (r)		15,502,220

TABLE 1 QUANTITY AND VALUE OF MINERALS AND PETROLEUM					
COMMODITY	UNIT	2001		2002	
		QUANTITY	VALUE	QUANTITY	VALUE
MANGANESE ORE	t	498,603	76,091,438	578,388	75,626,451
NICKEL INDUSTRY					
Cobalt By-Product	t	2,008 (r)	77,843,596 (r)	2,197	56,481,268
Cobalt Metal	t	1,483	48,471,747	2,143	51,122,414
Cobalt Sulphide	t	774 (r)	19,958,728 (r)	514	14,166,005
TOTAL COBALT			146,274,071 (r)		121,769,687
Nickel Concentrate	t	1,010,419 (r)	1,671,766,445 (r)	1,233,825	1,840,524,648
Nickel Metal	t	35,301	402,713,927	32,012	401,212,339
Palladium By-Product	kg	828	32,267,391	811	16,146,791
Platinum By-Product	kg	174	5,302,472	122	2,945,218
TOTAL NICKEL INDUSTRY			2,258,324,306 (r)		2,382,598,683
PETROLEUM					
Condensate	kl	6,015,068	1,787,908,337	6,878,561	1,928,576,225
Crude Oil	kl	14,061,255	4,246,653,099	15,216,491	4,457,025,360
LNG	Btu 10 ⁶	389,175,965 (r)	2,945,056,448 (r)	394,112,142	2,791,216,449
LPG - Butane	t	475,246	217,539,558	458,153	197,559,482
LPG - Propane	t	385,834	185,081,893	357,413	165,884,336
Natural Gas	'000m ³	7,741,021	646,370,705	7,851,893	659,905,719
TOTAL PETROLEUM			10,028,610,040		10,200,167,571
PIGMENTS					
Red Oxide	t	1,939 (r)	380,812 (r)	2,081	456,825
SALT	t	8,576,415	249,240,285	9,171,463	255,375,152
SILICA-SILICA SAND					
Silica	t	98,162	981,620	99,232	992,320
Silica Sand	t	509,761 (r)	6,403,228 (r)	532,433	5,797,318
TOTAL SILICA-SILICA SAND			7,384,848 (r)		6,789,638
SILVER	kg	122,780 (r)	30,716,237 (r)	98,896	24,917,841
SPONGOLITE	t	14,300	1,908,974	12,693	1,817,362
TALC	t	160,867	14,201,162	132,211	11,775,309
TIN-TANTALUM-LITHIUM					
Spodumene	t	79,859	n/a	79,085	n/a
Tantalite	t	806	n/a	985	n/a
Tin Metal	t	976	7,787,068	763	4,967,874
TOTAL TIN-TANTALUM-LITHIUM			205,733,427		222,102,027
VANADIUM	t	4,450	25,297,369	5,614	30,929,289
TOTAL VALUE			27,356,150,820 (r)		27,339,280,897

Note: Quantities used in this table only apply to Minerals and Petroleum covered by the Mining Act 1978, the Petroleum Act 1967, the Petroleum (Submerged Lands) Act 1982 and relevant State Agreement Acts.

(a) Also known as synthetic rutile

(e) Estimate

(r) Revised from previous edition

n/a Breakdown of garnet, spodumene and tantalite values not available

TABLE 2 QUANTITY AND VALUE OF SELECTED MAJOR COMMODITIES MAJOR COMMODITIES

	Unit	1993		1994		1995		1996	
		Quantity	Value \$M	Quantity	Value \$M	Quantity	Value \$M	Quantity	Value \$M
ALUMINA	Mt	7.80	1,891.86	7.93	1,684.58	8.07	1,757.36	8.25	1,967.81
BASE METALS									
Copper Metal	kt	28.98	30.21	35.11	68.13	24.31	73.29	23.07	51.28
Lead Metal	kt	32.28	7.84	20.29	7.32	15.64	8.25	17.08	9.90
Zinc Metal	kt	141.10	87.02	123.62	85.14	126.34	87.73	106.86	71.28
TOTAL BASE METALS			125.07		160.59		169.27		132.46
COAL	Mt	5.47	248.44	5.03	234.02	6.06	280.66	5.81	268.38
COBALT	kt	0.30	10.92	0.66	35.84	0.82	56.37	0.94	63.52
DIAMONDS	M ct	22.65	486.77	27.72	470.34	23.45	480.15	47.43	442.01
GOLD	tonnes	183.47	3,139.61	192.98	3,265.93	189.48	3,163.66	221.18	3,528.64
HEAVY MINERAL SANDS									
Ilmenite	Mt	1.01	85.40	1.08	93.52	1.00	96.27	1.08	114.29
Rutile	kt	56.60	29.97	87.16	44.46	124.87	68.14	110.65	79.17
Upgraded Ilmenite (Synthetic Rutile)	kt	375.00	174.42	453.00	208.47	535.00	254.58	522.00	258.23
Zircon	kt	299.76	46.26	444.26	99.00	458.44	152.54	372.70	197.54
Other HMS			6.49		6.62		8.07		25.26
TOTAL HEAVY MINERAL SANDS			342.54		452.07		579.60		674.49
IRON ORE	Mt	116.34	2,996.73	124.26	2,630.61	135.97	2,980.69	133.65	2,924.48
MANGANESE ORE	kt	247.86	43.40	202.52	22.74	227.90	28.42	296.81	32.67
NICKEL METAL	kt	55.46	437.74	77.00	630.13	101.36	1,094.17	108.38	1,033.88
PETROLEUM									
Condensate	Gl	2.17	359.86	2.34	331.19	3.83	564.91	4.97	773.72
Crude oil	Gl	4.05	709.32	8.75	1,299.75	8.68	1,384.83	11.26	1,958.82
LNG	Btu 10 ¹²	264.75	997.88	335.11	1,080.17	375.37	1,390.75	377.82	1,391.20
LPG - Butane	kt	-	-	-	-	19.42	4.73	158.96	37.44
LPG - Propane	kt	-	-	-	-	14.14	3.44	150.84	36.93
Natural Gas	Gm ³	4.21	422.96	4.92	441.96	5.83	421.92	6.62	494.68
TOTAL PETROLEUM			2,490.02		3,153.07		3,770.58		4,692.80
SALT	Mt	6.53	159.57	6.86	153.49	7.29	155.81	7.21	143.61
OTHER			101.85		113.83		126.44		144.19
TOTAL			12,474.52		13,007.24		14,643.18		16,048.94

1997		1998		1999		2000		2001		2002	
Quantity	Value \$M	Quantity	Value \$M	Quantity	Value \$M	Quantity	Value \$M	Quantity	Value \$M	Quantity	Value \$M
8.48	2,084.71	8.75	2,429.70	8.93	2,311.38	10.00	3,187.47	10.75	3,766.55	11.17	3,400.60
28.32	62.46	28.24	57.13	26.23	46.25	34.04	82.61	50.24	120.71	66.76	148.59
23.20	9.91	39.52	15.09	55.28	17.23	73.08	25.76	91.38	44.90	70.40	32.69
117.20	118.10	149.33	127.85	222.54	219.59	257.72	290.11	210.84	208.72	218.80	173.06
	190.47		200.07		283.07		398.48		374.33		354.35
5.69	260.53	5.61	249.35	6.23	268.02	6.20	257.84	6.20	258.21	6.26	266.40
1.27	84.58	1.22	58.77	1.01	37.68	3.59	157.66	4.26	146.27	4.85	121.77
40.42	421.19	52.27	642.39	51.64	640.06	42.30	713.68	21.68	499.53	34.37	652.46
238.34	3,414.61	231.43	3,477.73	211.55	2,939.98	199.04	3,078.65	192.20	3,236.20	188.76	3,457.23
1.23	133.59	1.29	150.85	1.24	152.95	1.30	185.47	0.83	137.32	0.84	128.82
111.78	78.53	96.93	76.45	113.40	82.26	122.15	100.58	112.93	99.01	125.41	102.66
581.00	292.86	529.48	289.79	522.93	288.01	617.53	377.50	646.46	418.66	586.99	364.82
292.79	160.34	277.35	154.37	322.94	139.14	347.93	172.11	353.17	230.00	366.45	244.55
	22.86		26.13		26.13		27.27		24.23		21.54
	688.18		697.59		688.49		862.93		909.22		862.39
151.72	3,633.34	143.75	4,103.92	143.01	3,517.17	158.87	4,365.19	166.01	5,369.71	171.76	5,064.87
176.99	22.15	79.43	8.13	108.16	13.20	259.53	33.61	498.60	76.09	578.39	75.63
122.99	1,136.00	143.08	1,039.12	121.89	1,084.96	153.51	2,243.28	181.17	2,074.48	183.18	2,241.73
6.44	1,103.31	6.41	887.06	5.57	1,013.30	6.20	1,946.37	6.02	1,787.91	6.88	1,928.58
9.54	1,719.80	10.98	1,497.55	8.49	1,559.29	13.74	4,472.42	14.06	4,246.65	15.22	4,457.03
375.60	1,595.47	387.96	1,402.12	387.38	1,486.32	384.64	2,524.83	445.14	2,901.26	394.11	2,791.22
320.43	93.17	384.54	86.31	390.08	116.55	450.57	225.36	475.25	217.54	458.15	197.56
253.82	73.83	263.82	55.87	260.44	81.77	364.53	183.36	385.83	185.08	357.41	165.88
7.33	571.51	6.33	527.96	6.60	569.33	6.93	607.64	7.74	646.37	7.85	659.91
	5,157.09		4,457.20		4,826.57		9,959.98		9,984.81		10,200.17
8.12	172.12	8.48	210.17	9.02	212.74	7.71	197.32	8.58	249.24	9,171.46	255.38
	101.69		206.14		192.81		297.01		367.71		386.30
	17,366.66		17,780.28		17,016.13		25,753.10		27,312.35		27,339.28

