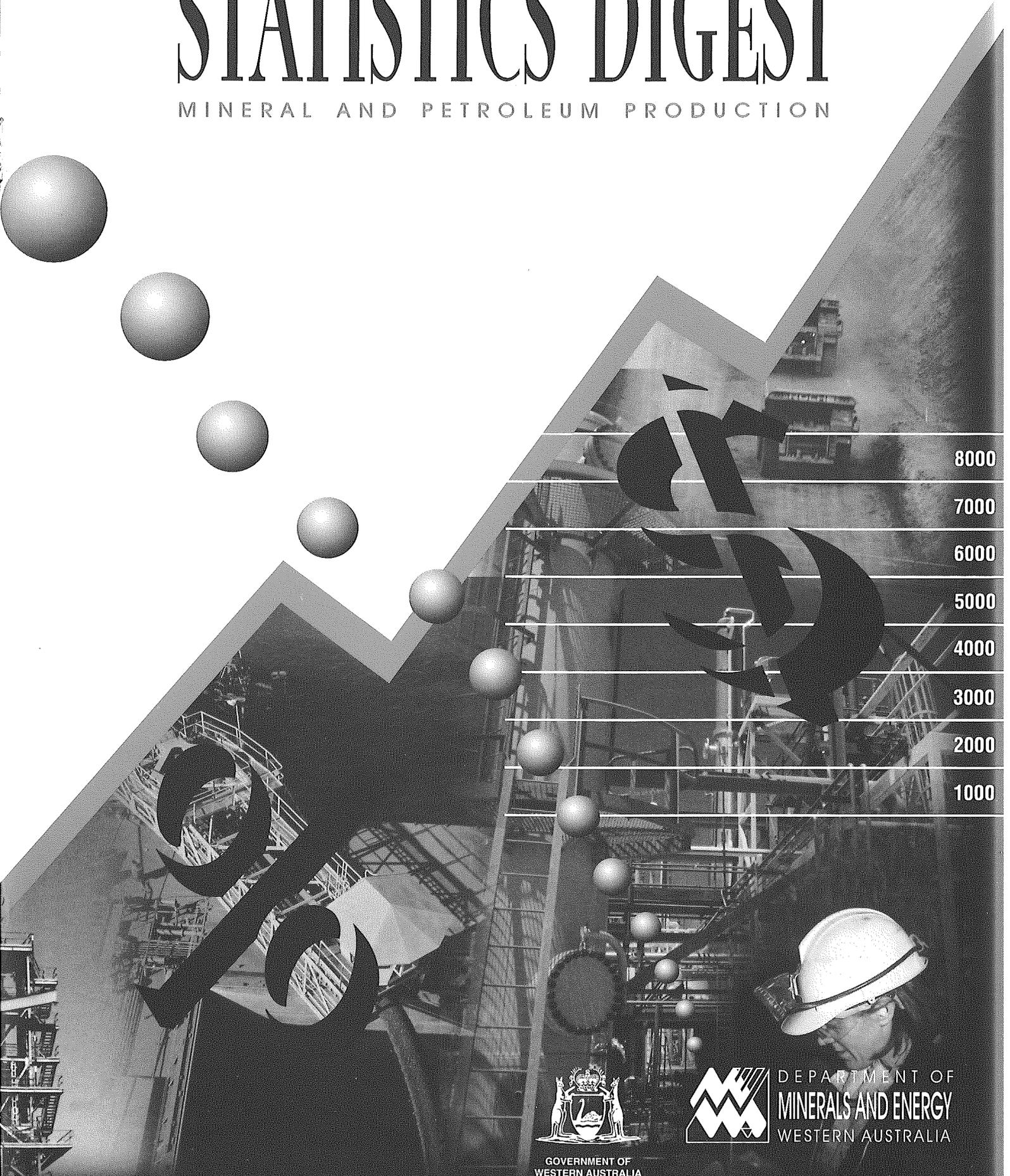


1996

# STATISTICS DIGEST

MINERAL AND PETROLEUM PRODUCTION



8000

7000

6000

5000

4000

3000

2000

1000



GOVERNMENT OF  
WESTERN AUSTRALIA



DEPARTMENT OF  
MINERALS AND ENERGY  
WESTERN AUSTRALIA

Policy and Planning Division

J | F | M | A | M | J | J | A | S | O | N | D

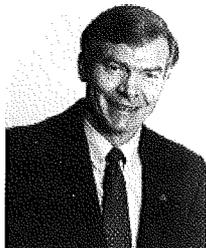
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## FOREWORD



L C Ranford  
ACTING DIRECTOR  
GENERAL

A handwritten signature in cursive script that reads "Lee Ranford".

The resources sector plays a key role in the State's economy and this publication contains the most comprehensive statistical information available on the Western Australian mining and petroleum industry.

1996 once again heralded the growing importance of petroleum, with new production records set for oil, gas and condensate. For the second year running, the value of petroleum production has been greater than that for other resources. With a value of production in 1996 of \$4.7 billion, it now represents almost 30% of the State's value of production for minerals and energy.

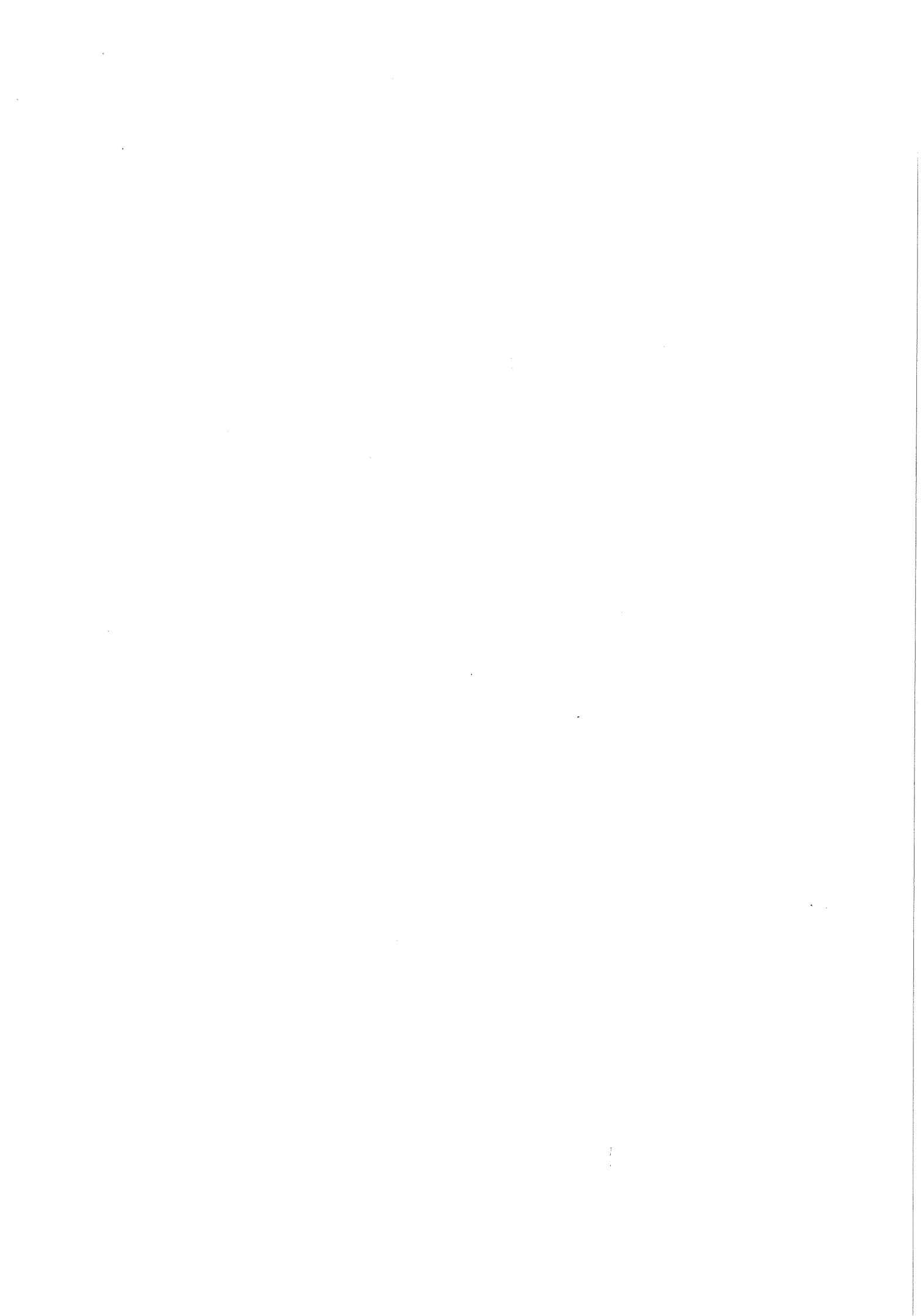
Significantly, growth in the petroleum sector is taking place at a time when the long held goal of Government to enhance downstream processing of the State's resources is coming to fruition. The iron ore sector for example, whilst having a lacklustre year, is the focus of a number of downstream processing projects, including BHP's DRI plant, the commissioning of which is planned for later this year.

Growing supplies of oil and gas in conjunction with deregulation of the State's energy market augur well for an exciting future for not only the iron ore industry, but also alumina, gold and the many new nickel projects which are planned.

The Native Title Act (NTA) continued to impact adversely on the mining and petroleum sectors. At the end of 1996 there were over 200 native title claims covering some 72% of Western Australia including most areas of known mineralisation. Additional uncertainty and confusion arose from the Wik decision. Western Australian officials have been working with the Commonwealth and other States in an attempt to identify amendments to the NTA which would make the system more workable.

The industry's strength and resilience was exhibited in 1996 with most other sectors, in addition to petroleum, also performing well. This was despite a year of mixed directions in commodity markets and a gradual rise in the value of the Australian dollar.

The matters referred to above are described in some detail within this Digest. The information and statistics were assembled by the Department with assistance from the Australian Bureau of Statistics, Australian Bureau of Agricultural and Resource Economics and resource companies. I thank these organisations for their help; it would be impossible to present such a comprehensive publication without it.



# 1. ECONOMIC AND SOCIAL ENVIRONMENT

## 1.1 World Economy Review

*USA, Japan and East  
Asian growth promising.  
Europe outlook mixed.*

It is estimated that in 1996 the global economy grew by 3.8%. This was up on the 1995 growth rate of 3.5%. The United States economy continued to grow at a steady pace and, despite lacklustre growth in the June quarter, the Japanese recovery gained substantial momentum. The outlook for Western Australia's East Asian trading partners also improved as authorities began to ease monetary policy after successfully reducing inflation and current account pressures.

The United States economy grew by 2.4% in 1996. Growth was underpinned by business investment which has been increasing strongly over the last two years. Whilst some weakness in private consumption was evident in the closing months of 1996, consumer confidence remained high, buoyed by high levels of employment and rising net worth of households. Although growth was tempered by a flat external sector, increasing export orders over the year and stronger growth in the United States' major export markets suggest that the external sector is likely to turn around in the medium term. Overall, the outlook for the United States is for continued solid growth of around 2.0% in 1997.

Despite contracting in the second half of 1996, overall, Japan's economic growth gained momentum over the year with GDP increasing by an estimated 3.6%. Whilst consumer spending suffered a decline during the year, partly due to a food poisoning scare, it now appears to have recovered, supported by growth in employment and bonuses. The main risk now to stronger consumer demand is an expected increase in the value added tax rate from 3% to 5% in April 1997. Business investment has been an important feature of growth over the past year and is likely to be sustained by strong profit increases and business attempting to keep a competitive edge. The forecast for Japanese growth through 1997 is now around 2.7%. The external sector is also expected to contribute to this growth in the near term in response to recent weakening in the Yen.

Growth in the major European economies averaged around 1.6% in 1996 and is expected to accelerate. Germany's GDP grew a negligible 1.1%, but is expected to strengthen in 1997 to expand by 2.2%. In particular, with improved business confidence, investment is expected to pick up in response to greater foreign demand, tax cuts and an end to the inventory adjustment. Indeed, business expectations have already begun to improve. Whilst Budget cuts to welfare payments are expected to dampen consumer demand, the effect will be muted by low inflation and interest rates.

Growth in the United Kingdom has proved robust with GDP increasing an estimated 2.4% in the past year. The United Kingdom's economy has been pumped up for elections, with improved consumer demand due to rising real incomes, tax cuts and relatively low mortgage interest rates. Similar to Germany's experience, business investment in the United Kingdom has been weak in recent quarters, but low levels of stocks and strong business confidence point towards a strengthening in investment. In addition, pent-up demand and a high level of affordability are expected to flow through to strong growth in the housing sector. Overall, the United Kingdom economy is expected to grow by 3% or more in 1997.

France slowed to a crawl in 1996 but is set to grow by 2.5% in 1997. Italy's GDP increased only an estimated 0.8% in 1996 and is expected to remain weak with only 1.2% growth forecast for 1997.

Western Australia's major East Asian trading partners experienced slower growth in 1995 and the first half of 1996. This was due to a decline in the demand for their electronics exports, the depreciation of the Yen, a blow-out in current account deficits and the need to curb inflation. Since then, tighter monetary policy throughout 1995 and early 1996 in most East Asian economies has been successful in reducing inflation and current account pressures that were being experienced after several years of strong economic growth. In addition, stronger world growth has resulted in increased demand for East Asian exports, which in turn has flowed through to stronger rates of industrial production. The real appreciation of most East Asian currencies is unlikely to impact significantly on exports in the medium term as most currencies remain undervalued.

Forecasters expect China and what are called "Dynamic Asian Economies (DAEs)" to exhibit resilient growth, reflecting more moderate monetary policy settings and higher world demand for exports. China's growth for example, which fell from 10.2% to 9.5% in 1996, is now expected to be back up around 10% for 1997 and 1998. DAEs such as Taiwan, Hong Kong, Singapore, Thailand and Malaysia are all expected to grow by between 6% and 6.5% compared with from 7% to 8% in the last couple of years.

In Eastern Europe, three major emerging market economies - Poland, Czech Republic and Hungary - continued to benefit from market reforms, privatisation programs, trade with Western Europe and foreign investment. Average annual growth across these three countries continued in 1997 at around 4%. Growth of this magnitude can be expected to continue in the near future.

### *Russia bottoms out.*

Russia's economic downturn, which commenced in the early 1990s, continued in 1996 with negative growth of around 7%. The country continues to grapple with political and economic reforms which are adversely affecting economic growth. However, the slump in Russia's economy is believed by some to have bottomed out by the end of 1996 and the economy is expected to grow from 2% to 3% in 1997.

These assessments suggest that world economy prospects are mostly solid and that the outlook for growth in Western Australia's major export markets continues to be very favourable.

## 1.2 Review of the Western Australian and Australian Economy

*Australian growth mixed, WA better than average.*

The Western Australian economy grew by a strong 6.8% in 1996. This was the fastest growth of any State and remained significantly stronger than national growth of 4.0% over 1996. Both State and national growth rates exceeded those of the previous year.

The increases in Western Australia's annual average economic growth reflected particularly healthy growth in business investment which was up 19.6% in 1996. Exports provided an additional strong impetus to growth with the external sector growing by 5.8% in 1996. Whilst private final consumption grew strongly towards the end of the year, overall, its 1996 growth of 2.7% was the slowest growth rate for five years. Activity in the housing sector also remained subdued, although strong growth in the December quarter of 1996 was a tentative indication of recovery for 1997.

Growth in Western Australia's economy is likely to continue to be bolstered by strong underlying business investment. Confidence is high and the number of prospective investment projects is at record levels and growing, so the outlook is extremely favourable.

Similar factors drove the national economy in 1996 and it appeared to be operating at different paces in different sectors. There was strong growth in investment, which increased 12.2% in the four quarters to September 1996, particularly in the mining and service related areas. This contrasted with slow growth in consumer spending, as indicated by, for example, the seventh consecutive monthly decline in passenger vehicle registrations in December 1996. Easing in consumption spending seemed to be associated with slowing growth in household disposable income and an apparent increase in the rate of saving, which is a Federal Government target.

Western Australian employment growth followed the pattern of growth in domestic demand. Employment, after growing strongly in the first half of 1996, fell slightly in the latter part of the year. Nevertheless, Western Australia's unemployment rate remained amongst the lowest in the nation at 7.7% as at November 1996. This compared with a national rate of 8.5%. Job advertisements data suggest that employment growth is likely to remain subdued at least until mid 1997.

*Good inflation results, falls to 2.6% in 1996.*

Commensurate with the above factors, the annual growth rate in the Consumer Price Index (CPI) fell significantly in 1996 to 2.6% both nationally and in Western Australia. This compared with 4.8% and 4.6% in 1995 for Western Australia and Australia respectively. Importantly, headline inflation continues to fall, which partly reflects reduced cost pressures from slower wages growth.

Lower inflation pressures, continued high unemployment and a sluggish housing sector triggered two cuts in official interest rates towards the end of 1996. Financial market commentators have not ruled out further reductions in interest rates over the near term if employment growth and business activity nationally remain weak. However, offsetting this is the threat of wages growth re-igniting inflationary pressures. Reflecting the official interest rate cuts, the yield on 90-day bills fell from around 7% in early September 1996 to just below 6% at the end of the year.