TABLE 3 CALENDAR YEAR 2002
QUANTITY AND VALUE BY LOCAL GOVERNMENT AREA

COMMODITY	LOCAL GOVT AUTHORITY	QUANTITY (TONNES)	METALLIC CONTENT	VALUE	Ref (p. 58)
ALUMINA	Boddington	3,303,669		1,075,781,052	
	Murray	5,464,511		1,617,032,228	
	Warooka	2,397,939		707,789,606	
TOTAL ALUMINA		11,166,119		3,400,602,886	(c), (d)
BASE METALS			Cu tonnes		
Copper By-Product	Coolgardie		7,264	11,943,174	
	Dundas		299	834,400	
	Kalgoorlie-Boulder		29	88,840	
	Ravensthorpe		125	363,169	
	Roebourne		4,338	12,729,293	
	Wiluna		289	819,757	
	Total			12,344	26,778,633
			Cu %		
Copper Concentrates	Yalgoo	152,084	21.03	62,552,810	(a)
			Cu tonnes		
Copper Cathode	East Pilbara		22,436	59,262,305	(a)
Total Copper				148,593,748	(a), (b)
			Pb %		
Lead	Derby-West Kimberley	89,122	73.31	30,403,525	
	Yalgoo	19,217	26.33	2,286,498	
	Total	108,339	64.98	32,690,023	(a)
			Zn %		
Zinc	Derby-West Kimberley	270,599	58.02	123,834,174	
	Yalgoo	151,020	40.93	49,229,943	
	Total	421,619	51.90	173,064,117	(a)
TOTAL BASE METALS				354,347,888	
CHROMITE	Meekatharra	57,142	Cr ₂ O ₃ % 39.67	3,948,138	(a)
CLAY					
Attapulgit	Mullewa	11,926		1,245,433	
Clay Shale	Collie	15,822		158,220	
Fire Clay	Broome	2,470		55,104	
Kaolin	Bridgetown-Greenbushes	377		36,155	
Saponite	Coorow	1,191		75,940	
TOTAL CLAY		31,786		1,570,852	(e)
COAL	Collie	6,262,538		266,402,673	(f)
CONSTRUCTION MATERIALS					
Aggregate	Broome	85,269		2,268,561	
	East Pilbara	42,463		213,372	
	Port Hedland Town	32,967		169,394	
	Roebourne	313,821		2,447,672	
	Wyndham-East Kimberley	114,819		627,288	
	Total		589,339		5,726,287
Gravel	Broome	38,018		296,382	
	Collie	170,000		93,500	
	Coolgardie	29,064		160,234	
	Kalamunda	97,082		679,574	
	Port Hedland Town	2,436		15,664	
	Wyndham-East Kimberley	4,208		23,901	
	Total		340,808		1,269,255

COMMODITY	LOCAL GOVT AUTHORITY	QUANTITY (TONNES)	METALLIC CONTENT	VALUE	Ref (p. 58)
Rock	Broome	900		26,996	
	Derby-West Kimberley	84		422	
	Dundas	6,178		78,764	
	Kalgoorlie-Boulder	261,713		1,408,855	
	Karratha	82,939		2,025,912	
	Wyndham-East Kimberley	447		2,241	
	Total	352,261		3,543,190	
Sand	Ashburton	100		3,500	
	Broome	35,264		301,018	
	Coolgardie	56,303		296,758	
	Coorow	4,834		24,170	
	Dandaragan	1,754		8,981	
	Derby-West Kimberley	5,515		27,565	
	Esperance	6,146		30,729	
	Leonora	6,980		41,880	
	Marble Bar	20,644		103,219	
	Meekatharra	14,552		74,931	
	Menzies	16,034		80,168	
	Northam	79,187		395,935	
	Port Hedland Town	32,582		130,328	
	Roebourne	60,444		361,045	
	Wanneroo	1,296,354		5,721,914	
	Wyndham-East Kimberley	4,392		22,838	
Yilgarn	3,426		17,129		
	Total	1,644,511		7,642,108	
Sandstone	Wanneroo	868		47,740	
TOTAL CONSTRUCTION MATERIAL		2,927,787		18,228,580	(e)
DIAMONDS	Derby-West Kimberley		carats 24,232	5,832,178	
	Wyndham-East Kimberley		34,343,575	646,627,292	
TOTAL DIAMONDS			34,367,807	652,459,470	(a)
DIMENSION STONE					
Granite	Coolgardie	171		27,900	
	Dundas	446		142,900	
	Roebourne	22		1,100	
	Total	639		171,900	
Marble	Ashburton	515		183,099	
Other	Marble Bar	435		226,690	
TOTAL DIMENSION STONE		1,589		581,689	(e)
GEM & SEMI-PRECIOUS STONE					
			kg		
	Ashburton	1,280		989	
	Carnarvon	203,581		182,741	
	Marble Bar	279,800		244,450	
	Meekatharra	22,268		13,251	
TOTAL GEM & SEMI-PRECIOUS STONE		506,929		441,431	(d)
GOLD					
			Au kg		
	Boddington		143	2,593,633	
	Coolgardie		23,715	434,283,099	
	Cue		4,254	77,967,717	
	Dundas		4,079	74,783,256	
	East Pilbara		34	632,297	

TABLE 3 CALENDAR YEAR 2002 QUANTITY AND VALUE BY LOCAL GOVERNMENT AREA					
COMMODITY	LOCAL GOVT AUTHORITY	QUANTITY (TONNES)	METALLIC CONTENT	VALUE	Ref (p. 58)
GOLD (cont.)	Halls Creek		48	898,918	
	Kalgoorlie-Boulder		48,125	881,968,070	
	Laverton		14,861	272,041,411	
	Leonora		40,293	737,960,064	
	Meekatharra		14,748	270,206,978	
	Menzies		4,275	78,369,080	
	Mt Magnet		6,470	118,601,162	
	Sandstone		3,353	61,267,347	
	State-wide		665	12,055,236	
	Wiluna		13,724	251,198,004	
	Yalgoo		3,109	57,009,605	
	Yilgarn		6,860	125,394,208	
TOTAL GOLD			188,757	3,457,230,086	(g)
GYPSUM	Carnarvon	1,202,256		22,015,926	
	Corrigin	4,696		72,246	
	Dalwallinu	78,168		1,097,616	
	Dandaragan	44,784		447,840	
	Dundas	49,578		346,559	
	Esperance	5,155		41,240	
	Kent	20,745		269,691	
	Koorda	150		3,000	
	Lake Grace	26,270		232,374	
	Merredin	3,584		34,006	
	Nungarin	13,783		98,956	
	Perenjori	1,553		13,977	
	Ravensthorpe	14,670		91,500	
	Wyalkatchem	36,565		292,526	
Yilgarn	475		5,484		
TOTAL GYPSUM		1,502,432		25,062,941	(f)
HEAVY MINERAL SANDS					
Garnet Sand	Northampton	101,845		n/a	
Ilmenite	Bunbury City	307,658	TiO ₂ % 54.66	51,252,194	
	Capel	250,569	54.00	40,085,435	
	Carnamah	123,372	57.96	12,453,304	
	Dandaragan	155,926	54.00	25,033,042	
	Total	837,525		128,823,975	
Upgraded Ilmenite	Capel	225,818	TiO ₂ % 92.00	135,313,419	
	Carnamah	183,086	92.00	109,706,610	
	Dandaragan	178,089	92.00	119,790,984	
	Total	586,993		364,811,013	
Leucoxene	Bunbury City	3,200	TiO ₂ tonnes 2,945	2,080,301	
	Capel	17,364	14,480	8,173,323	
	Dandaragan	23,186	18,479	10,951,880	
	Total	43,750	35,904	21,205,504	
Rutile	Bunbury City	3,926	TiO ₂ tonnes 3,671	3,487,841	
	Carnamah	92,061	86,652	74,975,234	
	Dandaragan	29,424	28,248	24,200,131	
	Total	125,411	118,571	102,663,206	
Staurolite	Dandaragan	2,120		330,906	

COMMODITY	LOCAL GOVT AUTHORITY	QUANTITY (TONNES)	METALLIC CONTENT	VALUE	Ref (p. 58)
			ZrO ₂ tonnes		
Zircon	Bunbury City	19,133	12,436	12,175,644	
	Capel	57,416	37,320	39,098,397	
	Carnamah	196,382	127,648	132,699,945	
	Dandaragan	93,521	60,789	60,580,367	
	Total	366,452	238,193	244,554,353	
TOTAL HEAVY MINERAL SANDS		2,443,522		873,368,293	(a)
INDUSTRIAL PEGMATITE MINERALS					
Feldspar	Marble Bar	60,096		3,045,580	
	Mukinbudin	1,732		36,844	
	Total	61,828		3,082,424	(e)
IRON ORE					
Domestic Ore	East Pilbara	6,599,275		192,414,071	
Exported Ore	Ashburton	76,150,475		2,208,798,322	
	Derby-West Kimberley	221,284		7,296,759	
	East Pilbara	85,211,140		2,546,121,428	
	Yilgarn	3,582,281		110,243,934	
	Total	165,165,180		4,872,460,443	
TOTAL IRON ORE		171,764,455		5,064,874,514	(a)
LIMESAND-LIMESTONE-DOLOMITE					
Dolomite	Lake Grace	7,315		146,300	
	Yilgarn	10,134		177,978	
	Total	17,449		324,278	
Limesand-Limestone	Broome	657		3,284	
	Carnamah	26,072		78,860	
	Cockburn	1,988,329		5,865,570	
	Coorow	16,378		81,890	
	Dandaragan	34,112		192,786	
	Dundas	145,055		2,175,825	
	Exmouth	2,469		23,152	
	Gingin	31,163		587,927	
	Irwin	180,153		512,222	
	Kwinana	9,175		35,685	
	Leonora	759,875		1,519,750	
	Manjimup	3,003		49,079	
	Shark Bay	637		89,180	
	Wanneroo	353,967		3,872,076	
	Wiluna	45,328		90,656	
	Total	3,596,373		15,177,942	
TOTAL LIMESAND-LIMESTONE-DOLOMITE		3,613,822		15,502,220	(e)
MANGANESE ORE					
	East Pilbara	578,388	Mn% 48.80	75,626,451	(a)
NICKEL INDUSTRY					
Co tonnes					
Cobalt By-Product	Coolgardie		1,408	33,929,955	
	Dundas		109	2,944,777	
	Kalgoorlie-Boulder		336	9,444,503	
	Ravensthorpe		34	950,663	
	Roebourne		186	5,529,288	
	Wiluna		124	3,682,082	
	Total		2,197	56,481,268	
Cobalt Metal	Kalgoorlie-Boulder		417	6,000,200	
	Laverton		1,726	45,122,214	
	Total		2,143	51,122,414	

TABLE 3 CALENDAR YEAR 2002
QUANTITY AND VALUE BY LOCAL GOVERNMENT AREA

COMMODITY	LOCAL GOVT AUTHORITY	QUANTITY (TONNES)	METALLIC CONTENT	VALUE	Ref (p. 58)
NICKEL INDUSTRY (continued)					
Cobalt Sulphide	Kalgoorlie-Boulder		514	14,166,005	
TOTAL COBALT			4,855	121,769,687	(a), (b)
			Ni tonnes		
Nickel Concentrates	Roebourne	31,055	3,416	41,828,865	
	Coolgardie	401,679	20,742	251,734,715	
	Dundas	40,304	5,581	69,753,396	
	Kalgoorlie-Boulder	132,636	28,231	339,614,741	
	Leonora	311,503	40,005	486,664,521	
	Ravensthorpe	57,707	2,360	30,253,023	
	Wiluna	258,941	50,835	620,675,387	
	Total	1,233,825	151,170	1,840,524,648	
			Ni tonnes		
Nickel Metal	Kalgoorlie-Boulder		6,722	82,262,116	
	Laverton		25,290	318,950,223	
	Total		32,012	401,212,339	
TOTAL NICKEL			183,182	2,241,736,987	(i)
			Pd kg		
Palladium By-Product	Coolgardie		744	14,718,734	
	Roebourne		67	1,428,057	
	Total		810	16,146,791	(b)
			Pt kg		
Platinum By-Product	Coolgardie		122	2,945,218	(b)
TOTAL NICKEL INDUSTRY				2,382,598,683	
PETROLEUM					
			Kilolitres		
Condensate	Ashburton	374,781		94,072,035	
	Carnamah	189		9,170	
	Irwin	1,169		292,760	
	Roebourne	6,502,422		1,834,202,260	
	Total	6,878,561		1,928,576,225	
			Kilolitres		
Crude Oil	Ashburton	3,988,532		1,200,653,300	
	Irwin	5,600		1,484,199	
	Roebourne	11,222,359		3,254,887,861	
	Total	15,216,491		4,457,025,360	
			Btu 10 ⁶		
LNG	Roebourne	394,112,142		2,791,216,449	
			Tonnes		
LPG - Butane	Roebourne	458,153		197,559,482	
			Tonnes		
LPG - Propane	Roebourne	357,413		165,884,336	
			'000 m ³		
Natural Gas	Ashburton	1,432,493		81,627,028	
	Carnamah	32,862		6,071,758	
	Irwin	143,216		17,941,515	
	Roebourne	6,243,322		554,265,418	
	Total	7,851,893		659,905,719	
TOTAL PETROLEUM PRODUCTS				10,200,167,571	(d)

COMMODITY	LOCAL GOVT AUTHORITY	QUANTITY (TONNES)	METALLIC CONTENT	VALUE	Ref (p. 58)
PIGMENTS					
Red Oxide	Cue	2,081		456,825	(a)
SALT					
	Ashburton	1,162,596		30,648,000	(a)
	Carnarvon	1,130,247		31,402,680	(a)
	Esperance	11,505		450,489	(h)
	Port Hedland Town	1,944,713		54,361,657	(a)
	Roebourne	3,809,915		106,423,474	(a)
	Shark Bay	999,809		26,227,467	(a)
	Wyalkatchem	141		12,406	(h)
	Yilgarn	112,537		5,848,979	(h)
TOTAL SALT		9,171,463		255,375,152	
SILICA-SILICA SAND					
Silica	Moora	99,232		992,320	
Silica Sand	Albany	78,061		1,617,000	
	Coolgardie	92,748		227,232	
	Swan	361,624		3,953,086	
	Total	532,433		5,797,318	
TOTAL SILICA-SILICA SAND				6,789,638	(a)
SILVER BY-PRODUCT					
			Ag kg		
	Coolgardie		158	42,447	(a), (j)
	Derby-West Kimberley		1,732	707,807	(a), (b)
	Roebourne		16,835	4,522,466	(a), (j)
	Statewide		28,372	7,055,765	
	Yalgoo		51,798	12,589,356	(a), (j)
TOTAL SILVER			98,896	24,917,841	
SPONGOLITE	Plantagenet	12,693		1,817,362	(h)
TALC	Meekatharra	16,979		2,268,624	
	Three Springs	115,232		9,506,685	
TOTAL TALC		132,211		11,775,309	(f)
TIN-TANTALUM-LITHIUM					
Spodumene	Bridgetown-Greenbushes	79,085	Li ₂ O tonnes 4,542	n/a	
Tantalite	Bridgetown-Greenbushes	907		n/a	
	Coolgardie	68		n/a	
	Yalgoo	10		n/a	
	Total	985		n/a	
Tin	Bridgetown-Greenbushes		Sn Tonnes 763	4,967,874	
TOTAL TIN-TANTALUM-LITHIUM				222,102,027	(a)
VANADIUM	Mt Magnet		V ₂ O ₅ tonnes 5,614	30,929,289	(f)
TOTAL VALUE				27,339,280,897	