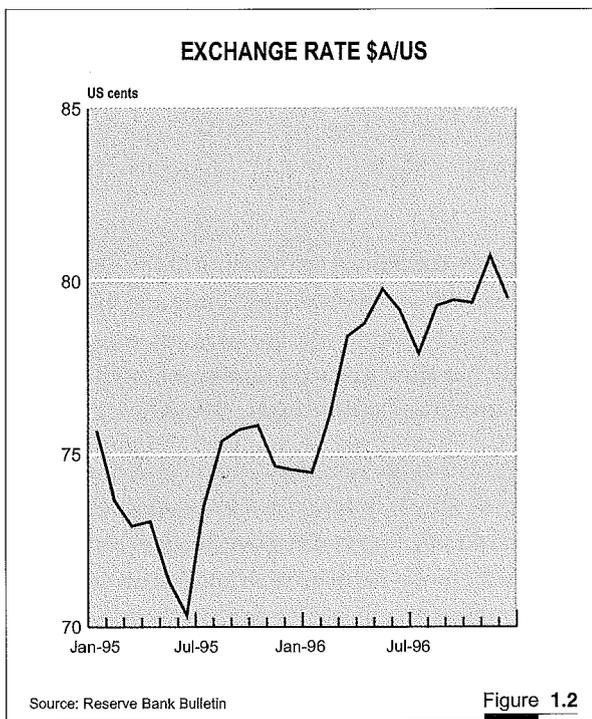
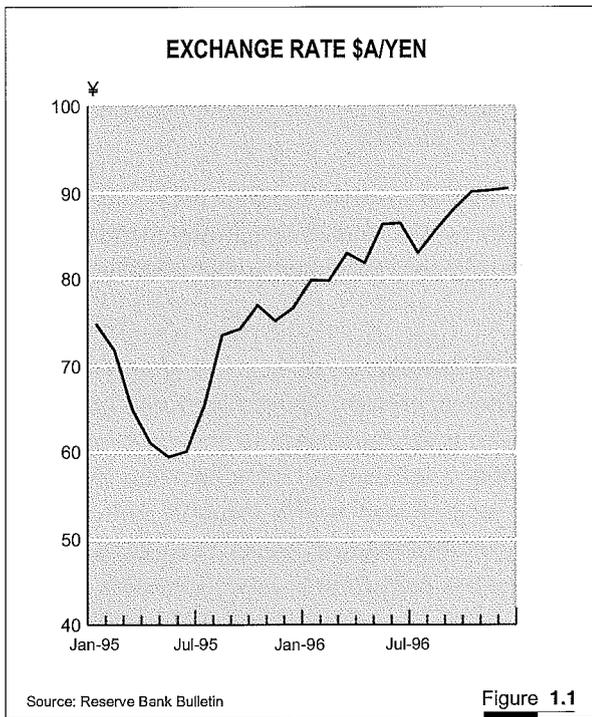
Although underlying inflation continued to slow, the Reserve Bank rejected business calls for another credit easing over the next three months or so. This reflects a reluctance to push the economy too fast and an attempt to drag down expectations of future inflation. This is particularly important now as Australia's labour market is moving between traditional industrial relations institutions and enterprise bargaining, resulting in an uncertain wage setting environment.

## *Australian dollar appreciates.*

1996 saw the Australian dollar appreciating against the US currency to trade on average at US\$0.7846. This compared with US\$0.7394 over 1995. The

Australian dollar traded particularly strongly over the final quarter, reaching a peak of US\$0.8214 in early December 1996, the highest level since October 1990. The catalyst for the drive higher came primarily from strong Japanese capital flows into the Australian bond market and a firming in copper and aluminium prices. Similarly therefore, the Australian dollar appreciated against the Yen, trading on average at 85.43 Yen over 1996 compared with 69.49 Yen in 1995. The Australian dollar also performed strongly against other major currencies, with the Trade Weighted Index reaching a high of 60.6 on 3 December, its highest level since 1991.

The overall outlook for the economy in 1997/98, according to the 1996/97 Federal Treasury's mid-year review, is for growth of 3.5% based on stronger consumer spending on the back of solid growth in real disposable income and interest rate cuts in the second half of 1996. In addition, the forecast is supported by a recovery in housing investment, the timing of which remains one of the most difficult parts of the economy to predict, and forecasters have now pushed the upturn into the second half of calendar 1997. Offsetting this, however, is a forecast easing in public sector spending and slowing of business investment compared with 1996/97.



### 1.3 Economic Factors Affecting the Mining Industry

*Commodity prices mixed, gold down, petroleum up, alumina and base metals mixed, iron ore stable.*

The major factor affecting the economics of mining and petroleum extraction is the price received for the resource extracted. In terms of commodity prices, producers' fortunes in 1996 depended on which market they were in. Gold for example performed very poorly, falling from a high of US\$417/oz in February 1996 to hit a three-year low at the end of the year. Petroleum products on the other hand were the best performing commodity in 1996, with oil prices reaching six-year highs towards the end of 1996, trading above US\$26/barrel on the back of cold weather concerns and low inventories. Iron ore prices also recorded a marginal increase in calendar 1996. Nickel prices eased off in 1996 as did aluminium which reached a 30-month low in October 1996 to rally upwards again at the end of the year. Base metals, though, exhibited no clear overall signal at all. Lead continued to climb to new highs since 1993, copper dropped around 20% in 1996 and zinc remained steady. However, base metal markets have since rebounded very strongly to exhibit boom conditions, with zinc for example kicking off in 1997 to hit its highest level in four years.

Commodity markets in 1997 look like being similar to 1996 - supply shocks and tight stocks boosting prices at times, but the underlying trend being stable to marginally higher. Whilst this is seen by forecasters as the story for commodities as a whole, within this group some commodities will have greater potential than others to rally. For example, the Australian Bureau of Agricultural and Resource Economics (ABARE) forecasts an improvement in metal prices and an easing in petroleum prices in 1997. This depends on the US economy remaining on a slow steady growth path with low inflation and a modest pick-up in the economies of Japan and Western Europe. However, without strong synchronised growth and the odd surge in inflation, commodity price rises will be constrained with prices responding primarily to supply shocks.

A positive development emerging for mineral commodity markets is that Soviet stockpiles appear to be depleted and there are early signs of pressure on prices from Soviet dumping having ended. Over recent years the collapse of the USSR had triggered frenetic dumping of all types of commodities in search of foreign exchange.

*Major trading partners provide routine outlook for WA despite A\$ effect on prices.*

For Western Australian miners in particular, major trading partners continue to provide substantial impetus. The expected improvement in the Japanese economy as well as a positive economic outlook for other Asian economies should continue to benefit the State's mining industry. The region currently takes more than three-quarters of the State's mineral and energy exports and will remain the main target of exporters.

As so many export contracts are written in \$US, the exchange rate between the \$A and \$US is a very significant economic determinant affecting the Australian mineral industry. For example, a 1% appreciation in the value of the \$A against the \$US equates to a decrease in sales value of around \$29 million a year for the iron ore industry and \$26 million a year for the petroleum sector. In this respect, currency movements over 1996 were not favourable to Australian mineral and energy producers. 1996 saw the Australian dollar appreciate against the US currency and trade particularly strongly over the final quarter of 1996, reaching a peak of US\$0.8214 in early December 1996, the highest level since October 1990.

*WA competitiveness boosted  
by energy deregulation.*

Focusing internally, Western Australia's mining industry competitiveness continued to improve with the further deregulation of the energy market in 1996. This included the completion of the Goldfields Gas Pipeline which was officially opened in October and continuation of the program of phasing in access to the Dampier to Bunbury natural gas pipeline for large gas customers. Gas customers taking at least 1,000 TJ per annum through a single connection are now able to contract directly with the gas supplier of their choice. This arrangement was extended from 1 January 1997 to customers taking at least 500 TJ per annum.

Since gas suppliers have been allowed to contract directly with major gas customers, it has been estimated that gas prices in the Pilbara have fallen by over 50%. This will further assist the development of the State's mining industry by significantly improving the viability of potential secondary mineral processing projects in the region.

In addition to the developments in the gas market, in February 1996 the State Government announced plans to phase in access for large electricity producers and consumers to Western Power's high voltage electricity transmission and distribution systems. Open access is to be provided to large electricity consumers according to a schedule commencing from 1 January 1997. Deregulation of access to Western Power's systems is expected to create competitive pressures between electricity generators which should ultimately lead to the supply of cheaper electricity, which in turn will provide a further boost to economic development.

*Hilmer reforms practical  
benefits.*

More generally, the market framework within which the mining industry operates had its competitiveness enhanced with all States and Territories (except Western Australia) enacting legislation which subjects their public enterprises to the provisions of the Trade Practices Act (TPA) from 21 July 1996. This was a major step in National Competition Policy resulting from the Commonwealth, State and Territory governments endorsing the 1993 Commonwealth Independent Committee of Inquiry into National Competition Policy (the "Hilmer Report") and subsequent signing of agreements in April 1995 to put into effect various microeconomic reforms.

*Diesel fuel rebate concerns  
in Federal budget.*

In August the Commonwealth Government released its 1996/97 Budget. The diesel fuel rebate scheme (DFRS) for the mining industry was retained despite early speculation that it would be scrapped. However, in an apparent effort to prevent exceeding expenditure levels on the DFRS, the Commonwealth has continued to fine-tune the eligibility criteria. The mining industry remains concerned that the new definition of beneficiation and limit on vehicle sizes, for example, appear to jeopardise the rebate now received for bona fide activities associated with mining. Mining industry representative bodies have stated that any move to reduce DFRS coverage will undermine the mining industry's competitiveness and result in lower grade minerals being left in the ground.

*Section 23 (pa) exemption  
from income tax for  
prospectors removed.*

The 1996/97 Commonwealth Budget also removed the exemption previously provided under paragraph 23 (pa) of the Income Tax Assessment Act 1936 to income derived by bona fide prospectors from the sale, transfer or assignment of rights to mine for gold or any other prescribed metal or mineral. Removal of the exemption is being phased in over the period 19 August 1996 to 19 August 2001. Over this period only the increase in value of mining rights is taxable. The value accrued to 19 August 1996 remains exempt until 19 August 2001. After this date the exemption will be completely removed and total value taxable.

*Other budget measures.*

Two other significant 1996/97 Federal Budget measures affecting the resources sector included:

- The reduction in the premium rate of deduction for research and development expenditures from 150% to 125%. This could impact upon mining industry research levels; and
- Changes to "thin capitalisation rules" designed to prevent non-residents from over-gearing their Australian investments and extracting profits through tax deductible interest charges. The changes mean that foreign entities must have increased equity in an Australian company if the local entity is to receive a tax deduction for all interest payable on loans. This measure may direct overseas controllers of local companies to convert interest-bearing loans into shares or face losing currently legitimate tax deductions. Given the substantial foreign ownership of the State's mining and energy industries, through local subsidiaries of foreign corporations, this measure has the potential to impact adversely on the mining and petroleum industry.

*Commonwealth budget shifts reductions in grants to State.*

In its aim to reduce the budget deficit, the Commonwealth Government also implemented significant reductions in funding for the States and Territories. The major impact arose from the agreement at the June 1996 Premiers' conference for the States and Territories to make payments to the Commonwealth in 1996/97 and the following two years as a contribution to reducing the Commonwealth's Budget deficit. In return the Commonwealth agreed to extend the real per capita guarantee on Commonwealth financial assistance grants to 1998/99, and to maintain the schedule of competition payments agreed in 1995 with the previous Federal government. These are subject to satisfactory progress on the implementation of National Competition Policy reforms.

The States and Territories are expected to contribute A\$1,559 billion over the next three years to the Commonwealth's Budget deficit reduction program, with Western Australia's share amounting to A\$151 million. Western Australia's payment will be made through cuts to its Commonwealth financial assistance grants (CFAG) over the next three years.

In addition, the 1996/97 distribution of CFAG to the States was changed in line with Grants Commission recommendations. Compared with 1995/96, this resulted in a \$67 million reduction in Western Australia's share of CFAGs. Grants Commission recommendations based on studies of State economies in 1995/96 were presented at the 1997 Premiers' Conference. They recommended that Western Australia's share of CFAGs be cut a further \$33.5 million for 1997/98.

*Pressures on State finances continue as Federal deficit remains high.*

The Commonwealth's policy of shifting a portion of its budget deficit problems onto the States will constrain Western Australia's ability to fund infrastructure necessary to foster the continued growth of its resources sector. Pressure on State funding is likely to continue with the Federal Government's announcement in its mid-year review of the Budget in January 1997 of a \$12 billion Budget blowout over the next four years. This will force the Federal Government to seek new savings of around \$2 billion to meet its pledge to balance the budget by 1998/99. The deterioration in the underlying Budget balance is due to large shortfalls in company tax revenue and a fall in inflation. The review showed that the projected Budget deficit for 1996/97 increased 50% to \$8.5 billion from the \$5.65 billion predicted in August 1996. Further blowouts over the next three financial years are expected to add another \$9.6 billion to the Budget bottom line.

**1.4 Social and Political Factors Affecting the Mining Industry**

*Native title delays remain a concern.*

The major issue during 1996 was again native title and its impact on the mining and petroleum sectors. At the end of 1996 there were 202 native title claims covering some 72% of Western Australia including most areas of known mineralisation.

The Western Australian Government has had procedures consistent with the Federal Government's Native Title Act (NTA) since the High Court decision of 16 March 1995. To 6 December 1996 the Department had referred some 6,765 exploration and mining titles to the NTA processes. All title applications are advertised by the Department of Minerals and Energy (DME) and relevant parties notified. If the area is not subject to a registered native claim at the end of the two month notification period the tenement is granted.

*932 of Exploration and Prospecting licences granted with a delay of 3-4 months of the NTA through the "expedited procedures".*

In the case of prospecting, exploration and certain miscellaneous licences, the State seeks the "expedited procedure" which applies to acts which do not have a significant impact on native title interests. Experience to date has been that about 93% of exploration and prospecting licences have been granted following this procedure. However, this process has meant a delay of some three to four months on top of the usual six to seven months to grant exploration licences.

If an objection to the expedited procedure is made by a registered native title claimant and the objection is upheld by the National Native Title Tribunal (NNTT), then the matter must proceed in accordance with the right to negotiate procedure.

In the case of mining leases and general purpose leases, all applications over areas that are the subject of a registered native title claim must undergo the right to negotiate procedure.

The right to negotiate procedure involves meetings of the various parties involved in negotiations related to the grant of tenements. These negotiations must be carried out in accordance with NTA procedures which require that negotiations carried out on behalf of the State be "in good faith" with a view to achieving an agreement with the tenement applicants and native title parties. Where no agreement results from negotiations within the prescribed six month time frame, any of the parties may apply for a determination by the NNTT.

*Mining lease applications held up by right to negotiate procedure.*

The delays experienced with mining leases have been much greater than with exploration licences. Approximately 80% of mining lease applications have become subject to the right to negotiate procedure. Of the 1,322 titles that had been submitted to the process in the period 16 March 1995 to 6 December 1996, only 72 had been granted as a result of successful negotiations. Another ten had been recommended for grant by the NNTT following determinations. However, these determinations are the subject of Federal Court appeals.

In August 1996 the NNTT found that the Western Australian Government had failed to "negotiate in good faith" and as a result over 900 mining lease applications subject to the NNTT's right to negotiate at the time of the ruling have had to restart their progress through the negotiation process.

A key issue for Western Australia is whether pastoral leases extinguish native title. This remains largely unresolved despite the High Court Wik decision.

On 23 December 1996 the High Court ruled that pastoral leases in Cape York in northern Queensland did not necessarily extinguish the native title claimed by the Wik people. It concluded that, because the nature of the Wik people's native title claim had not yet been determined and because the pastoral lease in question was a "limited grant of rights", there was potential for native and pastoral rights to co-exist. Therefore, the lease "may not" have extinguished native title.

Western Australian officials have been working with the Commonwealth and other States in an attempt to identify amendments to the NTA which would make the system more workable. Western Australia supports the amendments to the NTA currently before the Commonwealth parliament and is pressing for additional amendments which will deal with the uncertainty and confusion that has arisen from the Wik decision.

*National change of government to federal/national coalition in March.*

From a more general political perspective, 1996 was significant with Australians voting in a Coalition Government for the first time in 13 years in the Federal election held on 2 March 1996. The Coalition's election commitments significantly impacting on the resources sector included:

- no increases in the tax burden on the mining industry over the first term of Parliament;
- examination of the need to vary secondary taxation policies to encourage petroleum exploration and production;
- maintenance of the existing excise/royalty regime applicable to the North West Shelf area;
- abolition of the three mines uranium policy and export controls on all mineral commodities except uranium; and
- development of mechanisms accrediting State environmental procedures, so that wherever possible, proposals are only subject to one environmental assessment.

In general, at the time of the Federal election, the mining and petroleum industry welcomed the Coalition's resources and energy policy. Some policies, such as the abolition of the three mines uranium policy, have been instituted and details of these are provided below. Nonetheless, a number of the Government's resource and energy policy initiatives, particularly those dealing with native title, will be heavily scrutinised and may be blocked by the Senate.

*State election returns Liberal/National coalition in December.*

Western Australian State elections were held on 14 December 1996 with the State Coalition returned to power for a second term. In general, the Coalition's election platform in terms of the mining industry was a reiteration of existing policies and a commitment to extend those policies into a second term. The Coalition's major new mining initiative is its goal to have a petrochemical industry located in the Pilbara.

The new Federal Government in Canberra has adopted a policy of multiple land use which will have an impact on the nature of the regional forest agreements (RFAs) currently being negotiated with miners and the States.

RFAs are aimed at producing a comprehensive forest reserve system intended to set aside 15% of pre-European forest cover for each forest type. The scheme, developed by the previous government, is an attempt to end continual political battles over which forests should be conserved and which can be logged. In

reaching Western Australia's RFA, DME in conjunction with the Bureau of Resource Sciences completed a qualitative assessment of the mineral resource potential of the south-west forest region of Western Australia.

At the end of 1996, Federal Cabinet endorsed a plan to ensure that the RFAs under negotiation with the States do not have a flow-on effect of banning mining in several areas where it is currently allowed. Cabinet indicated it was prepared to allow mining and mineral exploration in "informal" forest reserves, but wished to ban such activities in specific "dedicated" reserves. Cabinet also indicated it wished to exclude areas with "high mineral potential" from the new reserves and it believed that any areas excised from the reserves for mining purposes should be replaced with "areas of equivalent conservation values".

*Federal State overlap and duplication in the environmental arena reduced.*

In November 1997 Federal Cabinet also approved simplification of the way in which environmental approval for a project is secured. The intention is to remove duplication and overlap from Federal and State environmental regimes, ensuring that projects have to satisfy a single set of regulations. The intention is also that the Federal Government will have discretion over all projects of national significance for the environment or economy, but be removed from less important decisions. Details of these plans are to be negotiated with the States at a meeting of the Council of Australian Governments in 1997 with a rewrite of all Federal environment law to be completed by the end of the same year.

*WA joins National Environmental Protection Council.*

Western Australia joined the National Environment Protection Council (NEPC) in 1996, making it a truly national body. The NEPC consists of Federal, State and Territory environment ministers working together to provide a consistent framework for environmental legislation. A meeting of the NEPC in November 1996 agreed to develop a national environment protection measure (NEPM) for a national pollutant inventory. The council also initiated a new NEPM on assessment of contaminated sites and approved protocols for community and business consultations on national measures and on guidelines for the environmental, social and economic assessment of future NEPMs. This followed strong pressure from industry, including the mining industry, for better consultation by the NEPC. Industry had complained that the NEPC was consulting after, rather than before, it drew up guidelines.

*International Greenhouse Gas Pressures.*

In July 1996, the Commonwealth also stated its views on the need to balance environmental and development considerations at the Climate Change Convention in Geneva. The Federal Government has adopted a stance of not signing any convention on climate change and greenhouse gas emissions which "unfairly" harmed Australia's economic welfare. The proposed convention on greenhouse gas emissions is due to be signed in Japan at the end of 1997. In its formal submission to the UN lodged on the 15 January 1997 deadline, the Commonwealth has remained steadfast in its insistence that those developed countries that would be hardest hit by reduction measures should be allowed to emit higher levels of greenhouse gases. Whilst the stance has garnered some support from the likes of Norway, Poland, France and Japan, it has raised concerns over the possible reaction of the US. It remains to be seen what the outcome of further negotiation will be.

*Uranium Mining three  
mines policy abandoned.*

Consistent with the new Commonwealth Government's platform it has abolished the former government's uranium three mines policy as well as removing price controls on coal, bauxite and mineral sands. This should see increased opportunities in the mining industry in Western Australia and in particular could lead to the future development of the Kintyre and Yeelirrie uranium deposits.

The new Commonwealth Government's stance on environmental and developmental issues can be seen as positive for the mineral and petroleum industries. However, as shown by the recent Chamber of Minerals and Energy Tracking Survey, environmental issues regarding the mining industry remain of significant concern to the community. It was timely therefore that in December 1996 the Minerals Council of Australia revealed its long awaited environmental management code. Eighteen companies are currently signatories to the code which commits them to excellence in environmental management through, for example, sustainable development, community consultation, application of risk management to environmental outcomes, and setting of environmental performance targets.

Figure 1.3

## LOCAL GOVERNMENT BOUNDARIES

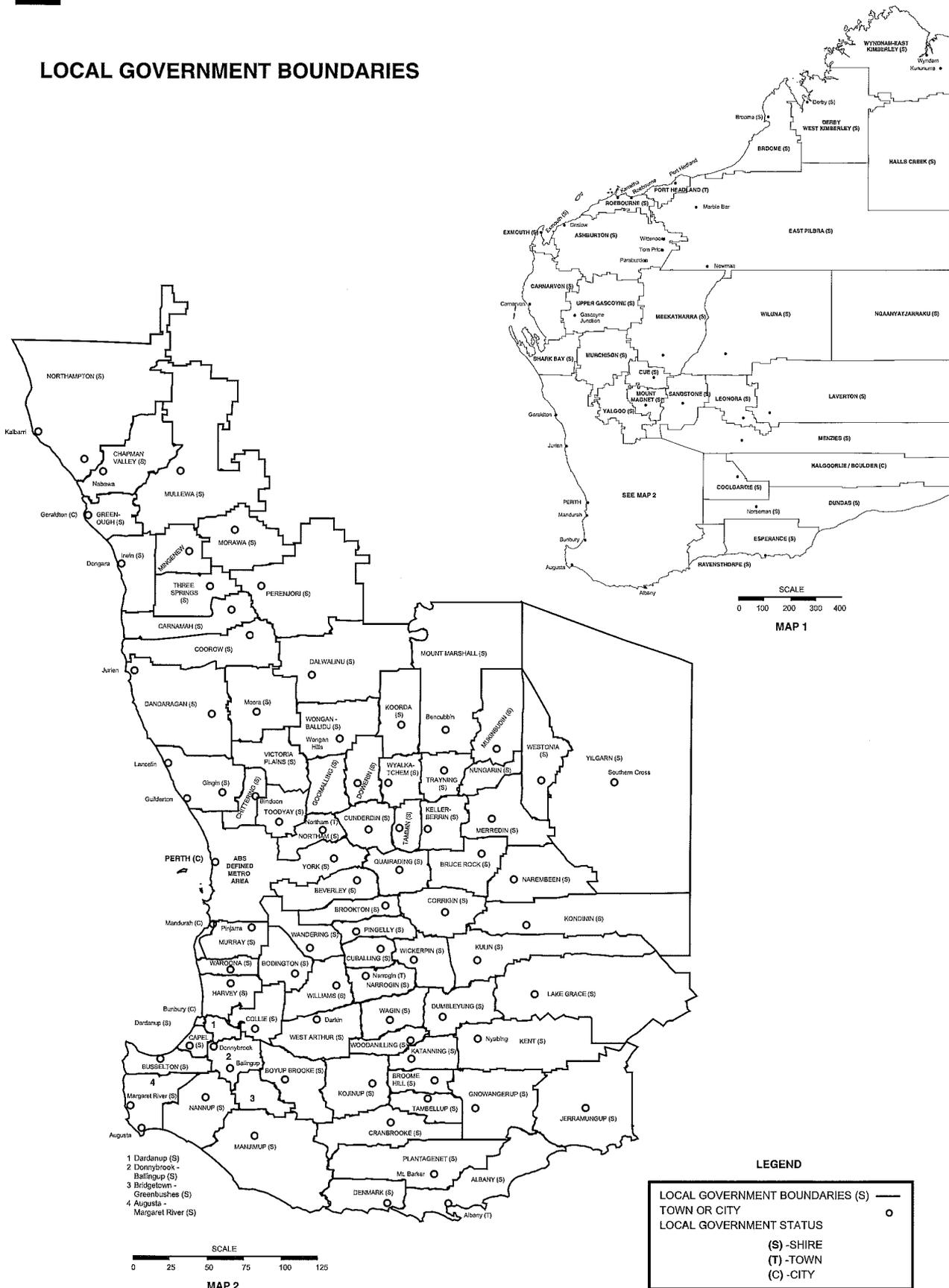
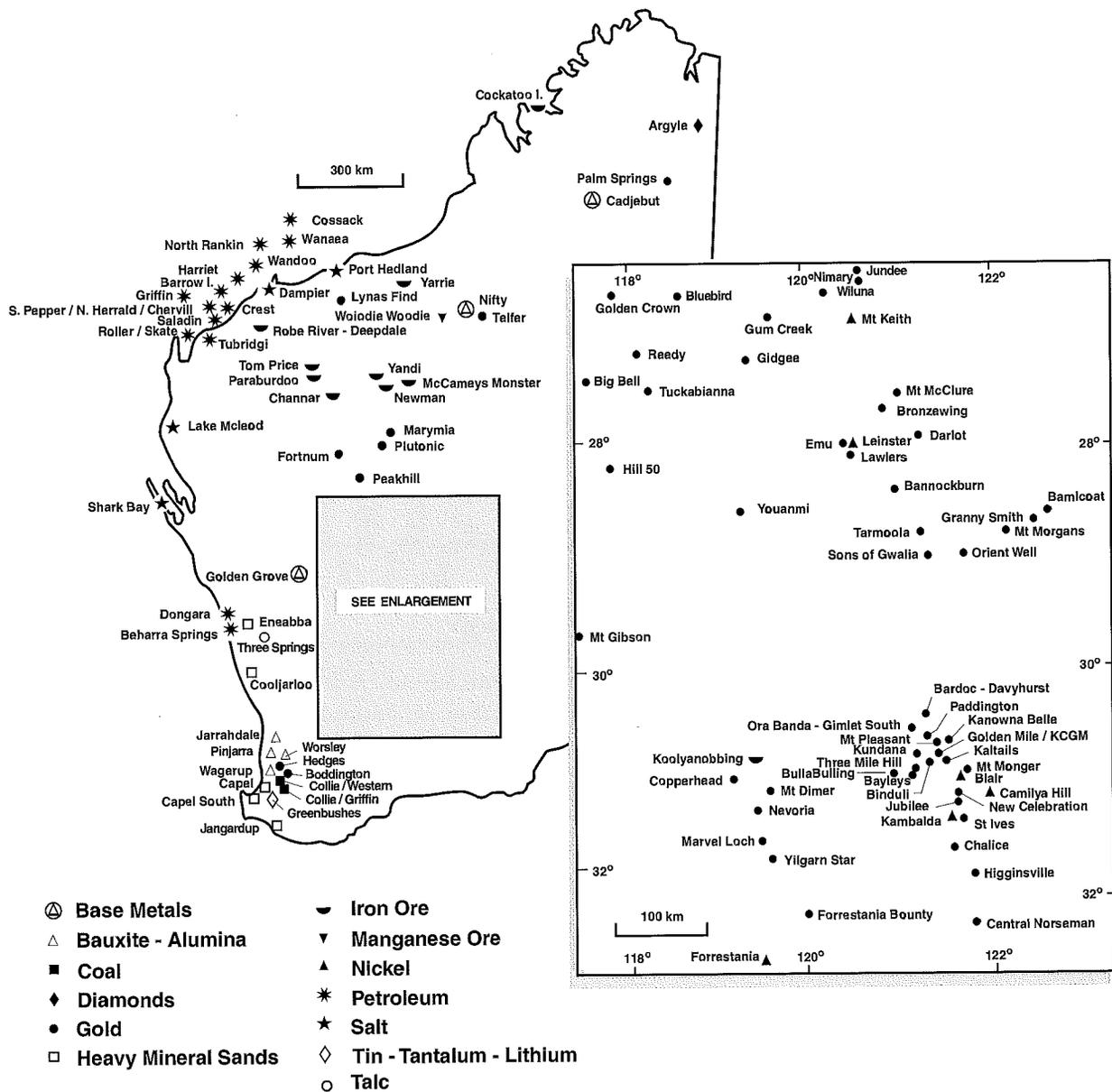


Figure 1.4

## MAJOR MINERAL AND PETROLEUM PROJECTS IN WESTERN AUSTRALIA

WITH AN ANNUAL VALUE OF PRODUCTION IN EXCESS OF \$10 MILLION



## 2. REVIEW OF MAJOR MINERALS AND PETROLEUM IN WA

### 2.1 Overview and Outlook

The value of mining and petroleum production increased by 9.3% in 1996 to reach \$16 billion. Key sectors contributing to this growth were petroleum, alumina and gold. Commodity prices were mixed in their movements over 1997, but appreciation in the Australian dollar over the year uniformly eroded the returns for most of the State's mineral and energy producers.

The petroleum sector performed particularly well in 1997, reaching \$4,693 million in total value of production. The value of oil and condensate production, for example, increased 40% on the back of both higher output and prices. The petroleum sector now contributes almost 30% to the State's value of minerals and energy production.

In a year of depressed spot prices for alumina, ironically the State's alumina sector increased its value of production by 12%. This was mostly because of higher contract prices settled on prior to the drop in spot prices. The State's gold industry also increased its value of production by 11%, but unlike petroleum and alumina had to achieve it through higher output to counteract a year of lower prices.

Other sectors were mixed. The nickel industry suffered from lower prices, while buoyant markets helped mineral sands continue its solid recovery. Lacklustre Japanese steel manufacturing was reflected by a stagnant iron ore industry. However, the gathering pace of downstream processing and increasing prominence of new Asian markets augur well for an exciting future.

Looking ahead at the mineral, and energy industry as a whole, its value in Western Australia is estimated to be in the range of \$21 - \$24 billion in 2000/01. This will require an average annual rate of growth in production from now to 2000/01 to be in the vicinity of 7% to 9%. These forecasts are of course predicated on particular price assumptions and, most importantly, on the likelihood of new projects advancing. For example, the value of alumina production in a low growth scenario is estimated to increase at an average annual rate of 6% based on current facilities and production levels. However, in a high growth scenario where it is assumed that all new expansion plans reach fruition, the average annual growth rate to 2000/01 for the value of alumina output could be around 13%.

### 2.2 Petroleum

For the second year running petroleum has been the State's most valuable resource sector. New annual production rate records were set for oil, gas and condensate with the value of output in 1996 rising by 24% to reach \$4,693 million.

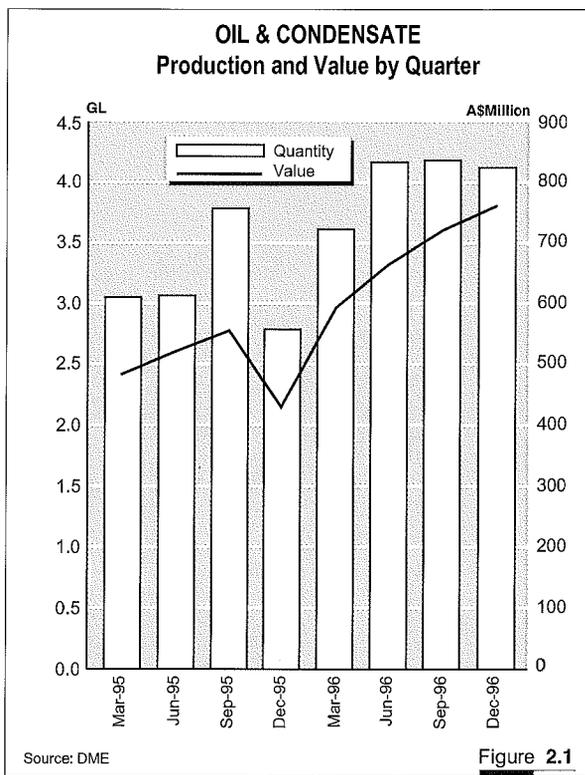
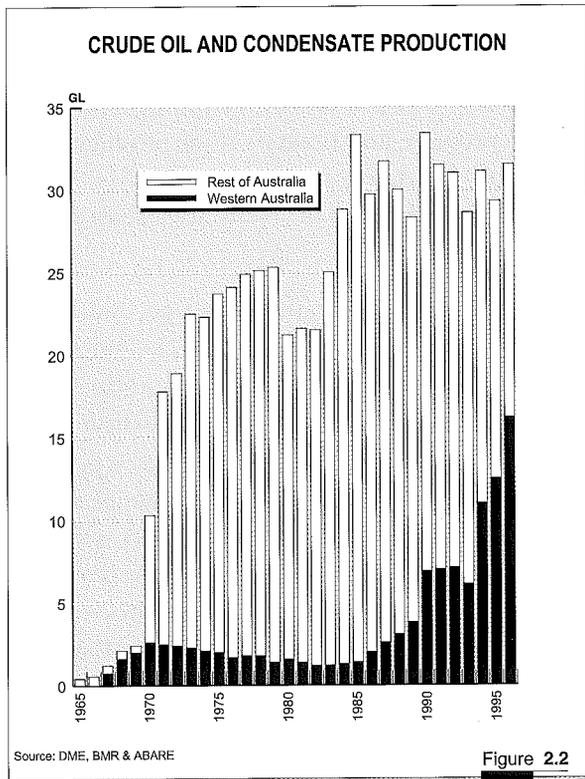


Figure 2.1

Western Australia is now securely Australia's premier petroleum producer. In 1996 the State accounted for approximately 51% of Australia's total crude oil and condensate production as well as 48% of its gas production.

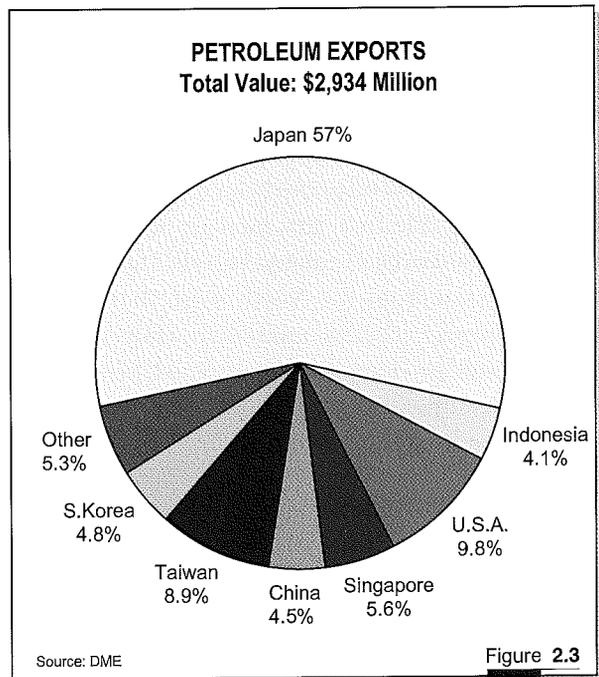
Within the petroleum sector, crude oil production worth \$1,959 million, was the most significant product. Volume of production was up 30% in 1996 to reach 71 million barrels. This large increase was mainly attributable to the first full year's production from the Wanaea and Cossack oilfields. Output from these fields was 25 million barrels in 1996 and represented the first production of crude oil from the North West Shelf (NWS) Project.

In 1996, 45% of Western Australia's crude oil production was exported overseas. Of this proportion, most went to Asia, with 22% destined for Japan and over 40% split equally between Indonesia, South Korea and Singapore. United States was also prominent, accounting for around 24% of overseas sales.

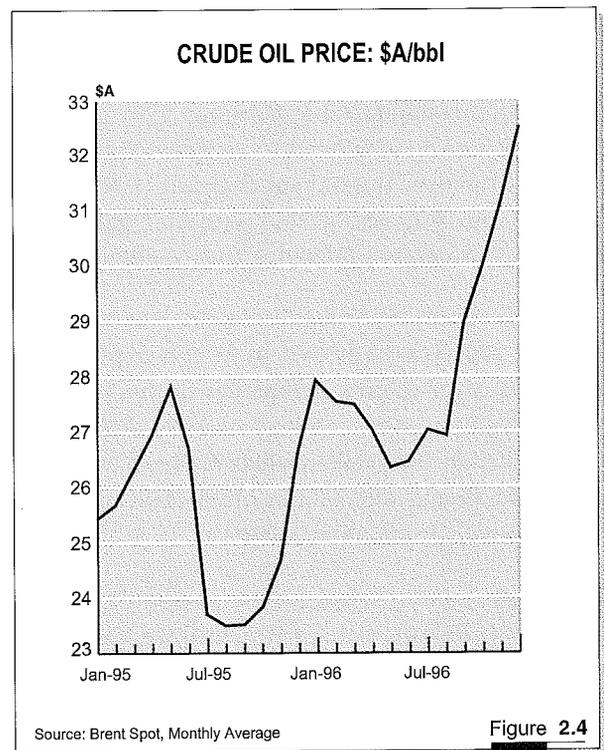


The decrease in stockpiles, particularly in OECD countries, was a major feature of the predominantly tight world oil market in 1996. Oil inventories fell to their lowest level in almost 20 years in early 1996 as the major refineries allowed inventory levels to run down in a move to reduce costs. Refineries also expected that the resumption of exports by Iraq would fill the gap, but it didn't happen. Consequently, in addition to higher output, the value of Western Australia's crude oil production was also boosted by higher prices received by the State's producers which in 1996 averaged US\$22.20 per barrel. This compared with US\$18.80 per barrel in 1995. There was notable volatility in oil prices in early 1996 as Iraq and the United Nations were negotiating the return of Iraqi oil. The move was halted however by Iraq's invasion of the Kurdish province and subsequent US reaction. Iraq has since returned to the market albeit on a very small basis as part of an "oil-for-aid" deal.