TABLE 4 ROYALTY RECEIPTS 2001 AND 2002				
COMMODITY	2001	2002	2002 Growth	
	Total Value	Total Value	\$	%
ALUMINA	62,545,602	57,229,192	-5,316,410	(9)
BASE METALS				
Copper	3,230,825	4,994,097	1,763,272	55
Lead	1,715,148	1,699,051	-16,097	(1)
Zinc	11,952,797	8,710,570	-3,242,227	(27)
TOTAL BASE METALS	16,898,770	15,403,718	-1,495,052	(9)
CHROMITE	137,106	59,472	-77,634	(57)
CLAYS	94,284	92,456	-1,828	(2)
COAL	13,252,070	16,154,724	2,902,654	22
CONSTRUCTION MATERIALS				
Aggregate	129,415	193,795	64,380	50
Gravel	46,620	112,559	65,939	141
Rock	81,859	80,622	-1,237	(2)
Sand	351,898	495,356	143,458	41
Sandstone	330	150	-180	100
TOTAL CONSTRUCTION MATERIALS	610,122	882,482	272,360	45
DIAMONDS	84,697,851	77,106,520	-7,591,331	(9)
DIMENSION STONE	908	896	-12	(1)
GEM & SEMI-PRECIOUS STONES	20,213	33,116	12,903	64
GOLD	79,146,827	81,952,569	2,805,742	4
GYPSUM	472,947	423,660	-49,287	(10)
HEAVY MINERAL SANDS				
Garnet	560,373	478,264	-82,109	(15)
Ilmenite	9,193,664	8,622,901	-570,763	(6)
Leucoxene	598,466	769,988	171,522	29
Rutile	5,880,116	4,465,756	-1,414,360	(24)
Staurolite	3714	17,966	14,252	100
Zircon	10,471,688	11,310,818	839,130	8
TOTAL HEAVY MINERAL SANDS	26,708,021	25,665,693	-1,042,328	(4)
INDUSTRIAL PEGMATITE MINERALS				
Feldspar	88,884	133,759	44,875	50
IRON ORE	285,627,924	272,499,984	-13,127,940	(5)
LIMESAND-LIMESTONE-DOLOMITE				
Dolomite	2,731	5,570	2,839	104
Limesand-Limestone	1,819,654	1,472,379	-347,275	(19)
TOTAL LIMESAND-LIMESTONE-DOLOMITE	1,822,385	1,477,949	-344,436	(19)
MANGANESE	3,652,817	3,226,856	-425,961	(12)
NICKEL INDUSTRY				
Cobalt by-product	2,405,614	2,098,585	-307,029	(13)
Nickel	53,134,322	46,654,437	-6,479,885	(12)
Palladium by-product	861,780	541,236	-320,544	(37)
Platinum by-product	95,250	97,161	1,911	2
Rhodium by-product	1,183	1,546	363	31
TOTAL NICKEL INDUSTRY	56,498,149	49,392,965	-7,105,184	(13)

COMMODITY	2001	2002	2002 Growth	
	Total Value	Total Value	\$	%
PETROLEUM				
Condensate	111,133,725	100,008,091	-11,125,634	(10)
Liquified Natural Gas	182,040,346	125,578,265	-56,462,081	(31)
LPG - Butane	14,876,844	9,838,950	-5,037,894	(34)
LPG - Propane	11,670,920	8,239,666	-3,431,254	(29)
Natural gas	37,723,670	33,465,536	-4,258,134	(11)
Crude Oil	137,004,815	161,366,777	24,361,962	18
TOTAL PETROLEUM	494,450,320	438,497,285	-55,953,035	(11)
PIGMENTS				
Red oxide	2,522	103,387	100,865	*
SALT	2,169,931	1,961,366	-208,565	(10)
SILICA SAND	313,633	314,292	659	0
SILVER	661,265	577,205	-84,060	(13)
SPONGOLITE	98,259	65,154	-33,105	(34)
TALC	86,651	75,166	-11,485	(13)
TIN-TANTALUM-LITHIUM				
Spodumene	897,060	1,002,951	105,891	12
Tantalite	4,228,808	4,992,273	763,465	18
Tin	209,998	130,818	-79,180	(38)
TOTAL TIN-TANTALUM-LITHIUM	5,335,866	6,126,042	790,176	15
VANADIUM	317,186	38,434	-278,752	100
TOTAL REVENUE	1,135,710,513	1,049,494,342	-86,216,171	(8)

Note: All Royalty Receipts above are only those paid to the Consolidated Revenue Fund during the period. It does not include royalty receipts collected on behalf of the Commonwealth.

* 2002 receipts reflect previous years adjustments

TABLE 5 AVERAGE NUMBER OF PERSONS EMPLOYED IN THE WA MINERALS AND PETROLEUM INDUSTRIES

MINERAL/Company	Operating Site	2001	2002
BASE METALS			
Barmenco Pty Ltd	Elizabeth Hill	1	5
Normandy Mining Ltd	Scuddles	313	300
Straits Resources Ltd	Nifty	474	488
Western Metals Ltd	Pillara	513	502
TOTAL BASE METALS		1,301	1,295
BAUXITE - ALUMINA			
Alcoa of Australia Ltd	Huntly	732	740
	Jarrahdale	20	0
	Kwinana Alumina Refinery	1,466	1,514
	Pinjarra Refinery	1,404	1,434
	Wagerup Alumina Refinery	942	1,002
	Willowdale	260	349
Australian Fused Materials Pty Ltd	Rockingham Fused Alumina Plant	204	169
Worsley Alumina Pty Ltd	Worsley - includes Mount Saddleback	209	214
	Worsley Refinery	1,332	1,211
TOTAL BAUXITE — ALUMINA		6,569	6,633
COAL			
Griffin Coal Mining Co. Pty Ltd	Muja	289	292
Wesfarmers Coal Ltd	Premier/WCL	388	357
TOTAL COAL		677	649
DIAMONDS			
Argyle Diamond Mines Pty Ltd	Lake Argyle	1,009	1,077
Kimberley Diamond Company NL	Ellendale	0	24
TOTAL DIAMONDS		1,009	1,101
GOLD			
AngloGold Australia Ltd	Sunrise Dam	579	675
Australian Gold Fields NL	Bannockburn	3	0
Australian Gold Resources Ltd	Gidgee	92	113
	Perth Mint	91	88
	First Hit	0	20
Barra Resources Ltd	Darlot	110	131
Barrick Gold Corporation	Lawlers	192	218
	Plutonic	430	542
	Norseman	223	206
Central Norseman Group	Coolgardie	0	50
Coolgardie Mining Company Pty Ltd	Davyhurst	90	114
Croesus Mining NL	Binduli	21	27
	Mayday North	2	0
	Hannan South	33	33
	Dalgaranga	55	0
Equigold NL	Kirkalocka	0	56
Gindalbie Gold NL	Minjar	17	63
Gold Fields Ltd	Emu	1,248	1,263
	Kambalda-St Ives	1,142	1,444
Hill 50 Gold NL	Hill 50, Mt Magnet	398	392
Kalgoorlie Consolidated Gold Mines Pty Ltd	Golden Mile - Superpit	1,180	1,238
King Solomon Mines Limited	Gullewa	0	36
Lakewood Mill Pty Ltd	Lakewood	11	10
LionOre Australia Pty Ltd	Thunderbox	0	147
Lynas Gold NL	Mt Olympus	41	45
Mines and Resources Australia Pty Ltd	White Foil	0	158

MINERAL/Company	Operating Site	2001	2002	
New Hampton Goldfields NL	Big Bell	445	440	
	Jubilee	221	90	
	New Celebration	121	276	
	Telfer	326	373	
Nickel Seekers	Daisy-Milano	16	21	
Normandy Yandal Operations Ltd	Bronzewing, Mt McClure	321	481	
	Jundee, Nimary	563	446	
	Wiluna	304	261	
Perilya Mines NL	Fortnum	21	0	
Placer Dome Inc	Granny Smith	586	463	
Placer Dome Asia Pacific Limited	Kanowna Belle	343	373	
	Lady Ida	30	0	
	Kundana	261	248	
	Paddington	403	310	
	Resolute Ltd	Chalice	2	5
		Higginsville	4	11
Sons of Gwalia NL	Carosue Dam	191	269	
	Marvel Loch	256	485	
	Sons of Gwalia	217	205	
	Tarmoola	356	275	
	Bluebird	247	307	
Troy Resources Ltd	Bulchina-Mt Klemptz	47	52	
Viceroy Australia Pty Ltd	Bounty	166	68	
Worsley Alumina Pty Ltd	Boddington	498	86	
Other		35	39	
TOTAL GOLD		11,938	12,653	
HEAVY MINERAL SANDS				
BHP Titanium Minerals Pty Ltd	Beenup	34	33	
Cable Sands Pty Ltd	Bunbury	347	316	
Doral Mineral Sands Pty Ltd	Dardanup	10	103	
GMA Garnet Pty Ltd	Narngulu Garnet Plant	28	32	
	Port Gregory	16	17	
	Rockingham Zirconia Plant	26	28	
Hanwah Advanced Ceramics Australia Pty Ltd	Rockingham Zirconia Plant	26	28	
Iluka Resources Limited	Capel	654	481	
	Eneabba	300	295	
	Narngulu Synthetic Rutile Plants	393	431	
TiWest Pty Ltd	Chandala-Muchea	247	183	
	Cooljarloo	283	251	
TOTAL HEAVY MINERAL SANDS		2,338	2,170	
IRON ORE				
BHP Iron Ore (Goldsworthy) Ltd	Finucane Island	235	414	
	Yarrie	193	188	
BHP Iron Ore (Jimblebar) Ltd	Jimblebar	110	141	
BHP Iron Ore Ltd	Mining Area C	0	161	
	Mt Newman Railway	348	571	
	Mt Whaleback	1,028	1,015	
	Nelson Point	702	876	
	Mt Newman Orebody 25	75	103	
	Port Hedland HBI Plant	979	796	
	Yandi	199	297	