In contrast to the dramatic rise in crude oil production in Western Australia the value of LNG output increased just over half a percent in 1996 to \$1,391 million. Almost all LNG was exported overseas to Japan. Whilst growth in LNG production in 1996 was subdued, the longer term outlook is exciting. New LNG markets are opening up in Asia, the Japanese market is expanding and potential new projects are being



examined. These include WAPET's plans for a possible stand-alone LNG development based on the Gorgon field and the NWS Partners' proposal to expand the NWS facilities in anticipation of increased gas sales. The NWS Partners' proposal consists of constructing a second trunkline to the Burrup Peninsula and two extra processing trains. In addition, the NWS participants are in the process of proving up gas reserves from their Perseus field and in conjunction with WAPET are also considering an integrated LNG



project using gas from the Gorgon and Rankin gas fields.

In 1996, the value of condensate production was \$774 million, a significant 37% increase on the previous year. Whilst higher world oil prices helped boost this figure, it was mainly due to a 30% increase in production which reached over 31 million barrels. This reflected higher output from the North West Shelf Project through greater capacity utilisation. Only a quarter of condensate production was consumed domestically. Remaining output was exported overseas, mostly Asia, with Taiwan the major customer.

The value of natural gas production increased 11% in 1996 to \$495 million. This was chiefly due to the commencement of production from the East Spar subsea gas gathering system towards the end of 1996. East Spar is one of several gas fields now supplying the Goldfields Gas Pipeline which saw gas deliveries into Kalgoorlie commence in October 1996. A number of power station projects have since been completed along the pipeline route.

East Spar is also expected to contribute to greater gas production in 1997 with a full year's output from this field. East Spar will also assist in boosting oil output in 1997 with an estimated output of 2.5 million barrels of condensate in a full year's production. However, expected increased oil production in 1997 should mainly emanate from Wandoo and Stag. Whilst the Wandoo oil field has been in production since 1993, an additional platform, Wandoo B, has now been installed as part of full field development, production from which commenced in February 1997. Further oil production is scheduled to commence from the Stag and Lambert/Hermes fields in late 1997. Both Wandoo and Stag are 40 million barrel size fields. Lambert/Hermes is estimated at 20-30 million barrels.

The longer term outlook for oil production beyond 1997 is also very positive with the exploration programs of petroleum companies in the far north west of the State finally coming to fruition, for example Laminaria/Corallina oil field which has been estimated to contain around 200 million barrels of oil and is due to commence production in 1999.

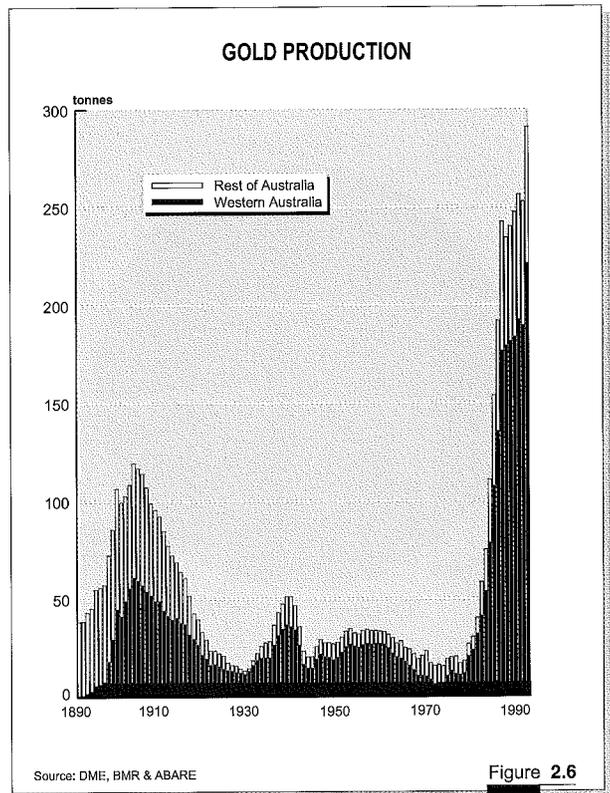
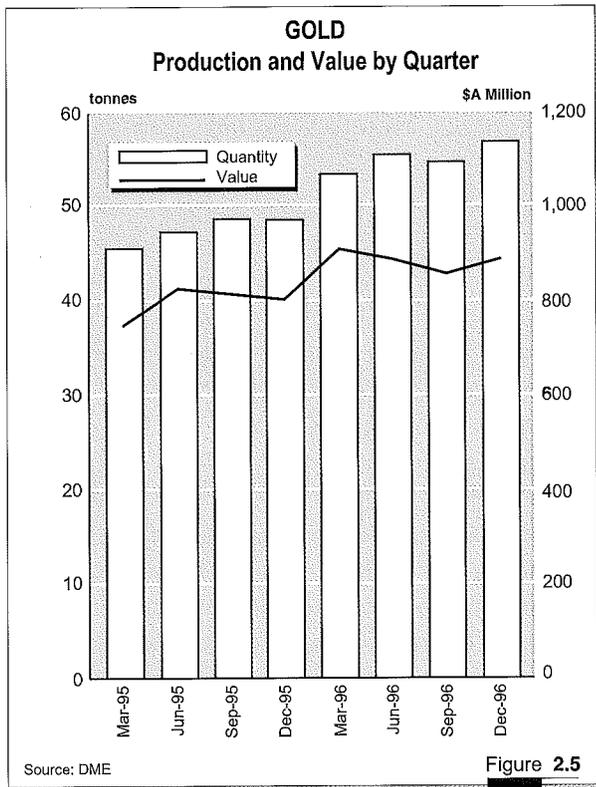
1996 saw the first full year's production from Woodside Petroleum's \$300 million liquefied petroleum gas (LPG) plant. In 1996 the plant produced approximately 310,000 tonnes of LPG worth \$41 million. All production was exported to Asia, mainly

China, Japan and Philippines. LPG is a by-product from associated gas produced in large quantities from Wanaea and Cossack fields. Stripping LPG gases (mainly propane and butane) from producing gas fields ensures that natural gas meets its quality specifications and gives the North West Shelf project greater diversity.

With so many oil, gas delivery and gas processing projects expected to come on stream in either 1997 or subsequent years, the outlook for the State's petroleum industry is extremely positive. The consensus of opinion on oil prices though, is that they will ease over at least the next two years to around US \$20 per barrel. The decline reflects expected increases in global production and some growth in stocks. The production increases are expected from non-OPEC countries, particularly the United Kingdom, Norway, Brazil, Mexico and Australia. In the longer term, increased production should also emanate from Kazakhstan, Turkmenistan, Azerbaijan and Russia as they slowly sort through their problems of ownership, control and financial development of their considerable petroleum resources.

2.3 Gold

Western Australian gold production continued to grow strongly in 1996 with 221 tonnes of gold produced during the year, a 17% increase on 1995. This accounted for 76% of total gold produced in Australia in 1996. The value of production increased by 11% to \$3,526 million.



- Golden Mile - Kalgoorlie - 23.2 tonnes;
- Kambalda - St Ives - 12.9 tonnes;
- Telfer - 11.4 tonnes;
- Boddington - 10.0 tonnes;
- Bronzewing - 8.4;
- Granny Smith - 8.3; and
- Jundee - 7.4 tonnes.

Although the average world gold price increased from US\$384/oz in 1995 to US\$388/oz in 1996, an appreciation in the Australian currency from US\$0.74 to US\$0.78 caused a fall in the average Australian Dollar denominated gold price from \$519 per ounce to \$495 per ounce. Consequently, growth in the value of production trailed output.

Approximately 85% of gold production was exported to Asia, with the remainder destined almost entirely for Europe. Most exports into Asia went to South Korea. Gold export quantities from Western Australia outstripped production by 7% in 1996. This is because exported gold production is being supplemented with stocks from previous years' production when exports lagged behind output.

The 13 biggest producing projects in Western Australia accounted for half of the State's gold production in 1996. The largest projects, each with gold production worth over \$100 million in 1996, were:

The gold industry has recently been hit by falls in the price of gold from US\$380 per ounce in December 1996 to around US\$340 per ounce by mid-February 1997, its lowest level in three years. This has largely been driven by falling investment demand, primarily in response to prevailing low world inflation and strong investment returns in global equity markets. Investment demand has also been dampened by expectations of increased supply from emerging producer regions and concerns relating to potential increases in sales by Central Banks in European Union member countries and the International Monetary Fund (IMF).

Analysts suggest that gold is beginning to lose its allure as a speculative investment commodity and is increasingly viewed as a normal commodity subject to regular supply and demand forces. Concurrent with this shift in sentiment, Central Banks divested some of their gold stocks in 1996, forcing the gold price down. Central Banks currently hold about 33,000

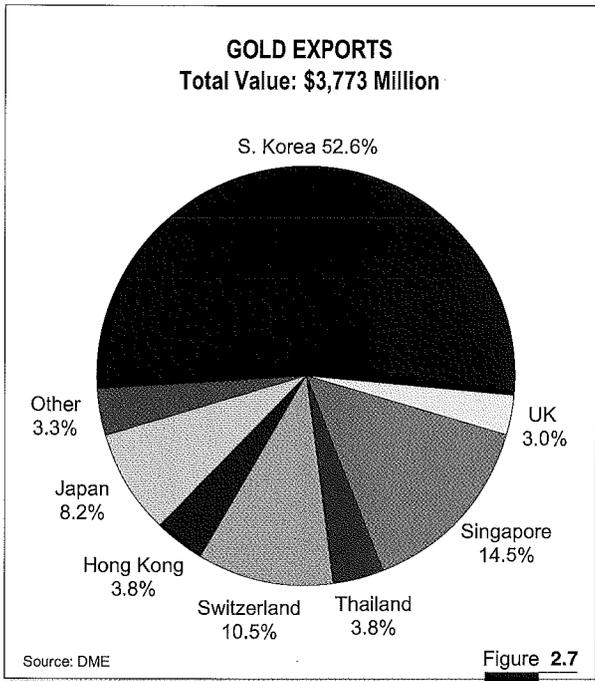


Figure 2.7

tonnes of gold (over 14 years of current world annual production) and analysts suggest these banks are unhappy with current returns on this stock. This over-hang in supply is unique to gold in the commodity market and is increasingly being questioned.

Recent price falls have underlined the importance to Australian producers of extensive hedging positions. Statistics show that on average, Australian producers have 1.7 years of hedging in place, more than adequate to deal with short-term falls in the price of gold.

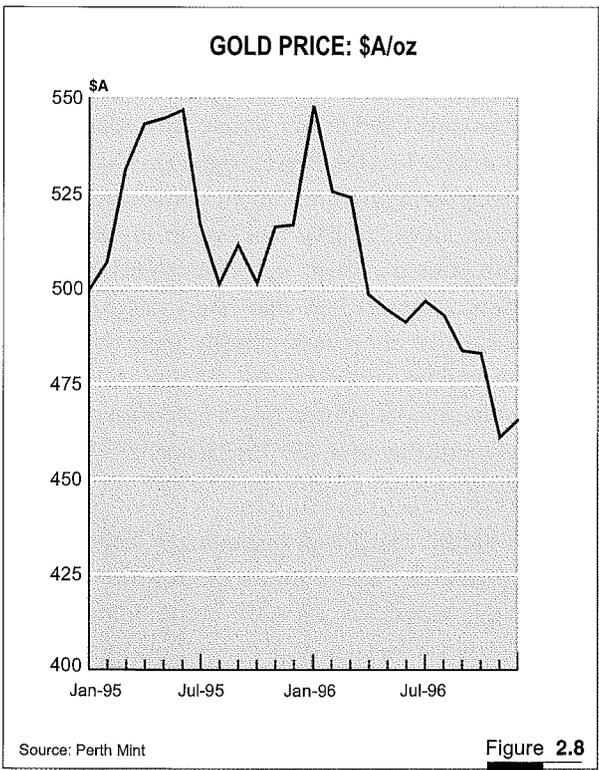


Figure 2.8

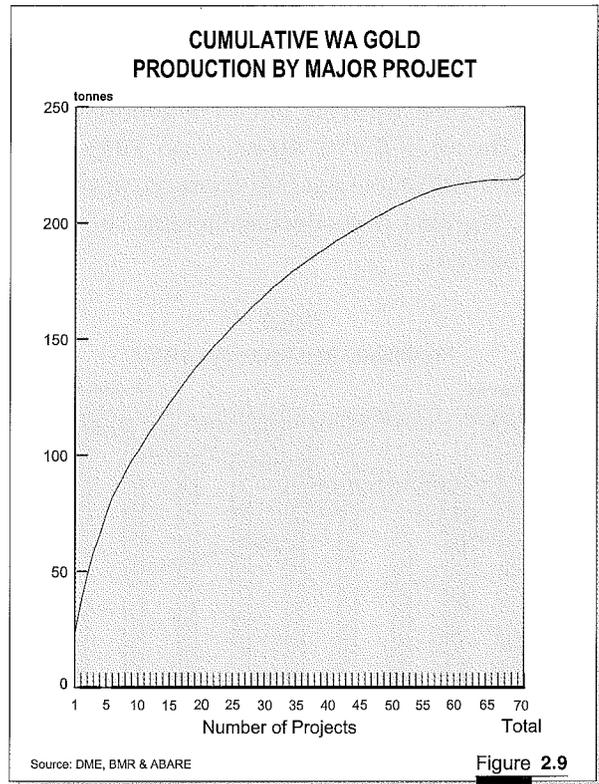


Figure 2.9

Western Australia's gold industry enjoys the advantage of being highly capital intensive and cost competitive compared to the rest of the world. A study by Surbiton Associates Pty Ltd has found the gold industry to be fundamentally sound despite sharemarket concerns. Some 80% of Australian gold miners are producing at cash costs of less than A\$450 per ounce and up to 50% are producing at less than A\$350 per ounce.

Obviously a sustained downturn in the price of gold would not be welcomed by the gold industry. The hardest hit would be the smaller producers and exploration companies which see access to risk capital drying up as nervous investors abandon the more speculative end of the industry in favour of larger, more secure producers. Also, the process of high-grading production is only a short term solution to price problems, since in the longer term the practice can significantly reduce mine life by effectively sterilising lower-grade ore which becomes waste.

With the flight of risk capital to the more secure end of the share spectrum and the reduction in value of gold shares, the impetus for listing Australian companies on sharemarkets overseas has increased. Even before the recent price fall, companies have actively sought listing on Canadian and US sharemarket boards. Local companies listed on these foreign boards have maintained market values significantly higher than comparable Australian companies listed on the

Australian sharemarket. Suggested reasons for this anomaly include a deeper pool of investors and a greater willingness to undertake risk by investors in the American market.

No major gold discoveries (on the scale of Bronzewing for example) have been made since the flurry of finds in the early 1990s. However remaining reserves still stand at ten years of production with companies expanding resource bases for existing operations. Western Australia's strong gold reserve situation is being supported by the trend towards underground development of sulphide ores. For example, Plutonic Resources Ltd has upgraded the underground ore body at its Centenary project to 2.1 million ozs. This project is in close proximity to the company's Darlot underground gold mine. The company has yet to decide whether to build a new plant for Centenary and treat it as a separate mine or develop it as part of the existing Darlot project.

In 1996, an estimated 2,328 tonnes of gold was produced worldwide. Supply is forecast to increase strongly over the next five years at an average annual rate of 2.7% to reach 2,737 tonnes in 2002. Significant contributors to the increase are expected to be emerging producer regions such as Asia and South America. In 1990 emerging producers accounted for 26% of world mine production while in 1996 this is estimated to have increased to 36% and is projected to increase further to 41% by 2002. Production in these regions is being driven by recent increases in exploration efforts of large global mining companies which are seeking low cost deposits outside traditional gold provinces where production costs and environmental and other constraints are increasing. Interest in hitherto undeveloped mining provinces is also being stimulated by increased political stability and policy reform in a number of developing countries, coupled with their high mineral prospectivity.

According to ABARE, Australia production in 1996-97 is forecast to expand by 11% to reach 303 tonnes. This rapid growth is expected to continue until 1999-2000 by which time production is projected to be 336 tonnes. Growth in production is projected to plateau after 1999-2000.

Growth over the next three years will be primarily derived from existing gold projects and committed new projects. This expected production growth is the result of several historical factors. Most important was the rapid increase in exploration expenditure, which to a large extent brought about the development of a number of newly discovered

deposits such as Bronzewing (WA), Jundee (WA), Nimary (WA) and Cadia Hill (NSW).

The increase in exploration expenditure was largely the result of the rapid real increase in total industry gross margins in the early 1990s, from A\$0.48 billion in 1991 to A\$1.01 billion in 1994. This was driven by the rise in cash margins from A\$143 per ounce to A\$201 per ounce over the same period.

The high levels of exploration expenditure resulted in Australia's demonstrated resources of gold expanding from 2,129 tonnes in 1990 to 4,263 tonnes in 1995 - resources on which production growth in the next three years will be principally based.

Despite the positive short term production outlook, the Australian gold industry has now entered a period of rising costs. Over the next five years real operating cash costs are projected to increase to over A\$380 per ounce, a major reversal of the falling real trend in production costs since the early 1990s. Expanding costs and easing real gold prices are expected to influence the capacity of higher cost operations to maintain current output. Factors contributing to increasing costs include:

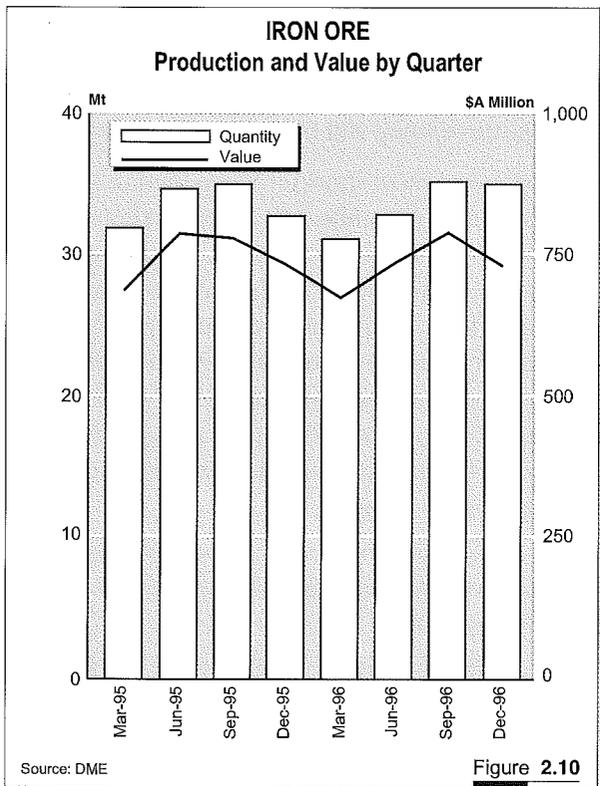
- a greater proportion of production being drawn from underground and deeper open cut operations;
- increasing depth of operations resulting in increased proportion of sulphide ore processed which raises processing costs; and
- likely increase in depth of new discoveries, raising exploration and mine development costs.