TABLE 5 AVERAGE NUMBER OF PERSONS EMPLOYED IN THE WA MINERALS AND PETROLEUM INDUSTRIES

MINERAL/Company	Operating Site	2001	2002
IRON ORE (continued)			
Hamersley Iron Pty Ltd	Brockman No. 2 Detritals Group	175	58
	Dampier Port Operations	858	773
	Hismelt - Kwinana	143	322
	Marandoo	152	191
	Paraburdoo	687	634
	Hamersley Railway	382	96
	Tom Price	1,016	1,030
	Yandicoogina	224	249
Koolyanobbing Iron Pty Ltd	Cockatoo Island	18	46
	Koolyanobbing	70	134
Robe River Mining Co. Pty Ltd	Cape Lambert	483	544
	Pannawonica Deepdale	336	358
	Robe River Railway	152	20
	West Angelas Rail	93	10
	West Angelas Port Facility	247	111
	West Angelas Plant	198	151
TOTAL IRON ORE		9,103	9,289
NICKEL			
Murrin Murrin Operations	Murrin Murrin	578	591
Centaur Mining & Exploration	Cawse	268	215
Lightning Nickel Pty Ltd	Long - Victor	0	16
LionOre Australia (Nickel) Ltd	Emily Ann	104	147
Outokumpu Mining Australia Pty Ltd	Black Swan	261	268
Preston Resources Ltd	Bulong	303	323
Sir Samuel Mines NL	Cosmos	60	86
Tectonic Resources NL	RAV 8	89	59
Titan Resources NL	Radio Hill	88	52
Western Mining Corporation Ltd	Kalgoorlie Nickel Smelter	812	676
	Kambalda Group	404	266
	Kwinana Refinery	528	308
	Leinster	831	821
	Mt Keith	834	871
TOTAL NICKEL		5,160	4,699
PETROLEUM PRODUCTS			
Apache Energy Ltd	Campbell, Agincourt, Wonnich, East Spar, Harriet, Sinbad, Tanami, Stag, Chervil, North Herald,		
	South Pepper	208	230
ARC Energy NL	Dongara	6	6
BHP Billiton Petroleum (North West Shelf) Pty Ltd	Griffin	45	44
ChevronTexaco. Australia Pty Ltd	Barrow Island, Cowle, Roller, Skate, Saladin,		
	Yammaderry	158	119
Hardman Oil & Gas Pty Ltd	Woodada	5	5
Kimberley Oil NL	Lloyd	4	4
Mobil Exploration & Producing Australia Pty Ltd	Wandoo	29	38
Nexen Petroleum Australia Pty Ltd	Buffalo	20	20
Origin Energy Resources Ltd	Beharra Springs, Tubridgi	10	10
Petro Energy Pty Ltd	Mt Horner	2	2

MINERAL/Company	Operating Site	2001	2002
Woodside Energy Ltd	Cossack, Goodwyn, Hermes, Lambert, Legendre, North Rankin, Wanaea	759	703
TOTAL PETROLEUM PRODUCTS		1,246	1,181
SALT			
Dampier Salt Ltd	Port Hedland	93	88
	Dampier	274	249
	Lake MacLeod	213	170
Onslow Solar Salt Pty Ltd	Onslow	47	75
Shark Bay Salt JV	Useless Loop	72	66
TOTAL SALT		699	648
TOTAL CLAYS		75	73
TOTAL CONSTRUCTION MATERIALS		460	416
TOTAL DIMENSION STONE		91	93
TOTAL INDUSTRIAL PEGMATITE MINERALS		20	29
TOTAL LIMESTONE - LIMESAND		144	124
TOTAL MANGANESE ORE		81	108
TOTAL PHOSPHATE		172	177
TOTAL SILICA - SILICA SAND		200	207
TOTAL TALC		90	97
TOTAL TIN - TANTALUM - LITHIUM		501	505
TOTAL VANADIUM - LITHIUM		125	96
ALL OTHER MATERIALS		117	250
TOTAL		42,116	42,469

(Source: AXTAT Reporting System, Mining Operations Division)

TABLE 6

PRINCIPAL MINERAL AND PETROLEUM PRODUCERS

effective 1 July 2003

BASE METALS*Copper*

Newmont Australia
PO Box 1123,
West Perth WA 6872,
(08) 9366 3232,
Golden Grove.
www.newmont.com

Straits Resources Ltd
Level 1, 35 Ventnor Avenue,
West Perth WA 6005,
(08) 9480 0500,
Nifty,
www.straits.com.au

WMC Ltd
191 Great Eastern Highway,
Belmont WA 6104,
(08) 9479 0500,
Kambalda,
www.wmc.com.au

Lead-Zinc

Newmont Australia
PO Box 1123,
West Perth WA 6872,
(08) 9366 3232,
Golden Grove.
www.newmont.com

Western Metals Ltd
263 Adelaide Terrace,
Perth WA 6000,
(08) 9221 2555,
Lennard Shelf,
www.westernmetals.com.au

BAUXITE-ALUMINA*Alumina*

Alcoa World Alumina Australia,
181-205 Davy Street,
Booragoon WA 6154,
(08) 9316 5111,
Del Park, Willowdale, Huntly,
www.alcoa.com.au

Worsley Alumina Pty Ltd
PO Box 344,
Collie WA 6225,
(08) 9734 8311,
Boddington,
www.wapl.com.au

CHROMITE*Chromite Ore*

Pilbara Chromite Pty Ltd,
62 Colin Street,
West Perth WA 6005,
(08) 9321 3633,
Coobina,
www.consminerals.com.au

CLAY*Attapulgite*

Hudson Resources Ltd
James Street, Narngulu,
Geraldton WA 6530,
(08) 9923 3604,
Lake Nerramayne.

Clay Shale

The Griffin Coal Mining Company Pty Limited
28 The Esplanade,
Perth WA 6000,
(08) 9261 2800,
Collie
www.griffincoal.com.au

Fire Clay

Broome Brick Company Pty Ltd
PO Box 323,
Broome WA 6725
(08) 9192 1385
Broome

Kaolin

Gwalia Consolidated Ltd
16 Parliament Place,
West Perth WA 6005,
(08) 9263 5555,
Greenbushes,
www.sog.com.au

Saponite

Watheroo Minerals Pty Ltd
PO Box 353,
Dunsborough, WA 6281,
(08) 9756 6121,
Watheroo Clays,
www.bentoniteproductswa.com.au

COAL

The Griffin Coal Mining Company Pty Limited,
28 The Esplanade,
Perth WA 6000,
(08) 9261 2800,
Collie
www.griffincoal.com.au

Wesfarmers Premier Coal Ltd,
Premier Road,
Collie WA 6225,
(08) 9780 2222
Collie
www.wesfarmers.com.au

CONSTRUCTION MATERIALS*Aggregate*

The Readymix Group (WA)
75 Canning Highway,
Victoria Park WA 6100,
(08) 9212 2000,
Boodarrie, Burrup-Dampier,
www.readymix.com.au

Gravel

Boral Resources (WA) Ltd
63 Abernethy Road,
Belmont WA 6104,
(08) 9333 3400,
Grosmont,
www.boral.com.au

WA Limestone Co.
41 Spearwood Avenue,
Bibra Lake WA 6163,
(08) 9434 2299,
Pickering Brook.

Sand

Boral Resources (WA) Ltd
63 Abernethy Road,
Belmont WA 6104,
(08) 9333 3400,
Grosmont,
www.boral.com.au

Rocla Quarry Products
130 Fauntleroy Avenue,
Redcliffe WA 6104,
(08) 9475 2555,
Gnangarra,
www.rocla.com.au

The Readymix Group (WA)
75 Canning Highway,
Victoria Park WA 6100,
(08) 9212 2000,
Various sites,
www.readymix.com.au

Tuma Holdings Pty Ltd
42 Noel Road,
Gooseberry Hill WA 6076,
Mobile: 0408 923 801
The Lakes, Mundaring

DIAMONDS

Argyle Diamond Mines
2 Kings Park Road,
West Perth WA 6005,
(08) 9482 1166,
Argyle,
www.argylediamonds.com.au

Kimberley Diamond Company,
12 Walker Avenue,
West Perth WA 6005,
(08) 9321 5887,
Ellendale,
www.kimberleydiamondco.com.au

DIMENSION STONE*Granite*

Allied Granites Pty Ltd,
4 Koojan Avenue,
South Guildford WA 6055,
Fraser Range Granite.

Mungari Quarries Pty Ltd,
Level 2, 343 Pacific Highway,
North Sydney NSW 2060,
(02) 9957 2002,
Drydens Find Granite.