These factors, together with the lower real gold price, are expected to result in a margin squeeze with the real cash margin of the Australian gold industry projected to fall \$40 per ounce from \$131 in 1996 to \$91 in 2002. This in turn is projected to result in a reduction in exploration expenditure.

Despite such constraints on industry growth, the outlook for the Australian gold industry remains positive. The industry has a demonstrated capacity to absorb potential cost increases by the application of new technology and techniques. About 27% of the projected production in 2001-02 is expected to come from as yet unannounced sources. Some of this additional production is expected to come from expanding gold provinces such as the Gawler Craton in South Australia, the Lachlan Fold Belt in New South Wales and the Yandal Belt in Western Australia.

## 2.4 Iron Ore

Western Australia produced 134 million tonnes of iron ore worth \$2,924 million in 1996. This represented a slight reduction on 1995 of 2% in both quantity and value, reflecting a subdued domestic Japanese economy and Japanese steel manufacturers being buffeted by a strong Yen. The appreciation in Australian currency over 1996 also hampered returns to local producers.



Total world iron ore production was around 1,000 million tonnes, dominated by China and Brazil which produced 235 and 172 million tonnes respectively. Australia was the world's third biggest producer with around 147 million tonnes of which Western Australia accounted for 91%. Exports from Western Australia totalled \$2,786 million in 1996. Japan was the major export destination, receiving 46% of exported ore. This was followed by China, to which around 20% was exported.

Most iron ore prices are fixed annually under long term sales contracts. Delivery of Brazilian ore to north west Europe and Australian ore to Japan are the major price reference points. In January 1997 Western Australian iron ore producers and Japanese steel mills announced iron ore price settlements for the Japanese fiscal year (JFY) 1997, which is effective from April 1997 to March 1998.

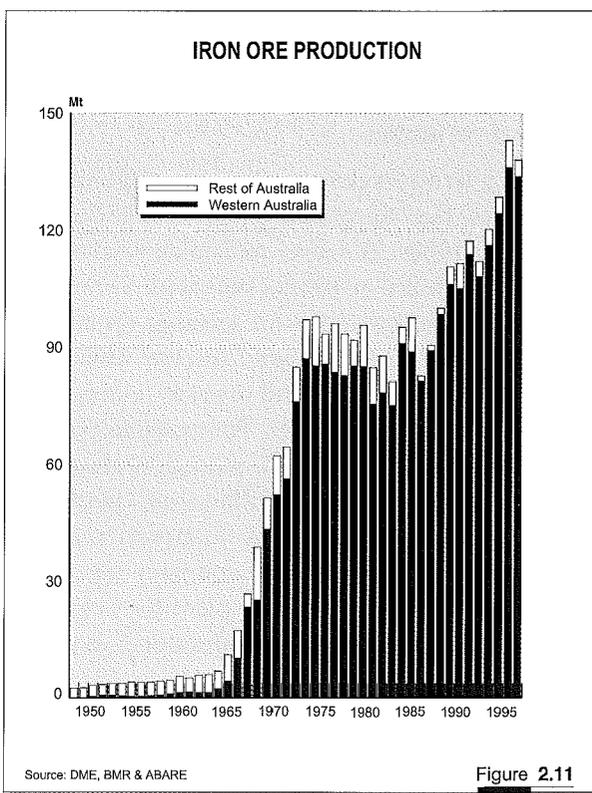


Figure 2.11

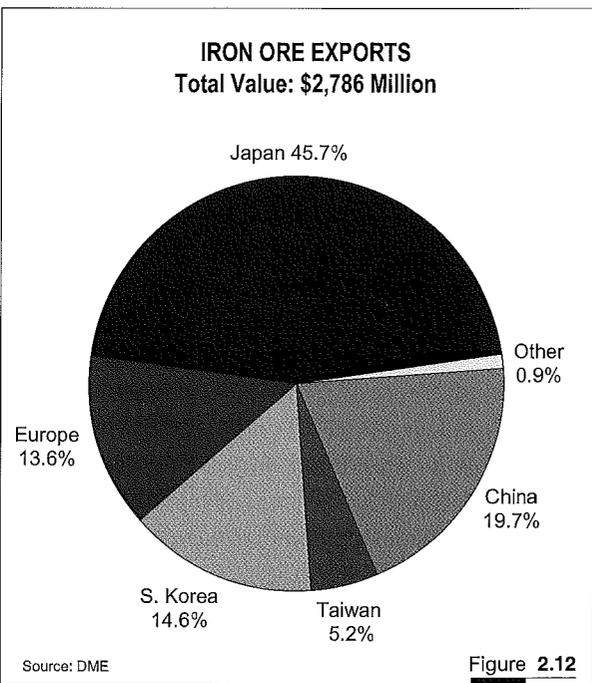
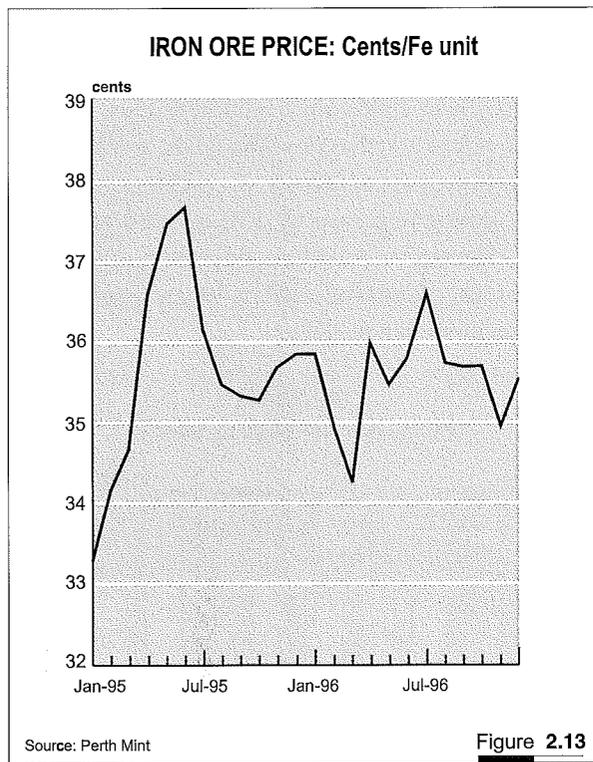


Figure 2.12

BHP and Hamersley Iron obtained a rise of 1.1% for fine ore and a rollover in the JFY 1996 price for lump ore and Robe River secured a 1.4% increase for its fine ore. These outcomes reflected a compromise between buyer and seller expectations. Japanese steel mills sought a price reduction, after forecast growth in steel output (on which JFY 1996 were primarily based) failed to materialise. On the other hand, iron ore suppliers sought a price rise, in part to justify the



significant capital expenditure required of them in order to increase capacity to meet forecast iron ore demand in the longer term.

A gloomy tone was also predominant in the world steel market prompting BHP's announcement in September 1996 that it would close its loss-making stainless steel reprocessing plant near Port Kembla. It also announced job cuts at its Newcastle steel works. BHP has said there was now over-capacity in the world stainless steel market. Indeed, European export prices for hot rolled steel fell around 40% in 1996. But importantly for Australian iron ore producers, Asian steel output has remained relatively robust. This has meant that Australian producers have been able to sustain higher sales than producers like Brazil who have Europe as their main market. ABARE has predicted that iron ore is expected to perform relatively well next year, underpinned by a return to growth in the European and Japanese steel markets after a draw-down of their excess stocks.

Significantly, while Japan remains Western Australia's major market, key Asian growth areas for steel production - China, India, Taiwan and Korea - are becoming increasingly important. Demand from these countries is expected to increase which will require a significant amount of capital expenditure to develop new sources of ore. Unfortunately, iron ore prices are unlikely to rise sufficiently to justify investment in

major greenfield operations. Therefore, increased supplies will come from low cost "brownfield" expansions by existing producers in the major supplier countries, namely Australia and Brazil. Locally, the Pilbara is the scene for much of this type of activity. The most recent announcement came from Robe River, with the launch of a feasibility study into development of the West Angelas deposit, about 100 km east of Paraburdoo.

Two other projects in the region at various stages of development are BHP's:

- Orebody 18, 5km west of its Jimblebar mine planned for operation late 1997; and
- Mining Area C 20 km south of the current Yandi operation.

In addition, Hamersley Iron is considering the development of Yandicoogina, 90km west of Newman. The only project independent of existing mine operators in the region is a proposal from Hancock prospecting for a 15 million tonne per annum operation at Hope Downs.

The range of new projects in the Pilbara either committed or under consideration raises the need to seriously consider options such as stand alone, sharing or paralleling of rail facilities in this region. At a cost of around \$1 million per line-km, rail could make up a significant part of capital costs for these projects. Linkages by existing producers are already planned to spread east and south. Hamersley Iron's spur line to Marandoo, for example, is to be extended to the east using the infrastructure corridor across Karijini National Park, whilst further extensions of BHP's spur line from the existing Yandi mine to Mining Area C are being planned. The progressive development of these infrastructure networks could potentially improve the viability of a number of orebodies in the region.

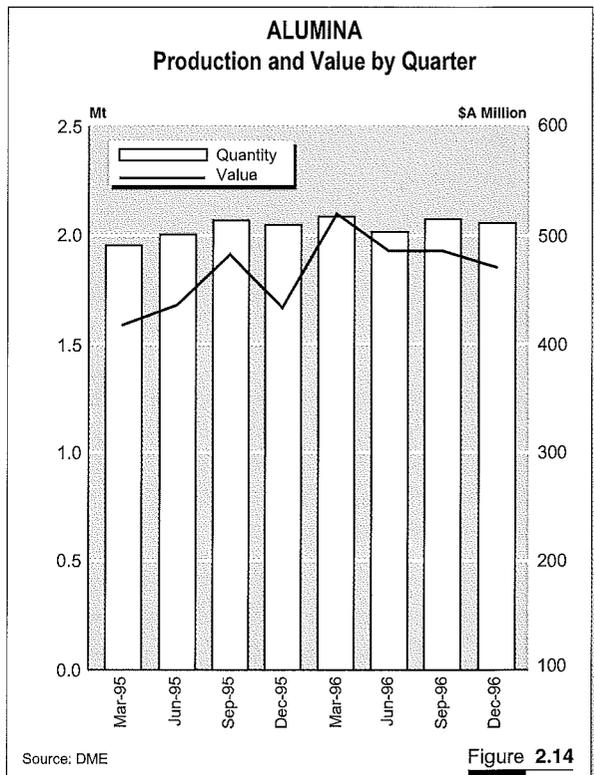
Another changing parameter for Western Australia's iron ore industry has been the growth in Asian steel mini mills coupled with reduced local energy and construction costs. Several players are now moving towards downstream processing in the form of direct reduced iron (DRI) to supply the Asian demand. BHP has been constructing a 2 million tonne per annum DRI plant at Port Hedland since late 1995. Commissioning is planned to commence in December 1997, to be finalised in mid 1998. In conjunction with

this, BHP's Port Hedland harbour tunnel project is planned to commence operation in 1997. The tunnel under Port Hedland will carry iron ore from Nelson Point to Finucane Island for either transfer to berth for shipping or to the DRI plant for processing.

BHP's DRI plant will be the first downstream iron ore processing facility to come on-line out of several currently being considered in Western Australia. Other projects include the Mid West Iron and Steel project, Mt Gibson Iron DRI/hot briquetted iron plant, Australian United Steel Industry's DRI project at Cape Lambert, Mineralogy's proposed magnetite processing facility and Robe River's proposed re-opening of its pellet plant at Cape Lambert.

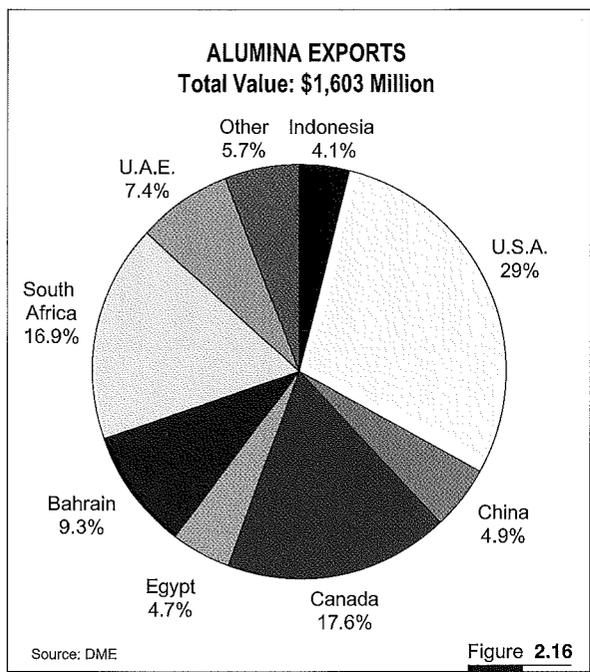
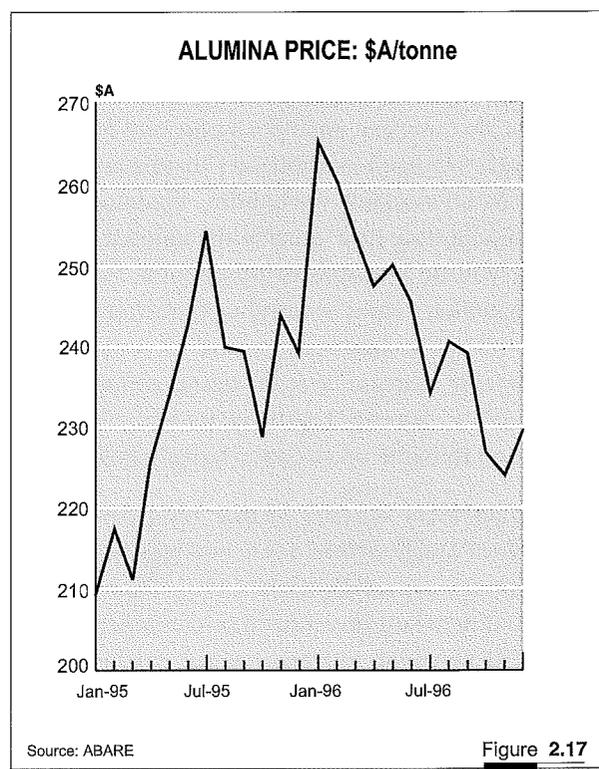
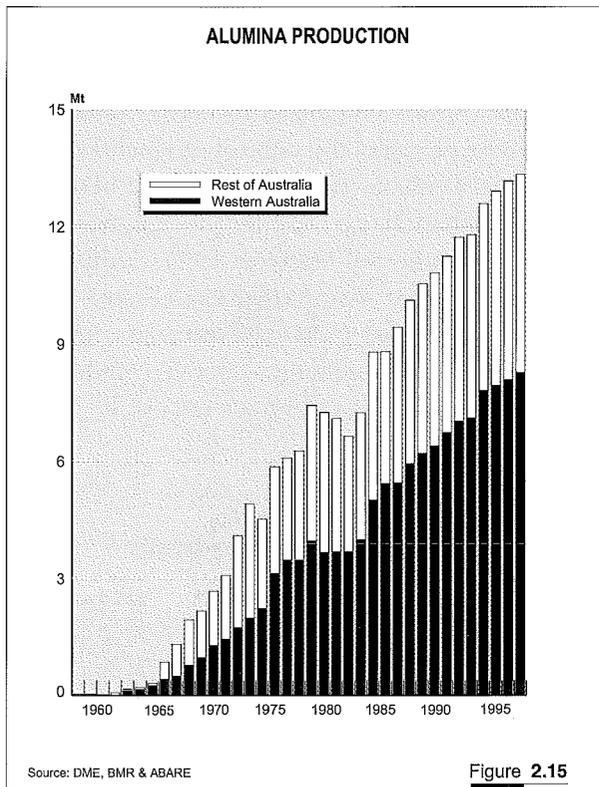
## 2.5 Alumina

Alumina output in Western Australia increased by a little over 2% in 1996 to 8.2 million tonnes. Average contract prices received by Australian producers in 1996 were up by around 5% on the previous year. Total value of production rose by 12% in 1996 to \$1,968 million. This value would have been higher had it not been for the offsetting effect of an appreciated Australian currency in 1996.



Western Australia produced over half of Australia's alumina in 1996. Over 85% of the State's production was exported overseas. North America figured most prominently as an importer of the State's alumina with 47% of exports destined for that region. Other significant importers from Western Australia were Africa (22%), Bahrain (9%), United Arab Emirates (7%) and China (5%).

Whilst contract prices received by producers were up on the previous year, world spot prices for alumina fell 34% to average US\$175 per tonne. Increases in world production of smelter grade alumina and weak demand in some markets, particularly China, were responsible for the price fall. It is estimated that less than a quarter of the world's alumina is traded on a spot basis. Nevertheless, spot prices usually dictate forthcoming contract rates. The higher contract values



1996, increased Chinese imports of alumina, decreased alumina production by the Commonwealth of Independent States (CIS) and production cuts by alumina producers Alcoa and Reynolds. The net result of these factors has been that total world alumina consumption in 1996 (41 million tonnes) outstripped supply (40 million tonnes) - an ironic outcome given the gloomy price conditions in the middle of 1996.

ABARE has forecast alumina prices to rise further in 1997 in response to increased demand for alumina from new smelters and smelter expansions. This of course is tied in with conditions in the aluminium market which, in common with several other metals, took a hammering in 1996. Poor underlying demand and depletion of stocks by consumers combined to depress market sentiment. The market improved at the end of 1996 in response to stronger demand, but nevertheless the aluminium spot price for the year as a whole was on average 17% lower. The consensus of forecasters is that both LME and producer aluminium inventories should decline further as economic growth translates into increased orders for aluminium products by manufacturers who are expected to rebuild stocks to ensure they can meet rising demand.

Whilst this represents a positive price outlook for Western Australia's producers, it needs to be tempered by a number of threats to the aluminium market. The

achieved in 1996 therefore reflected buoyant spot prices from the previous year.

Spot alumina prices have subsequently risen dramatically by some 40%. In March 1997 for example, the market was trading in the \$US200-220 per tonne range compared with \$150 per tonne in the middle of 1996. Factors responsible for this have been steadily higher aluminium production in the second half of

strength of demand is uncertain in major markets which have shown weakness in the past, such as Western Europe and Japan. The situation surrounding Russia is also unclear; specifically, no one is sure of the country's indigenous demand situation and hence Russian metal available for export. Foremost is the question regarding how quickly, the amount of idled capacity will be returned to production. Currently around a million tonnes of worldwide smelter capacity remains idle. The high cost nature of some of this capacity may prevent it from being restarted but considerable potential still exists for additional production to come on stream relatively quickly.

The longer term outlook is that high prices will certainly encourage at least some new production and rising stocks, especially after 1999. This will put renewed downward pressure on prices depending on the extent to which current smelter expansions go ahead. Some analysts in fact predict that the aluminium market is now at a point where announced capacity expansions over the rest of the decade are already likely to lead to another price slump early in the next decade.

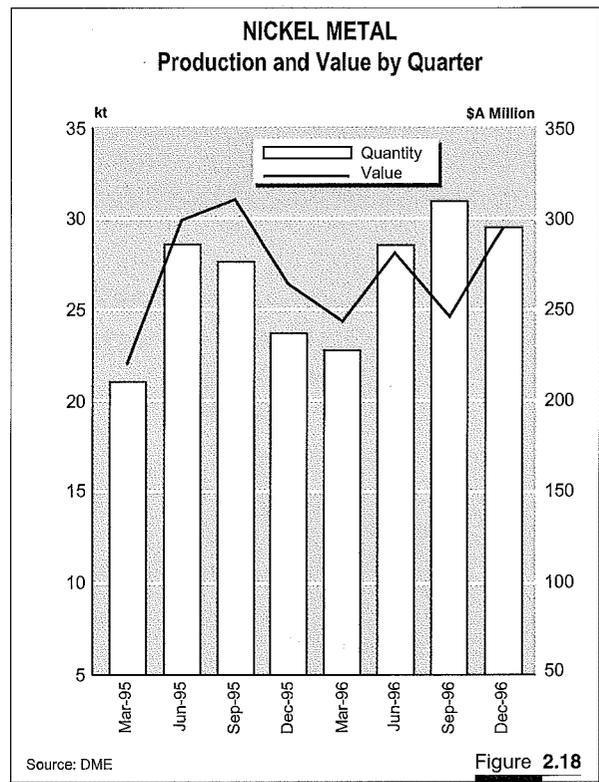
In relation to local developments, Alcoa in February 1996 resurrected its plans for a proposed two stage A\$970 million expansion of its Wagerup alumina refinery. The \$620 million first stage expansion would add 850,000 tonnes of output to its 25% share of the world alumina production capacity. If the expansion were to include the second stage this would almost double its current alumina output to 3.3 million tonnes per annum.

The State's other alumina producer, Worsley, is also currently undertaking a feasibility study of an \$800 million expansion of its refinery. The expansion, were it to proceed, would double its current capacity of 1.75 million tonnes per annum.

In another development, Alichem is working towards establishing an aluminium fluoride plant in Kwinana. A pre-feasibility study for processing alumina hydrate to produce 20,000 tonnes per annum of aluminium fluoride has been completed. It is expected that 75% of the final product will be sold on the domestic market. All environmental and statutory approvals have been granted.

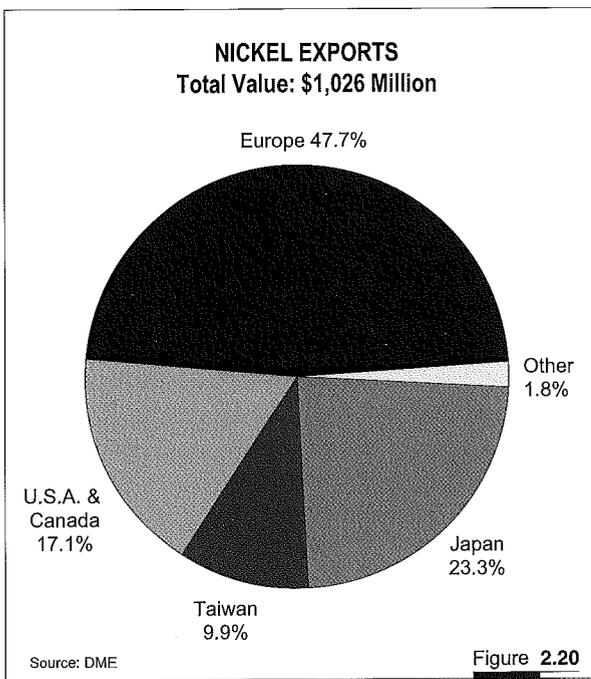
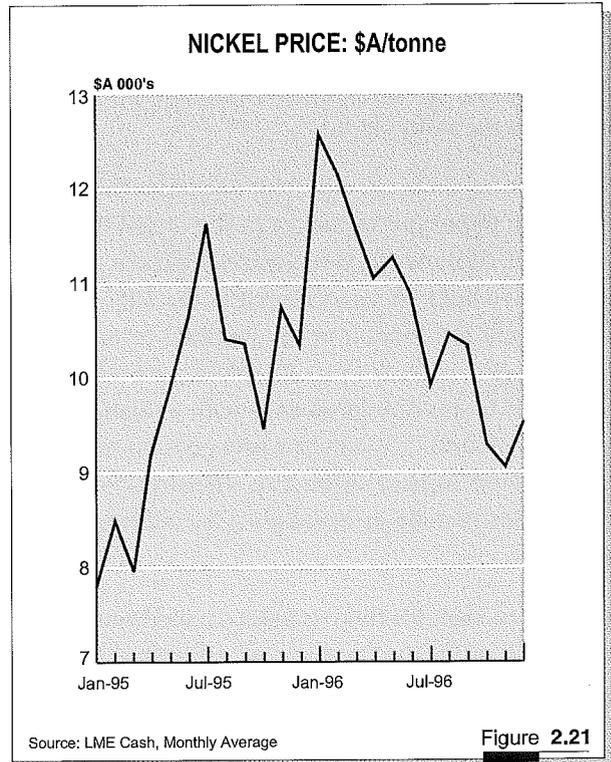
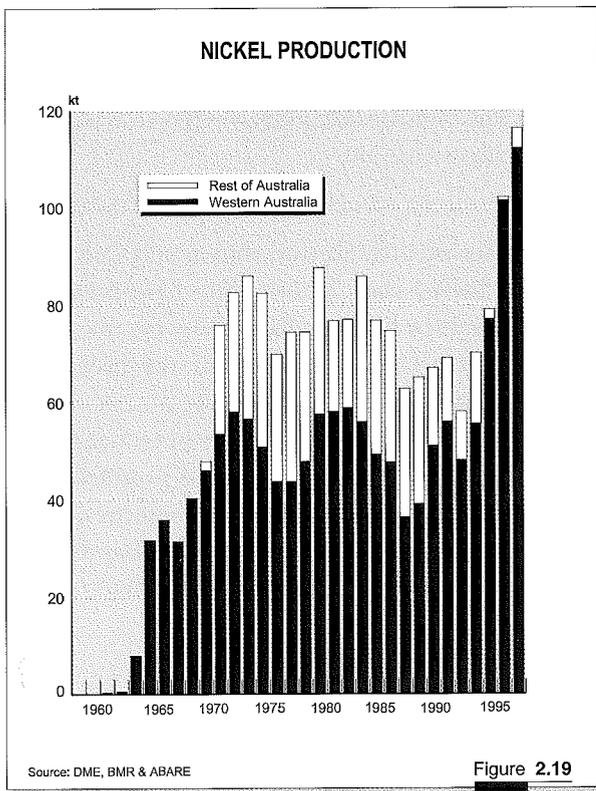
## 2.6 Nickel

Despite nickel output climbing 11% in 1996 to 112 thousand tonnes contained in matte, metal and concentrate products, the value of production fell by 6% to \$1,034 million. This reflected a year of weaker prices. After having risen over the previous two years, price on average fell 9% over 1996. Downward pressures on value were further exacerbated by the rise in the Australian Dollar. Nevertheless, nickel is now the fifth minerals/energy sector to record a value of production in excess of \$1,000 million.



The most significant contributions to increased nickel production came from higher output from WMC's Leinster operation and expanded Mt Keith project and improvements at the Kwinana nickel refinery. The development of Mt Keith has elevated WMC to the status of the western world's third largest producer after Canada's Falconbridge and Inco. It has also contributed to positioning Australia as the world's second largest producer behind Canada, excluding the CIS.

Unfortunately WMC's production in the coming year will be set back due to a section of its flash furnace roof collapsing at its Kalgoorlie smelter in April 1997. WMC has estimated a production loss of between



World nickel prices dropped in 1996 due to weak demand from the stainless steel sector. Commodity forecasters predict however that a rebound in consumption and subsequent draw-down in world stocks should see prices strengthen in 1997. Prices have in fact improved in the first quarter of 1997. In the longer term the consensus is that prices will decline to some lower base level. Western world production is already at a record and new projects with total capacity of 241,000 tonnes per year are committed to come on stream before the year 2000. A further potential 356,000 tonnes of annual output is awaiting commitment decisions.

In analysing the effects of increased production on prices, it needs at least to be balanced by the buoyant outlook for demand for nickel in stainless steel production. As pointed out at the Australian Nickel Conference, total world nickel demand is growing at about 3% per annum which means demand is increasing by about 30,000 tonnes per annum on average.

7,000 and 8,000 tonnes of nickel in matte form. The smelter is expected to be shut down for a month, with the production loss made up for towards the end of 1997.

Almost all nickel in 1996 was exported overseas, with significant destinations being Finland (29%), Japan (23%), North America (17%) and Taiwan (10%).

The most significant of new projects is Inco's giant Voisey Bay deposit in eastern Canada. Initial production from this project alone is estimated at 60,000 tonnes per annum, to rise eventually to 122,500 tonnes. This suggests Voisey Bay could be producing around 10% of the world's nickel by the year 2000. In

addition to its size, its proximity to the surface and the large amounts of copper and cobalt by-products suggest that its production costs will be amongst the lowest in the industry.

This development will reinforce Canada as the largest and most important influence in the nickel industry, exerting downward pressure on prices. These pressures could be exacerbated if the CIS were to resume full production in the medium term. It has been suggested by analysts that Voisey Bay will have the ability to drive out producers with operating costs over US\$3.00/lb. If Voisey Bay proceeds on schedule, it may well impact upon the decisions of those companies looking at developing nickel projects in this State.

In Western Australia there is indeed a plethora of new projects at various stages of assessment. The aforementioned factors, however, mean that not all projects being assessed are likely to come into production.

Nevertheless, future production will be boosted as some projects have progressed beyond the assessment stage. They include the \$184 million Bulong nickel project, 30 kilometres east of Kalgoorlie. Resolute Samantha announced the go-ahead for this project in September 1996. First production from this mine is expected to be in 1998 at around 9,000 tonnes per annum of contained nickel.

Outokumpu's smelter is also expected to start receiving additional concentrate input in 1997 from the new Silver Swan mine development operated by Mining Project Investor's (MPI). The Silver Swan decline was commenced in 1996 and is expected to intersect ore in mid-1997. Nickel output of around 12,000 tonnes per annum is expected from this project.

In April 1997 Anaconda Nickel announced that it would proceed with development of its \$900 million Murrin Murrin nickel project near Leonora after reaching a historic agreement with key Aboriginal groups in the region. Murrin Murrin is currently the biggest Western Australian nickel project on the drawing boards, with an estimated output of 45,000 tonnes per annum of contained nickel.

Other projects under consideration include:

- Cawse (Centaur Mining);
- Honeymoon Well (CRA-Outokumpu);
- Lake Johnston/Maggie Hayes (Forrestania Gold-Gencor Ltd); and
- Yakabindie (Dominion Mining-North Ltd);

Significantly, Bulong, Murrin Murrin and Cawse are based on laterite ores. Laterite ores have previously been disregarded by Australian producers due to the high cost of processing. However, the processing method proposed for these new laterite nickel projects in Western Australia has the potential to alter the supply picture significantly. The Goldfields Gas Pipeline will also significantly reduce energy costs in the Eastern Goldfields which will further improve the highly competitive cost position of the State's nickel industry.

- Carr Boyd (Defiance Mining);

**2.7 Heavy Mineral Sands**

Titanium dioxide prices fell to their lowest level in eight years at the end of 1996 because supply exceeded demand. However, the sudden drop in titanium dioxide prices did not flow through to the mineral sands industry. Lags in titanium dioxide prices flowing through to the heavy mineral sands market and long term price contracts meant that mineral sands continued to experience a solid recovery with higher prices over the year.

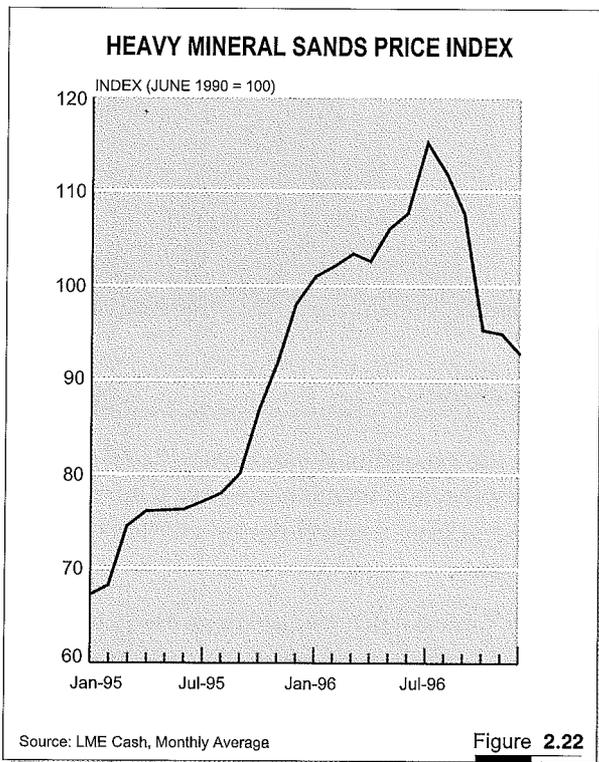


Figure 2.22

The State's total value of sales grew by over 9% to \$598 million. The value of heavy mineral sands exported overseas was \$519 million. A major export destination was the US which accounted for 26% of shipments. Japan and the Netherlands accounted for another 17% and 15% of sales respectively. Italy and the UK. were also prominent export destinations.

Western Australia is one of the world's most important producers of feedstocks for titanium dioxide pigments. The most significant of these are ilmenite, rutile and upgraded ilmenite (or synthetic rutile - SR). In 1996 the State accounted for approximately 80% of Australia's titanium feedstock production.

Ilmenite sales totalled 1.1 million tonnes in 1996, an 8% increase on the previous year. Thanks to prices which have been growing strongly since 1994, value of production was up by 19% to \$114 million. ABARE has suggested that a factor behind strengthening

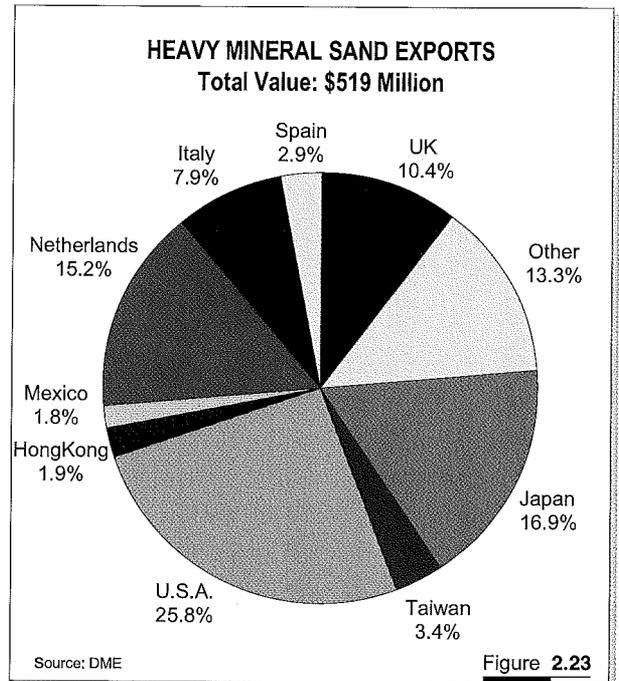


Figure 2.23

ilmenite prices is the progressive global run-down in supply of quality ilmenite available for external sale - as opposed to ilmenite particularly dedicated to slag or upgraded ilmenite/synthetic rutile plants.

Ilmenite production is expected to increase dramatically. In March 1997 BHP's Beenup titanium minerals mine came into production. With a projected output of 600,000 tonnes per annum, it is destined to be one of Western Australia's biggest producers of heavy mineral sands. About half of the ilmenite output will be exported in a joint venture with Tinfos Titan and Iron KS to Norway, where it will be smelted to chloride grade feedstock for titanium pigment manufacture. The balance of exports is destined mainly for European sulphate-route pigment plants.

Despite higher prices, the value of sales of upgraded ilmenite decreased by 16% to \$181.8 million. Western Australia produced 367,525 tonnes of upgraded ilmenite during the year. This represented almost half the world's estimated output of 750,000 tonnes in 1996.

The State's upgraded ilmenite industry will continue to play an important role in the world market as output is expected to increase in 1997. Westralian Sands, for example, is expanding its ilmenite processing plant at Capel with the construction of a second kiln which should be commissioned by the end of 1997. This will increase upgraded ilmenite production capacity to 230 - 250,000 tonnes per annum. Tiwest also continued further minor capacity increases at its

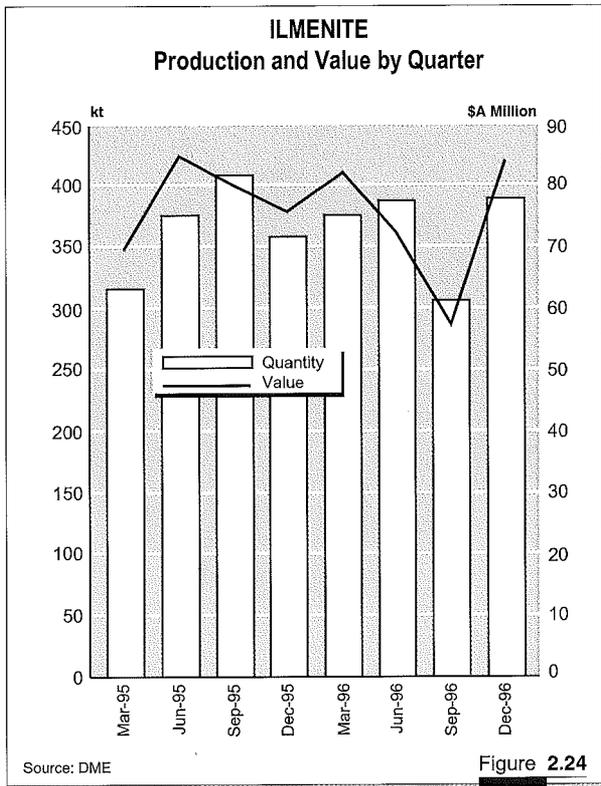


Figure 2.24

Chandala plant over 1996 by removing bottlenecks from existing processes.