FELDSPAR

Unimin Australia Ltd
26-28 Tomlinson Road,
Welshpool WA 6106,
(08) 9362 1411,
Pippingarra, Mukinbudin,
www.unimin.com.au

GOLD

Abelle Limited
35 Ventnor Avenue,
West Perth WA 6005,
(08) 9485 1476,
Gidgee,
www.abelle.com.au

Agnew Gold Mining Co Pty Ltd
PMB 10,
Leinster WA 6437,
(08) 9088 3834,
Agnew,
www.goldfields.co.za

AngloGold Australia Ltd
Level 13, 44 St Georges Terrace,
Perth WA 6000,
(08) 9425 4600,
Sunrise Dam,
www.anglogold.com

Croesus Mining NL
39 Porter Street,
Kalgoorlie WA 6430,
(08) 9091 2222,
Binduli, Central Norseman,
Davyhurst,
www.croesus.com.au

Gindalbie Gold NL
PO Box 512,
West Perth WA 6872,
(08) 9481 2232,
Minjar,
www.gindalbie.com.au

Harmony Gold (Australia) Pty Ltd
10 Ord Street,
West Perth WA 6005,
(08) 9211 3100,
Big Bell, Jubilee, New Celebration,
Hill 50-Mt Magnet,
www.harmony.co.za

Barrick Gold of Australia Limited
2 Mill Street,
Perth WA 6000,
(08) 9212 5777,
Darlot, Lawlers, Plutonic,
www.barrick.com

Kalgoorlie Consolidated Gold Mines Pty Ltd
Private Bag 27,
Kalgoorlie WA 6433,
(08) 9022 1100,
Golden Mile,
www.kalgold.com.au

Menzies Gold Ltd,
122 Kewdale Road,
Kewdale WA 6105,
(08) 9353 7200,
King Solomon,
www.menziesgold.com.au

Mines and Resources Australia Pty Ltd
256 Adelaide Terrace,
Perth WA 6000,
(08) 9202 1100,
White Foil

Newmont Australia
PO Box 1123,
West Perth WA 6872,
(08) 9366 3232,
Bronzewing-Mt McClure, Jundee-
Nimary,
Wiluna,
www.newmont.com

Placer (Granny Smith) Pty Ltd
PO Box 33,
Laverton WA 6440,
(08) 9088 2217
Granny Smith,
www.placerdome.com

Placer Dome Asia Pacific Limited
PO Box 1662,
Kalgoorlie WA 6433,
(08) 9080 6111,
Kanowna Belle,
www.placerdome.com

Placer Dome Asia Pacific Limited
PO Box 622,
Kalgoorlie WA 6433,
(08) 9080 6400,
Kundana, Paddington,
www.placerdome.com

Sipa Resources International NL
87 Colin Street,
West Perth WA 6005,
(08) 9481 6259,
Paraburdoo,
www.sipa.com.au

Sons of Gwalia Ltd
16 Parliament Place,
West Perth WA 6005,
(08) 9263 5555,
Carosue Dam,
Marvel Loch-Southern Cross,
Sons of Gwalia, Tarmoola,
www.sog.com.au

St Barbara Mines Ltd
Level 2, 16 Ord Street,
West Perth WA, 6005
(08) 9476 5555,
Bluebird.
www.stbarbara.com.au

St Ives Gold Mining Co Pty Ltd
C/- Kambalda Post Office,
Kambalda WA 6442,
(08) 9088 1111,
Kambalda-St Ives,
www.goldfields.co.za

Troy Resources NL
44 Ord Street,
West Perth WA 6005,
(08) 9481 1277,
Bulchina,
www.try.com.au

Worsley Alumina Pty Ltd
PO Box 48,
Boddington WA 6390,
(08) 9883 8260,
Boddington,
www.wapl.com.au

GYP SUM

Cockburn Cement Ltd
Russell Road,
East Munster WA 6166,
(08) 9411 1000,
Lake Hillman.

CSR Limited
19 Sheffield Road,
Welshpool WA 6106,
(08) 9365 1686,
Jurien Bay North.

Dampier Salt (Operations) Pty Ltd
152 St Georges Terrace,
Perth WA 6000,
(08) 9327 2257,
Lake MacLeod,
www.dampiersalt.com.au

Gypsum Industries
PO Box 952,
Canning Bridge WA 6153,
(08) 9364 4951,
Lake Cowcowing

Lake Hillman Mining Pty Ltd
PO Box 1,
Kalannie WA 6468,
(08) 9666 2045,
Lake Hillman

HEAVY MINERAL SANDS

Garnet Sand

GMA Garnet Pty Ltd
PO Box 188,
Geraldton WA 6530,
(08) 9923 3644,
Port Gregory,
www.gmagarnet.com

Ilmenite, Leucosene, Rutile and Zircon

Cable Sands (WA) Pty Ltd
PO Box 133,
Bunbury WA 6230,
(08) 9721 0200,
Jangardup, Sandalwood, Yarloop,
www.cablesands.com.au

Iluka Resources Ltd
5th Floor, 553 Hay Street,
Perth WA 6000,
(08) 9221 7611,
Capel, Eneabba, Yoganup,
Stratham,
www.iluka.com

TABLE 6

PRINCIPAL MINERAL AND PETROLEUM PRODUCERS

effective 1 July 2003

TiWest Pty Ltd
1 Brodie-Hall Drive,
Bentley WA 6102,
(08) 9365 1333,
Cooljarloo,
www.tiwest.com.au

IRON ORE**BHP Billiton Iron Ore (Goldsworthy) Ltd**

200 St Georges Terrace,
Perth WA 6000,
(08) 9320 4444,
Nimngarra-Yarrie,
www.bhpbilliton.com

BHP Billiton Iron Ore Ltd

200 St Georges Terrace,
Perth WA 6000,
(08) 9320 4444,
Jimblebar, Newman, Yandicoogina,
www.bhpbilliton.com

Channar Mining Pty Ltd

152 St Georges Terrace,
Perth WA 6000,
(08) 9327 2327,
Channar.

Hamersley Iron Pty Ltd

152 St Georges Terrace,
Perth WA 6000,
(08) 9327 2327,
Marandoo, Paraburdoo, Tom Price,
Yandicoogina,
www.hamersleyiron.com

Portman Iron Ore Ltd

1 William Street,
Perth WA 6000,
(08) 9426 3388,
Cockatoo Island, Koolyanobbing,
www.portman.com.au

Robe River Iron Associates

12 St Georges Terrace,
Perth WA 6000,
(08) 9421 4747,
Pannawonica, West Angelas
www.north.com.au

LIMESAND-LIMESTONE**Cockburn Cement Ltd**

Russell Road,
East Munster WA 6166,
(08) 9411 1000,
Cockburn, Dongara, Wanneroo

Limestone Resources Australia Pty Ltd

Parkland Road, Cnr Hasler Street,
Osborne Park WA, 6017,
(08) 9443 4244,
Wanneroo, Moore River,
Carabooda

Loongana Lime Pty Ltd

PO Box 808,
Kalgoorlie WA 6430,
(08) 9021 8055,
Loongana.

WA Limestone Co.

41 Spearwood Avenue,
Bibra Lake WA 6163,
(08) 9434 2299,
Postans

Gypsum Supplies

PO Box 952,
Canning Bridge WA 6153,
(08) 9364 4951,
Dongara-Denison, Cervantes,
Lancelin, Jurien.

MANGANESE**Pilbara Manganese Pty Ltd**

62 Colin Street,
West Perth WA 6005,
(08) 9321 3633,
Woodie Woodie,
www.consminerals.com.au

NICKEL**Anaconda Nickel Ltd**

Level 4, 30 The Esplanade,
Perth WA 6000,
(08) 9212 8400,
Murrin Murrin,
www.anaconda.com.au

Independence Gold

PO Box 893,
South Perth WA 6951,
(08) 9367 2755,
Long Nickel,
www.independencegold.com.au

LionOre (Australia) Nickel Ltd

Level 2, 10 Ord Street,
West Perth WA 6005,
(08) 9481 5656,
Emily Ann,
www.lionore.com

Mincor Resources NL

Level 1, 1 Havelock Street,
West Perth 6005,
(08) 9321 7125,
Miitel, Wannaway,
www.mincor.com.au

MPI Mines Ltd

Level 8, 10-16 Queen Street,
Melbourne Vic 3000,
(03) 9628 2214,
Black Swan,
www.mpimines.com.au

OMG Cawse Pty Ltd

Cawse Nickel Operations,
Locked Bag 32,
Kalgoorlie WA 6433,
(08) 9024 8800,
Cawse.

Preston Resources Ltd

Level 1, 16 Ord Street,
West Perth WA 6005,
(08) 9322 4166,
Bulong,

Sir Samuel Mines NL

24 Outram Street,
West Perth WA 6005,
(08) 9213 1588,
Cosmos,
www.jubileemines.com.au

Tectonic Resources NL

Suite 4, 100 Hay Street,
Subiaco WA 6008,
(08) 9388 3872,
RAV8,
www.tectonicres.com.au

WMC Ltd

191 Great Eastern Highway,
Belmont WA 6104,
(08) 9442 2000,
Kambalda, Leinster, Mt Keith,
www.wmc.com.au

PALLADIUM**WMC Ltd**

191 Great Eastern Highway,
Belmont WA 6104,
(08) 9442 2000,
Kambalda,
www.wmc.com.au

PETROLEUM**Apache Energy Ltd**

Level 3, 256 St Georges Terrace,
Perth WA 6000,
(08) 9422 7222,
Agincourt, Campbell, Chervil, East Spar, Endymion, Gibson, Gipsy, Harriet, Little Sandy, North Gipsy, North Herald, Pedirka, Rosette, Simpson, Sinbad, South Pepper, South Plato, Stag, Tanami, Victoria, Wonnich,
www.apachecorp.com

ARC Energy NL

Level 1, 46 Ord Street,
West Perth WA 6005,
(08) 9486 7333,
Dongara, Hovea
www.arcenergy.com.au

BHP Billiton Petroleum (North West Shelf) Pty Ltd

Level 42, Central Park,
152-158 St Georges Terrace,
Perth WA 6000,
(08) 9278 4888,
Chinook-Scindian, Griffin,
www.bhpbilliton.com

ChevronTexaco Australia Pty Ltd

Level 24, QV1 Building,
250 St Georges Terrace,
Perth WA 6000,
(08) 9216 4000,
Barrow Island, Cowle, Crest, Roller-Skate, Saladin, Yammaderry,
www.chevrontexaco.com

Hardman Oil and Gas Pty Ltd

5 Ord Street,
West Perth WA 6005,
(08) 9321 6881,
Woodada,
www.hdr.com.au

Kimberley Oil NL

Suite 12B, 573 Canning Highway,
Alfred Cove WA 6154,
(08) 9330 8876,
Blina, Boundary, Lloyd,
Sundown, West Terrace.

**Mobil Exploration & Producing
Australia Pty Ltd**

Level 7, 30 The Esplanade,
Perth WA 6000,
(08) 9480 0300,
Wandoo,

**Nexen Petroleum Australia Pty
Limited**

Level 18, 44 St George's Terrace,
Perth WA 6000,
(08) 9218 8911,
Buffalo,
www.nexeninc.com

Origin Energy Resources Ltd

34 Collins Street,
West Perth WA 6005,
(09) 9324 6111,
Beharra Springs, Tubridgi,
www.originenergy.com.au

Petro Energy Pty Ltd

242 Railway Parade,
West Leederville WA 6007
(08) 9 381 4744,
Mt Horner.

Woodside Energy Ltd

1 Adelaide Terrace,
Perth WA 6000,
(08) 9348 4000,
Athena, Cossack, Echo-Yodel,
Goodwyn,
Hermes, Lambert, Laminaria,
Legendre,
North Rankin, Perseus, Wanaea,
www.woodside.com.au

Agip Australia Limited

Level 3, 40 Kings Park Road,
West Perth WA 6005,
(08) 9320 1111,
Woolybutt.

PLATINUM**WMC Ltd**

191 Great Eastern Highway,
Belmont WA 6104,
(08) 9442 2000,
Kambalda,
www.wmc.com.au

SALT**Dampier Salt (Operations) Pty Ltd**

152-158 St Georges Terrace,
Perth WA 6000,
(08) 9327 2257,
Dampier, Lake MacLeod, Port
Hedland,
www.dampiersalt.com.au

Onslow Salt Pty Ltd

PO Box 23,
Onslow WA 6710,
(08) 9184 9000,
Onslow Salt,
www.onslowsalt.com

Shark Bay Salt Joint Venture

22 Mount Street,
Perth WA 6000,
(08) 9420 4320,
Useless Loop,
www.clough.com.au

WA Salt Supply Ltd

Cockburn Road,
Hamilton Hill WA 6163,
(08) 9335 9911,
Lake Deborah East, Pink Lake,
www.wasalt.com.au

SILICA-SILICA SAND*Silica***Simcoa Operations Pty Ltd**

PO Box 1389,
Bunbury WA 6231,
(08) 9780 6666,
Dalaroo,
www.simcoa.com.au

*Silica Sand***Rocla Quarry Products**

180 Fauntleroy Avenue,
Kewdale WA 6105,
(08) 9475 2555
Gnangarra,
www.rocla.com.au

TT Sand Pty Ltd

PO Box 1664,
Fremantle WA 6959,
(08) 9319 1371,
Mindijup.

SPONGOLITE**Supersorb Minerals NL**

55 Collie Street,
Albany WA 6330,
(08) 9842 1955,
Woogenellup,
www.supersorb.com.au

TALC**Luzenac Australia Pty Ltd**

GPO Box A42,
Perth WA 6837
(08) 9327 2844,
Three Springs,
www.luzenac.com

Unimin Australia Ltd

26-28 Tomlinson Road,
Welshpool WA 6106,
(08) 9362 1411,
Mt Seabrook.

TIN-TANTALUM-LITHIUM*Spodumene***Sons of Gwalia Ltd**

16 Parliament Place,
West Perth WA 6005,
(08) 9263 5555,
Greenbushes, Wodgina,
www.sog.com.au

*Tantalite-Tin***Sons of Gwalia Ltd**

16 Parliament Place,
West Perth WA 6005,
(08) 9263 5555,
Greenbushes, Wodgina,
www.sog.com.au

**Haddington International
Resources Ltd**

PO Box 1909,
West Perth WA 6872,
(08) 9226 1550,
Bald Hill,
www.haddington.com.au

ABBREVIATIONS, REFERENCES, UNITS & CONVERSION FACTORS

As the document makes use of abbreviations and references, an explanation of each has been included below. A conversion table, relating the units by which various commodities are measured, has also been provided.

ABBREVIATIONS

cons	concentrates	n/a	not applicable
f.o.t.	free-on-truck	f.o.b.	free-on-board
A\$	Australian Dollar	¥	Japanese Yen
ABS	Australian Bureau of Statistics	US\$	United States Dollar
AFR	Australian Financial Review	GDP	Gross Domestic Product
CSO	Central Selling Organisation	BMR	Bureau of Mineral Resources
DRI	Direct Reduced Iron	HBI	Hot Briquetted Iron
RBA	Reserve Bank of Australia	IMF	International Monetary Fund
ABARE	Australian Bureau of Agricultural and Resource Economics	LME	London Metal Exchange

REFERENCES TABLE 3

- (a) Estimated f.o.b. value
- (b) Metallic by-product of nickel mining
- (c) Value based on the average Australian value of alumina as published by the ABS
- (d) Delivered/shipped value
- (e) Value at works
- (f) Estimated ex-mine value
- (g) London PM Gold Fix price as supplied by WA Treasury Corporation
- (h) Estimated f.o.t. value
- (i) Estimated f.o.b. value based on the current price of nickel-containing products
- (j) By-products of gold mining
- (r) Revised from previous edition

UNITS AND CONVERSION FACTORS

	Metric Unit	Symbol	Imperial Unit	
Mass	1 gram	(g)	= 0.032151 troy (fine) ounce (oz)	
	1 kilogram	(kg)	= 2.204624 pounds (lbs)	
	1 tonne	(t)	= 1.10231 United States short ton [1 US short ton = 2,000 lbs]	
	1 tonne	(t)	= 0.98421 United Kingdom long ton [1 UK long ton = 2,240 lbs]	
	1 tonne LNG	(t)	= 52,000,000 (Btu)	
Volume	1 kilolitre	(kl)	= 6.28981 barrels (bbls)	
	1 cubic metre	(m ³)	= 35.3147 cubic feet (ft ³) [1 kilolitre (kl) = 1 cubic metre (m ³)]	
Energy	1 kilojoule	(kj)	= 0.94781 British Thermal Units (Btu)	
Energy Content				Prefix
	Coal	19.7 GJ/t		kilo (k) 10 ³
	Condensate	32.0 MJ/L		mega (M) 10 ⁶
	Crude oil	37.0 MJ/L		giga (G) 10 ⁹
	LNG	25.0 MJ/L		tera (T) 10 ¹²
	Natural gas	38.2 MJ/m ³		peta (P) 10 ¹⁵
	LPG-butane	28.7 MJ/L (1tonne LPG-butane = 1,720 litres)		
	LPG-propane	25.4 MJ/L (1tonne LPG-propane = 1,960 litres)		

DATA SOURCES

DATA SOURCES

Quantities for minerals and petroleum in this publication are collected by the Department's Royalty Branch and are based on information provided by the producers in royalty and production returns. The quantities specified relate to either mine production or sales as listed below for each commodity.