In the aftermath of RGC's mine closure in Sierra Leone, rutile prices on average strengthened by over 20% in 1996. Reflecting this, Western Australian sales value increased over 16% to \$79.2 million despite an 11% drop in sales quantity due to lower grades. World production of rutile is expected to rise strongly following the expected recommencement of operations at Sierra Rutile in early 1998. It is therefore difficult to judge how rutile prices are to perform over the next year. It depends on the extent to which there is an abatement in the panic element in prices which followed the Sierra Leone closure.

Climbing prices in titaniferous feedstocks helped boost leucoxene sales values by 98% to \$15.8 million. However the major contributor was through the 64% increase in sales tonnage to 33,170 tonnes.

1996 saw zircon prices continuing their strong upswing which began in 1995. The average export price of bulk zircon passed \$500/tonne early in the year and briefly exceeded \$600/tonne in July before stabilising in the \$550 to \$580/tonne range for the remainder of the year. The significant price rises counteracted a 19% drop in sales quantity to result in a 30% rise in sales value to \$197.5 million. A major contributory cause of the reduction in sales quantity was a decline in grades from RGC's Eneabba North

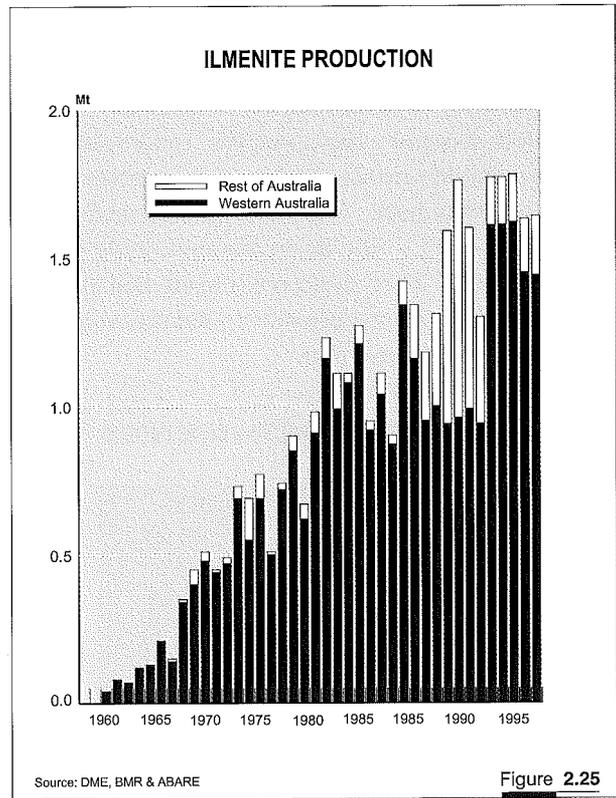


Figure 2.25

deposit. Zircon output is expected to be boosted by BHP's new Beenup titanium minerals mine which is projected to have a zircon output of 20,000 tonnes per annum.

Analysts forecast that economic growth in major consumer markets will contribute to a recovery in pigment demand as excess stocks are cleared. As pigment prices firm, associated feedstock prices are also expected to rise, especially for ilmenite and upgraded ilmenite. It is important that the predicted tighter titanium dioxide market conditions materialise if the mineral sands market is not to lose its recent market price gains. Unfortunately, conditions in the titanium dioxide market up till now have placed on hold SCM Chemicals' \$470 million expansion of its titanium dioxide plant at Kemerton. The expansion would have increased its production from 80,000 tonnes to 190,000 tonnes.

Meanwhile, Rhone Poulenc Chimie Australia has resurrected proposals to build and operate a rare earth plant near Pinjarra. The current proposal includes a facility to process up to 12,000 tonnes per annum of monazite and 15,000 tonnes per annum of solid rare earth nitrates. The Environmental Protection Authority has assessed the proposal and recommended approval. Commissioning of the project is proposed for 1997/98.

## 2.8 Diamonds

In 1996 the volume of diamonds sold from Western Australian more than doubled but, because of lower prices, the value of sales was down 8% to \$442 million.

Since the Bow River alluvial mine was placed on care and maintenance in late 1995, all production in 1996 emanated solely from the Argyle operation. The dramatic increase in sales volume occurred in the June quarter when the Central Selling Organisation (CSO) took up a large portion of deferred stocks.

In 1996 Argyle Diamond Mines completed its first six months of selling diamonds directly to the market. Sales were apparently in line with forecasts. Thanks to aggressive pricing strategies, the market has continued to support the Argyle product and the company hopes that sales will further expand in 1997.

Production from the Argyle mine reached 42 million carats in 1996. This was up 2.2 million carats on 1995 and was made up of 39.4 million carats from the AK-1 pipe and 2.6 million carats from the alluvial operations.

Ore processed from the AK-1 pipe increased because of higher plant throughput rates resulting from the changes to bottom cut-off size screens late in 1995. Alluvial ore processing also exceeded 1995 levels because of more effective processing by a new field screening unit and greater plant efficiency. Despite changing the lower cut-off size in the AK-1 plant, a higher than expected quantity of small, lower value diamonds continued to be recovered in 1996.

Argyle's open pit operation is due to finish in around 2002 - 2004. It has not been decided whether the movement underground will be made. A study into the underground mining of AK-1 ore was nearing completion with a report due in early 1997. It is estimated that an underground development would extend mine life by at least 5 to 7 years.

The marketing agreement between the owners of the Argyle diamond mine and the De Beers-owned CSO expired at the end of June 1996. Under that agreement the CSO was bound to purchase 78% of Argyle's output. However, in recent years the CSO deferred the purchase of up to 25% of Argyle's output and in 1995 imposed an 11% price cut.

The move to direct marketing by the Argyle joint venture has tested the cohesiveness of one of the oldest cartels in existence. It has been suggested that

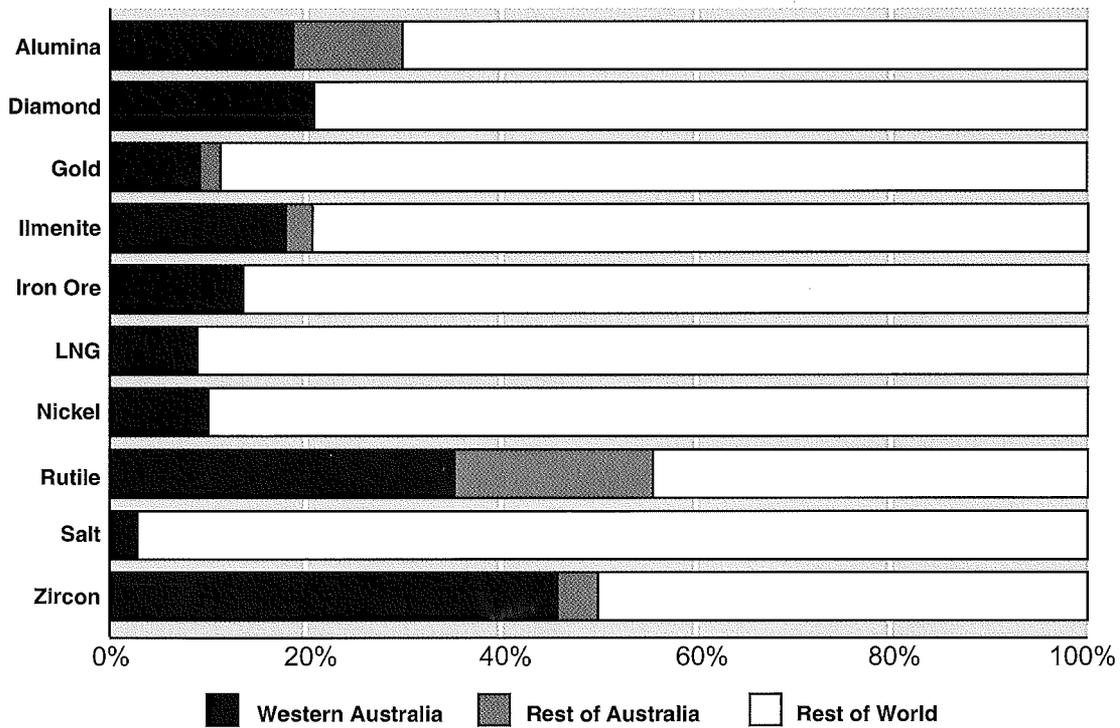
the world diamond marketing cartel controlled by De Beers was on the brink of dissolving until Russia signed a memorandum of understanding with the CSO in February 1996. However, leaks into the market of Russian gems, which reached \$US1 billion in 1996, have again started at around \$US50 million per month. Much of that is ascribed to gems destined for Russia's own cutting industry and the CSO claims to be broadly satisfied that the agreement is holding until a final deal is signed.

A three-year agreement that will give Russia over one-quarter of global sales through the CSO is expected some time in 1997. Notably, Russia contributed about 26% to CSO sales value compared with Argyle's 6% during its membership.

The CSO must also contend with the potential flood of additional gems from South Africa and Canada. The latest Australian company to mine diamonds in Africa, Moonstone Diamond Corporation, announced recently that it will market diamonds from its Namaqualand marine diamond operation outside the CSO. Also, in Canada, BHP's Lac de Dras diamond project contains a significant proportion of gem quality diamonds. A further long term threat to CSO market control is development of CRA - RTZ's Diavik diamond project in Canada. If BHP and CRA - RTZ opt out of the CSO, up to 20% of the world's gem diamond sales will be traded outside the CSO.

The outlook for the State's diamond industry is uncertain. Diamond markets remain in a significant state of flux following the withdrawal of Argyle and threats of sales outside the CSO. A positive aspect of the market is that demand for diamond jewellery remains high. Despite De Beers' difficulties it has managed record gem sales of around US\$5 billion in 1996. Demand from South-East Asia has been particularly strong, making the region the principal source of the phenomenal growth in sales of smaller gem diamonds of around one carat or less. Diamond market analysts estimate jewellery demand will maintain a growth rate in 1997 of around 5-6%.

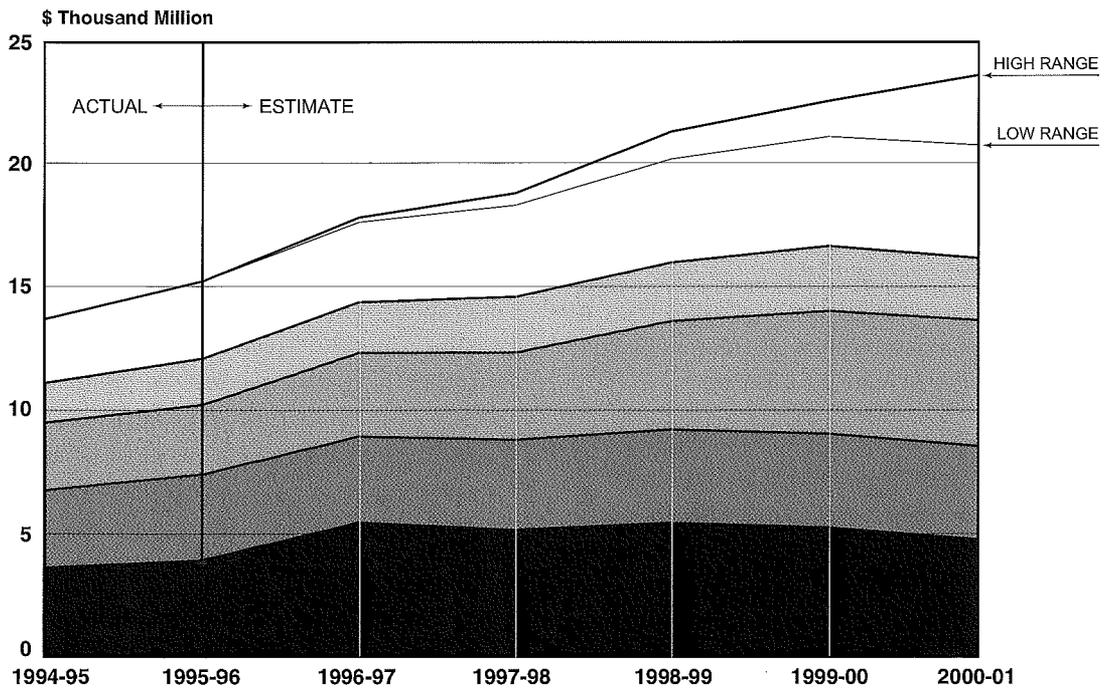
## SELECTED WA COMMODITIES RELATIVE TO WORLD PRODUCTION



Source: ABARE, 1995 Australian Commodity Statistics

Figure 2.26

## ESTIMATES OF MINERAL AND PETROLEUM VALUE OF PRODUCTION Value of Production to the Year 2000-01



Source: DME

Figure 2.27

## 2.9 Other Minerals

The combined value of the State's copper, lead and zinc production fell more than 25% in 1996 to \$126.5 million. These changes need to be interpreted with caution. The State's base metal sector is relatively small. This means that even a change in the timing of a single shipment of zinc, for example, can dramatically alter the apparent percentage change in sales from one year to the next.

A fourth year of depressed zinc prices meant that the value of zinc output was down by 22% to \$68.9 million. Low prices were further aggravated for local producers by the higher value of the Australian dollar in 1996. However, early tentative signs in 1997 point to a turn around in the zinc price situation. Since the end of 1996 LME zinc stocks have been falling and consumption has been increasing. The price of zinc kicked off in 1997 to hit its highest level in four years. But prices are likely to remain volatile as market expectations change in response to new supply and demand information. Nevertheless, the consensus amongst commodity analysts is that zinc prices should be at least 20% higher in 1997.

The outlook for Western Australian zinc output is also healthy. Western Metals announced in early 1997 that it had approved a \$50 million development of its Kapok lead-zinc deposit. This will add to the company's Cadjebut and Goongewa mines and is expected to come on stream by around the middle of 1997. In addition, Western Metals is now analysing the possibility of developing its Blendevale deposit.

A sharp drop in copper prices compounded by a local currency appreciation in 1996 translated to a big 35% cut in the value of the State's copper production. The copper price outlook is pessimistic, even though copper stocks on the LME are at record lows. Whilst there was a glimmer of hope towards the end of 1996 with some small price rises, basically the market has been depressed since the Sumitomo Corporation revealed it had lost \$US1.8 billion through unauthorised copper trading. The copper market went into a nose dive in 1996 when it was revealed that the former chief copper trader at Sumitomo Corporation, Yasuo Hamanaka, had racked up losses with hidden copper trades over a ten year period. The Sumitomo Corporation has reported that in the six months to September 1996, it had accumulated 284.8 billion Yen (\$3.6 million) in copper trading losses.

World lead consumption outstripped demand in 1996 and LME stocks have been at record lows. Not surprisingly, in contrast to other base metals, 1996 lead prices continued to rise for the fourth year in succession. This was reflected in the State's value of lead production which increased 19%, more than double physical sales which rose 9% to 17,085 tonnes. Increased world supply in response to buoyant prices means that one can expect lead prices to ease in 1997.

Coal output eased by 4% in 1996 to result in an equal 4% drop in the value of production to \$268 million. In November, production commenced from Griffin Coal Mining's \$60 million Ewington II open cut project. This will assist in providing feedstock for the new 300 megawatt coal-fired power station being constructed at Collie. The power station is expected to be operational in 1999. Development of the Western Collieries Premier open cut mine for dedicated supply to the new power station also commenced. Premier Pit 1 is producing coal with Pit 4 expected to be developed in 1997.

Manganese production increased more than 30% to 297,000 tonnes. The value of output increased 18% to \$33.5 million. Manganese operations were consolidated in 1996 under single ownership with the sale of Portman's Woodie Woodie mine to fellow manganese producer Valiant Consolidated. This has made Valiant Australia's second biggest producer of manganese, behind BHP's operations at Groote Eylandt in the Northern Territory.

Slt production was almost static in 1996 at 7 million tonnes, but poor prices saw the value of output drop 8%. The State's biggest salt producer, Dampier Salt Ltd, is to diversify into gypsum production at its Lake MacLeod operation. Initial contracts have been signed for commitment to developing a gypsum output capacity of up to 2 million tonnes per annum.

Tantalite production increased more than 47% to 538 tonnes worth \$34.5 million. This product is chiefly produced by Gwalia Consolidated from its Greenbushes and Wodgina mines. The Greenbushes operation also produces spodumene. Spodumene production increased 65% to 132 tonnes, worth \$17.1 million. More than 50% of the world's spodumene is mined at Greenbushes and changes in production levels closely reflect world demand.

### 3. EXPLORATION AND CAPITAL EXPENDITURE

#### Mineral Exploration

Mineral exploration in Western Australia expanded significantly despite uncertainties caused by the native-title debate. In 1996, mineral exploration expenditure reached \$616.1 million, 24% higher than the previous year, indicating a substantial increase in activity.

Western Australia attracted 57% of the total Australian mineral exploration budget. This compared with 56% in 1995. Increases in activity were recorded for all minerals.

Gold accounted for 72% of the State's exploration effort, down 2 percentage points on 1995. The slight decrease is attributable to some gold companies diversifying into other minerals, such as nickel and silver. Base metals (including nickel) increased its share to 16% and diamonds dropped slightly to 6%. Western Australia attracts the major part of the national exploration dollar for base metals, gold, diamonds, iron ore and heavy mineral sands and ranks second, behind the Northern Territory, for uranium. The uranium situation may change however as a result of increased optimism following changes to the Government's uranium policy.

Western Australia is the country's main focus for gold exploration, attracting 69% of Australia's gold exploration expenditure. In 1996 some \$445 million was spent on gold exploration in the State.

In 1996, gold discoveries and resource category upgrades contributed more than 300 tonnes of contained in-ground gold resources to the measured and indicated inventory. This translates to a discovery cost of around \$26/oz, providing very good value for exploration investment. A large proportion of the resource increase is in "brownfield" areas around existing mines.