Mine Production

Clays

Coal

Construction Materials

Dimension Stone

Gold

Gypsum

Limesand -Limestone -Dolomite

Silica - Silica Sand

Talc

Sales

Alumina

Base Metals (Copper, Lead and Zinc)

Chromite

Diamonds

Gem and Semi-Precious Stones

Heavy Mineral Sands

Industrial Pegmatite Minerals

Iron Ore

Manganese

Nickel Industry (Nickel, Cobalt, Platinum and Palladium)

Petroleum

Pigments

Salt

Silver

Spongolite

Tin -Tantalum - Lithium

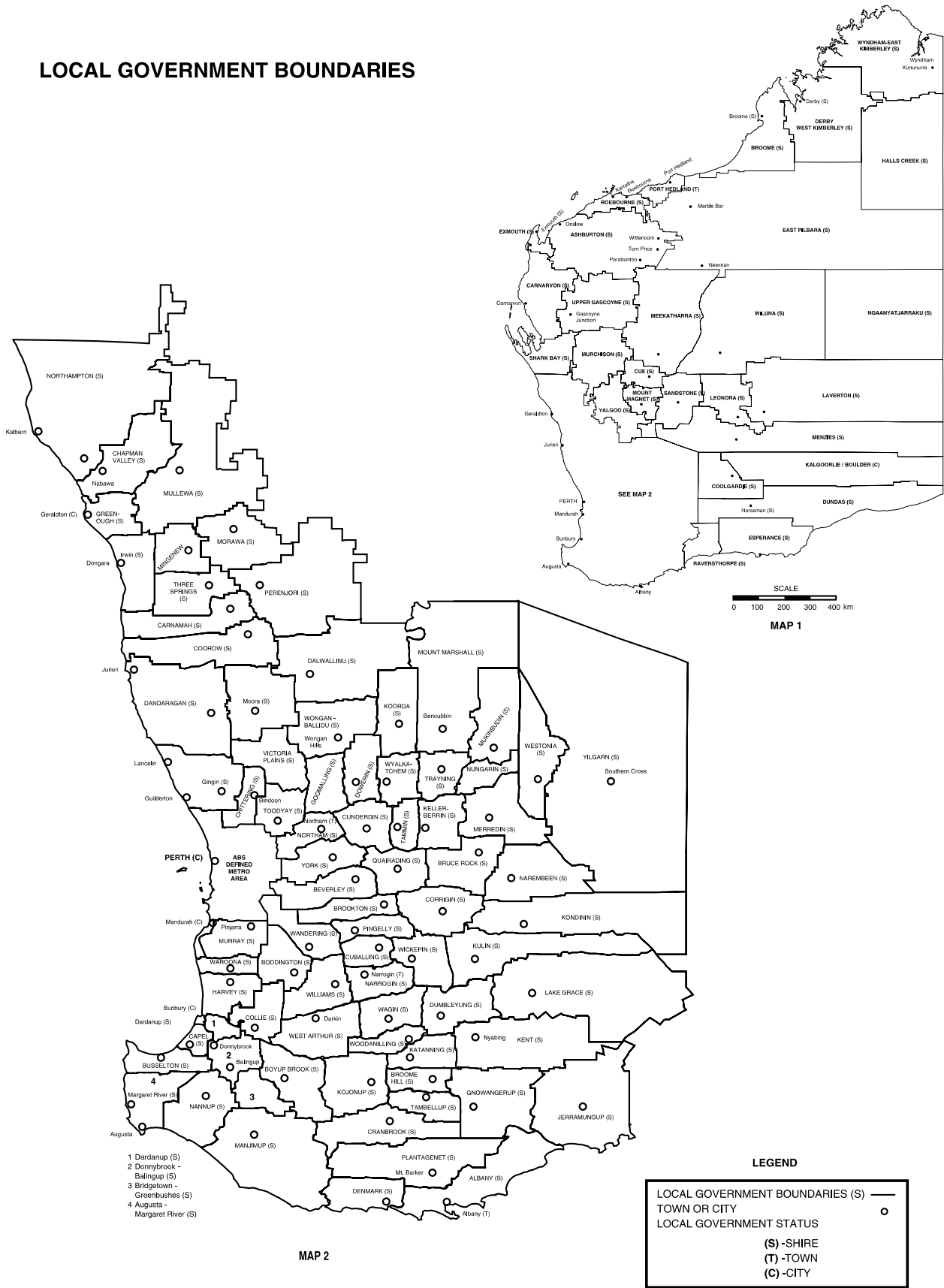
Vanadium

CLASSIFICATION OF COUNTRIES

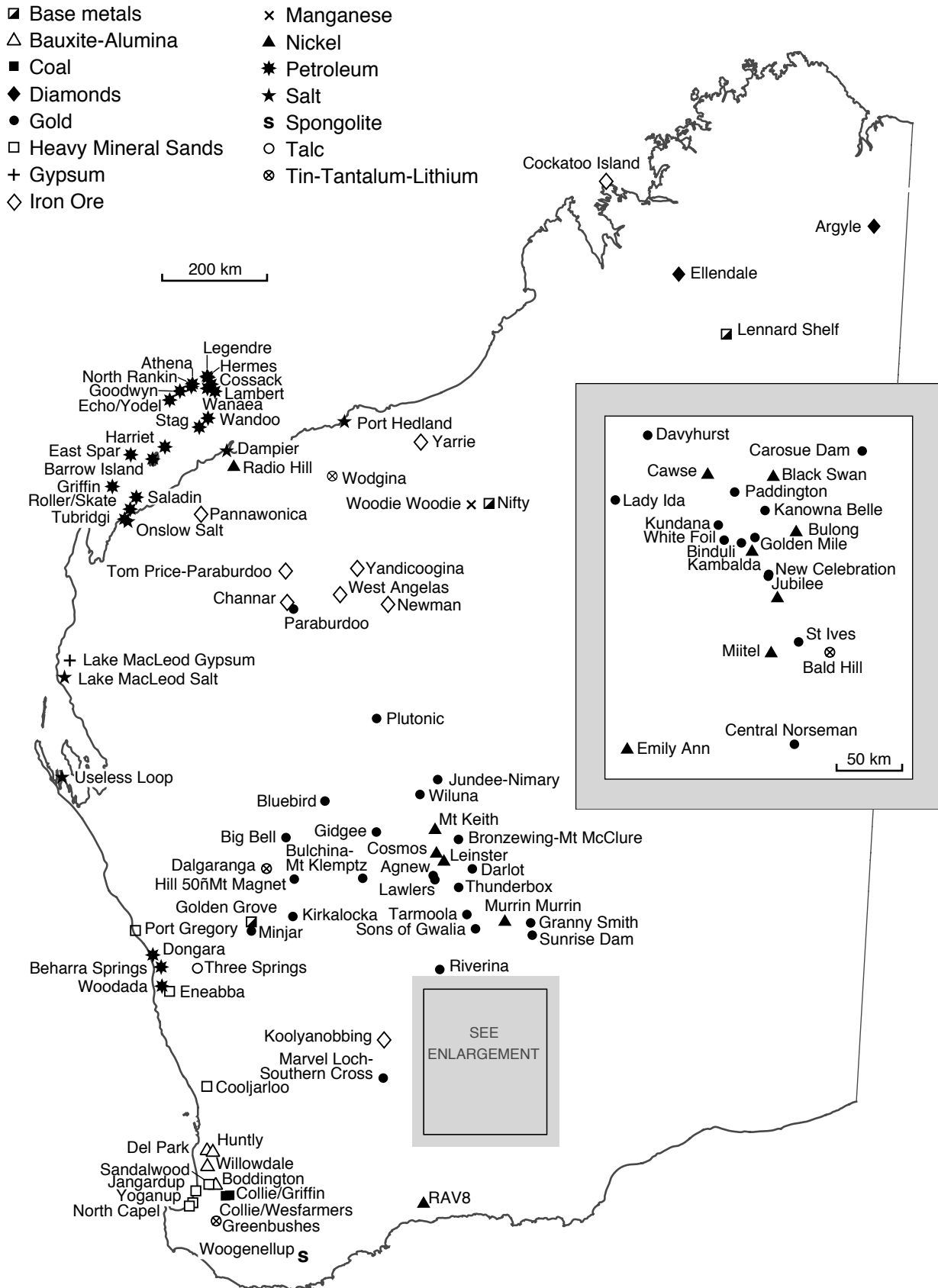
Euro area ¹ / European Union		Non-Japan Asia		Newly Industrialised Asia
<i>Austria</i>	<i>Ireland</i>	Afghanistan	Nepal	Hong Kong
<i>Belgium</i>	<i>Luxembourg</i>	Bangladesh	Pakistan	Korea
<i>Denmark</i>	<i>Netherlands</i>	Bhutan	Papua New Guinea	Singapore
<i>Finland</i>	<i>Portugal</i>	Brunei Darussalam	Philippines	Taiwan
<i>France</i>	<i>Spain</i>	Cambodia	Samoa	
<i>Germany</i>	Sweden	China	Solomon Islands	
<i>Greece</i>	United Kingdom	Fiji	Sri Lanka	
<i>Italy</i>		India	Thailand	
		Indonesia	Tonga	
		Kiribati	Vanuatu	
		Lao PD Republic	Vietnam	
		Malaysia	Newly industrialised Asia	
		Maldives	Mongolia	
		Myanmar		

¹Italics indicate countries that are members of the euro area.

LOCAL GOVERNMENT BOUNDARIES



MAJOR MINERAL AND PETROLEUM PROJECTS IN WESTERN AUSTRALIA





Department of
Industry and Resources

This publication is available on our website

www.doir.wa.gov.au

For further information on the mineral and petroleum resources of Western Australia to complement this publication please refer to:

Western Australia Mineral Exploration and Development

Western Australia Atlas of Mineral Deposits and Petroleum Fields 2003

Western Australian Oil and Gas Industry 2003

A Guide to Petroleum Exploration and Production in Western Australia

Prospect magazine

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100 Plain Street
EAST PERTH WA 6004

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email: enquiries@doir.wa.gov.au

For specific data enquiries email: jill.gregory@doir.wa.gov.au