"Greenfield" areas that have produced promising results during the year were the north and south belt areas of Laverton, the northern margin of the Ashburton Basin, the southern margin of the Marymia Inlier and on the Northern Territory border, south-east of Halls Creek. Most of the remaining exploration effort concentrated on extending orebodies, identifying new zones and the discovery of satellite orebodies near existing mines.

The Yilgarn Craton continues to be a major focus of activity. However, more explorers are focusing on the less traditional areas along its south-eastern and eastern margins.

Aggressive exploration in the Yandal area has been successful in upgrading measured and indicated resources. Exploration has concentrated around the Jundee, Nimary, Bronzewing, Mt McClure and Darlot mines.

Many of the long-established open pit operations of the Goldfields region have been delineating longer term resources below existing pit limits. This is being carried out to allow production to move underground progressively.

The combined exploration effort on base metals and nickel was \$98 million in 1996, a 51% increase on the previous year. It is estimated that the search for nickel made up the major proportion of this total.

Base-metal activity has concentrated in the Pilbara and Kimberley regions. Improving copper and zinc prices have increased interest in these commodities. However, many positive exploration results are incidental to the search for gold.

Regular announcements of good drill intersections have come from project areas that have been explored over the past few years, including Panorama in the Pilbara, Koongie Park in the East Kimberley, and Pilbara Range in the West Kimberley.

Nickel exploration has continued to surge even with a decreasing nickel price. The focus is on upgrading known deposits for "fast-tracking" development prior to 1999 when Voisey Bay in Canada is expected to be commissioned. This has resulted in a 40% increase in measured and indicated resources to 10.7 million tonnes of contained nickel for 1996. The interest shown in nickel indicates that the industry will remain buoyant over the short to medium term. In terms of exploration, there is excellent potential for locating new deposits outside the well explored and tightly held Eastern Goldfields.

Diamond exploration expenditure increased 28% to \$37 million. The increase is attributed to a few new players entering the scene and some old ones undertaking extra regional exploration. The diamond search has spread from the Kimberley to the south-west and Eastern Goldfields.

Interest in offshore diamonds continued to be high but very little exploration took place in 1996. Cambridge Gulf Exploration NL, a high profile explorer, had to delay exploration because of litigation over sampling tenements outside its own holdings. This was resolved late in the year and a suitable vessel was purchased for exploration to begin in December.

To the end of January drilling was suspended three times due to cyclones.

Iron ore exploration expenditure in 1996 increased by 82% to \$18 million. The major focus was on detailed evaluation of deposits that are programmed for development in the near future. The iron ore sector has continued a high level of interest through proposed developments of downstream processing such as beneficiation, direct reduction iron, and steel making. A number of projects have reached the feasibility-study stage, with the result that only limited on-ground exploration is currently being undertaken.

Much of the exploration for the proposed developments was completed in 1995 and feasibility studies continued throughout the year. These were focused on Giles Mini, Goldsworthy Mining Area C and West Angelas. Studies were completed for Yandi and Mt Newman Orebody 18. Extensive drilling at Koolanooka was also conducted to increase the resource base of the Mid-West Iron and Steel project.

At a cost of \$6 million in 1996, Western Australia retains the top share of the nation's heavy-mineral sands exploration expenditure. Exploration for heavy-mineral sands has a low public profile and is constantly competing with other land uses. Since 1992, the industry has gained access to enough land to retain the State's resource base of more than 100 million tonnes of contained heavy minerals. The only new discovery in 1996 was at Metricup, south-west of Busselton. Appraisal continued at Jangardup South, Yoganup, Yarloop and north of Brunswick Junction as replacements of nearby mines.

Exploration for paper coating and general filler kaolin in the south-west of the State has essentially ceased following feasibility studies indicating mining was not viable. The major setback was the costs involved in obtaining good quality water for producing high quality kaolin products.

### **Petroleum Exploration**

Because of a lack of official State petroleum exploration figures, in the past the Department of Minerals and Energy made its own estimates. The ABS now publishes data on State petroleum exploration expenditure which includes expenditure in the Timor Gap Zone of Cooperation, Area B.

ABS data suggest that in 1996, the State's petroleum exploration effort increased by 31% to A\$419 million. The 1996 outcome lifts the State's petroleum exploration expenditure above average 1990s levels,

and raised the State's share of Australia's petroleum exploration expenditure from 44% in 1995 to 54% in 1996.

Again in 1996, petroleum exploration activity was concentrated on the North West Shelf area, with some interest in the Bonaparte Basin.

Total Australian petroleum exploration expenditure in 1996 increased by 7% to A\$780 million. Of this total about 17% was spent on production lease areas while the remaining 83% was spent in all other areas. Compared with 1995, these figures represent a swing towards exploration expenditure on production leases.

ABS data suggest that offshore exploration, Australia wide, is taking place at record levels. In 1996 offshore exploration worth \$568.3 million accounted for 73% of all petroleum exploration and was up by 5% on 1995. Onshore petroleum exploration in Australia increased by 12% in 1996 to A\$212 million, only slightly increasing in proportion to offshore activity.

### **Mining Investment**

The ABS mining capital investment statistics are published for each financial year and show that in 1995/96 the State's investment increased by 3.1% to \$4,173 million. This outcome follows strong investment growth in the early 1990s and is more than double the level in 1991/92. Western Australia accounted for 58% of Australia's new 1995/96 mining capital expenditure.

There is currently over \$30,000 million worth of mining projects in Western Australia either under construction, committed or under consideration. Western Australia accounts for more than half of Australia's investment in proposed mining and downstream processing projects. About \$6,000 million of potential investment projects in Western Australia are subject to environmental and native title constraints. This represents about 12% of projects under consideration in this State.

Between now and the end of 1999 it is estimated that Australian companies will commission more than \$15,500 million of new capital investment either in Australia or offshore. The Australia wide trend in mining investment is not based on a speculative rush of exploration expenditure or high commodity prices, but on solid capital expenditure that will generate a growing mineral production profile leading into the next century. The seeds of this expansion were set in the late 1980s and early 1990s when large discoveries were made. New technology, improved infrastructure and microeconomic reforms have all contributed to encouraging companies to develop these large finds.

## 4. EMPLOYMENT IN THE MINERALS AND PETROLEUM INDUSTRY

The Department of Minerals and Energy's official employment statistics are compiled from industry returns and include contracted mining labour working on the mine sites.

In 1996 employment in the State's mineral and petroleum industry increased by about 8.3% to around 39,657 persons. All sectors of the State's mining industry recorded an increase in employment except bauxite/alumina, coal and petroleum. In particular, employment growth was significant in the base metals (15%), gold (12%), heavy mineral sands (36%) and iron ore (15%) industries where new projects and major expansions swelled employment numbers.

**TABLE 1 QUANTITY AND VALUE OF MINERALS & PETROLEUM**

COMMODITY\Mineral	UNIT	1995		1996	
		QUANTITY	VALUE \$A	QUANTITY	VALUE \$A
<b>BASE METALS</b>					
Copper Metal	t	24,312 (r)	73,294,232	(r) 21,496	47,840,607
Lead Metal	t	15,642 (r)	8,253,256 (r)	17,085	9,803,853
Zinc Metal	t	126,336 (r)	87,733,173 (r)	104,230	68,858,796
<b>TOTAL BASE METALS</b>			169,280,661 (r)		126,503,256
<b>BAUXITE-ALUMINA</b>					
Alumina	t	8,067,380	1,757,356,480	8,249,660	1,967,808,060
Gallium	kg	0	0	24,309	6,563,297
<b>TOTAL BAUXITE - ALUMINA</b>			1,757,356,480		1,974,371,357
<b>CLAYS</b>					
Attapulgite	t	18,159	3,804,561	17,173	4,180,355
Clay Shale	t	19,634	240,248	14,559	179,079
Fire Clay	t	67,802	81,363	116,850	245,820
Kaolin	t	3,297	170,422	400	57,874
White Clay	t	38,596	385,960	13,003	130,030
<b>TOTAL CLAYS</b>			4,682,554		4,793,158
<b>COAL</b>	t	6,062,404	280,656,243	5,814,923	268,381,210
<b>CONSTRUCTION MATERIALS</b>					
Aggregate	t	426,127 (r)	2,480,317 (r)	505,750	3,292,862
Gravel	t	148,469	803,927 (r)	181,500	1,053,434
Rock	t	50,242	633,258	549,600	3,303,495
Sand	t	1,706,340 (r)	7,672,398 (r)	1,405,522	6,198,484
Sandstone	t	92	21,823	0	0
<b>TOTAL CONSTRUCTION MATERIALS</b>			11,611,723 (r)		13,848,275
<b>DIAMOND</b>	ct	23,451,750	480,150,004	47,425,602	442,006,326
<b>DIATOMITE</b>	t	7,271	58,165	0	0
<b>DIMENSION STONE</b>					
Black Granite	t	0	0	946	283,695
Granite	t	40	12,000	220	11,000
Jasper	t	25	9,016	0	0
<b>TOTAL DIMENSION STONE</b>			21,016		294,695
<b>GEM &amp; SEMI-PRECIOUS STONE</b>					
Agate	kg	7,100 (r)	5,680	0	0
Chalcedony	kg	0	0	41	20,680
Chrysoprase	kg	92,503	660,920	0	0
Jasper	kg	39,220	47,136	0	0
Variscite	kg	25,701	35,990	0	0
<b>TOTAL GEM &amp; SEMI-PRECIOUS STONE</b>			749,726		20,680
<b>GOLD</b>	kg	189,479 (r)	3,163,658,973 (r)	221,033 (e)	3,526,340,555 (e)
<b>GYPSUM</b>	t	217,867 (r)	2,447,709 (r)	260,520	2,352,729
<b>HEAVY MINERAL SANDS</b>					
Garnet	t	84,909	8,067,752	88,493	9,415,064
Ilmenite	t	998,152	96,265,511	1,077,028	114,289,225
Upgraded Ilmenite (a)	t	452,736	215,433,965	367,525	181,809,730
Leucoxene	t	20,283	8,011,826	33,170	15,849,797
Rutile	t	124,870	68,141,539	110,651	79,167,249
Zircon	t	458,444	152,536,417	372,704	197,540,254
<b>TOTAL HEAVY MINERAL SANDS</b>			548,457,010		598,071,319

**TABLE 1 (cont.) QUANTITY AND VALUE OF MINERALS & PETROLEUM**

COMMODITY\Mineral	UNIT	1995		1996	
		QUANTITY	VALUE \$A	QUANTITY	VALUE \$A
<b>INDUSTRIAL PEGMATITE MINERALS</b>					
Felspar	t	66,610	2,345,293	24,824	923,644
<b>IRON ORE</b>					
Domestic	t	6,533,317	154,980,117	5,791,703	136,656,820
Exported	t	129,432,288	2,825,709,297	127,859,595	2,787,821,563
<b>TOTAL IRON ORE</b>		135,965,605	2,980,689,414	133,651,298	2,924,478,383
<b>LIMESAND-LIMESTONE-DOLOMITE</b>					
Dolomite	t	3,950	39,500	7,342	62,040
Limesand-Limestone	t	2,189,534 (r)	14,819,627 (r)	2,641,696	17,356,134
<b>TOTAL LIMESAND-LIMESTONE-DOLOMITE</b>			14,859,127		17,418,174
<b>MANGANESE ORE</b>	t	227,900 (r)	28,424,450 (r)	296,807	33,529,688
<b>NICKEL INDUSTRY</b>					
Cobalt by-product	t	824	56,374,547	942	63,521,086
Nickel Concentrate	t	751,788	1,094,171,929	764,281	1,033,883,708
Palladium by-product	kg	528	3,065,446	559	2,416,416
Platinum by-product	kg	74	1,734,790	119	1,584,578
<b>TOTAL NICKEL INDUSTRY</b>			1,155,346,712		1,101,405,788
<b>PEAT</b>	t	1,113	78,400	0	0
<b>PETROLEUM</b>					
Condensate	kl	3,828,078	564,909,332	4,965,927	773,723,615
Crude Oil	kl	8,683,505 (r)	1,384,829,505 (r)	11,258,708	1,958,824,698
LNG	Btu 106	375,374,192	1,390,749,933	377,819,333	1,391,202,011
LPG - Butane	t	19,423	4,729,257	158,962	37,441,182
LPG - Propane	t	14,139	3,442,453	150,835	36,929,761
Natural Gas	000m3	5,827,413	421,922,592	6,622,750	494,681,365
<b>TOTAL PETROLEUM</b>			3,770,583,072 (r)		4,692,802,632
<b>PIGMENTS</b>					
Red Oxide	t	0	0	6,000	164,250
<b>SALT</b>	t	7,290,514 (r)	155,813,175 (r)	7,198,516	143,281,783
<b>SILICA-SILICA SAND</b>					
Silica	t	84,696	846,971	79,048	790,479
Silica Sand	t	525,935	4,761,899	619,590	6,025,376
<b>TOTAL SILICA-SILICA SAND</b>			5,608,870		6,815,855
<b>SILVER</b>	kg	53,430 (r)	11,710,132 (r)	48,698	8,965,310
<b>TALC</b>	t	122,989	9,643,014	186,256	14,928,263
<b>TIN-TANTALUM-LITHIUM</b>					
Spodumene	t	80,135	12,019,364	131,932	17,139,744
Tantalite	t	365 (r)	33,617,052 (r)	538	34,463,377
Tin Metal	t	586 (r)	4,156,739 (r)	370	2,565,616
<b>TOTAL TIN-TANTALUM-LITHIUM</b>			49,793,155 (r)		54,168,737
<b>TOTAL VALUE</b>			14,604,025,078 (r)		15,955,866,067

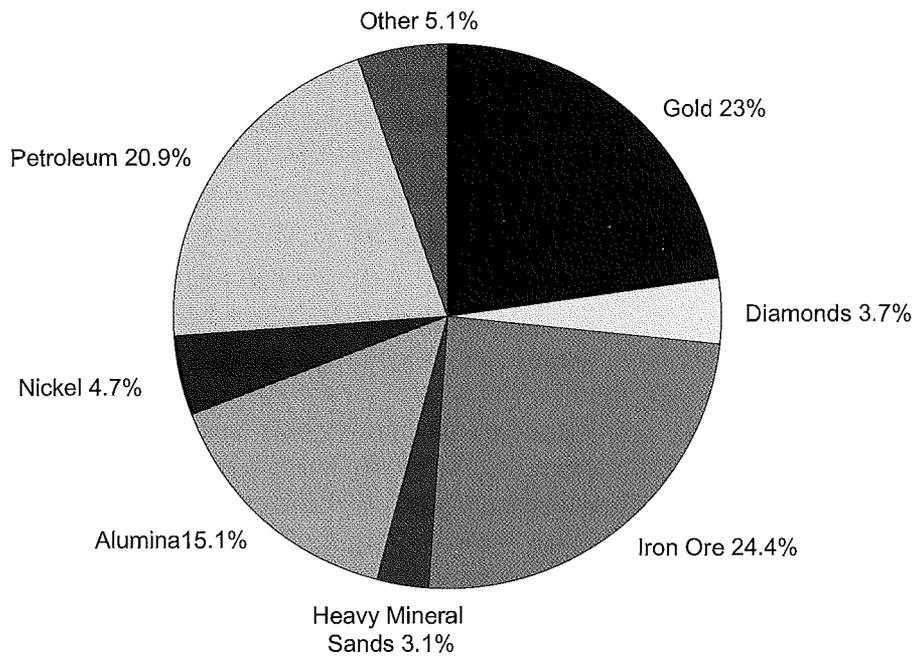
Note: Quantities used in this table apply only to Minerals and Petroleum covered by the Mining Act 1978, the Petroleum Act 1967, the Petroleum (Submerged Lands) Act 1982 and relevant State Agreement Acts.

(a) Also known as synthetic rutile

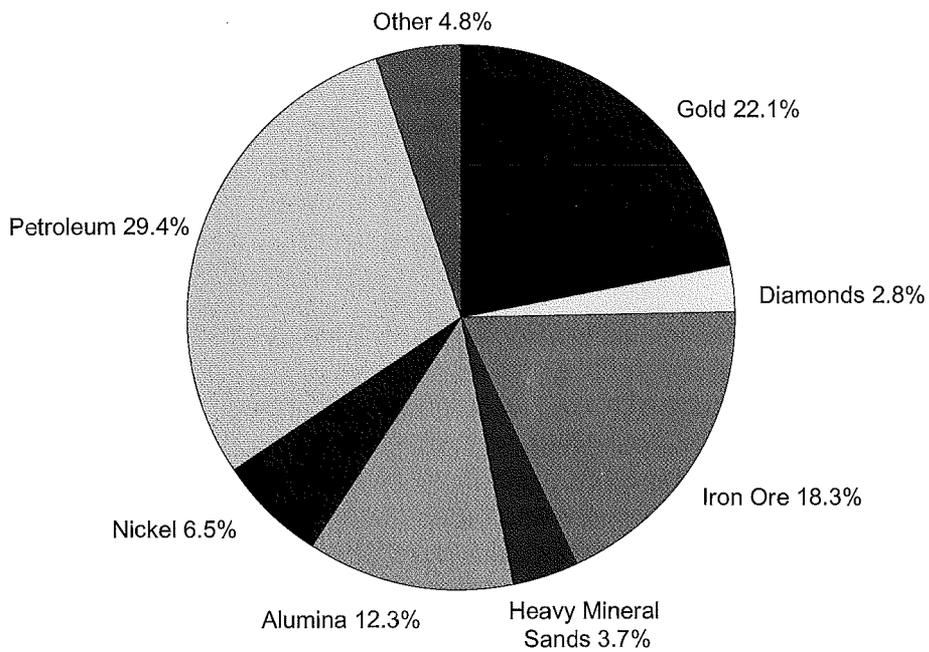
(e) Estimate

(r) Revised from previous edition

**COMPARATIVE VALUE OF PRODUCTION**  
**1991 Total: \$12,186 Million**



**1996 Total: \$15,956 Million**



Source: DME

**Figure 0.1**

**TABLE 2 QUANTITY AND VALUE OF SELECTED MAJOR COMMODITIES**

	Unit	1987		1988		1989		1990	
		Quantity	Value \$m						
ALUMINA	Mt	5.93	1,104.31	6.18	1,301.43	6.38	2,096.79	6.72	2,358.95
BASE METALS									
copper metal	kt	2.91	4.22	7.43	17.76	19.04	40.70	14.96	22.55
lead metal	kt	0.00	0.00	0.00	0.00	7.85	4.42	13.61	7.18
zinc metal	kt	0.00	0.00	20.25	14.70	38.06	48.15	51.70	61.55
COAL	Mt	3.71	144.94	3.79	158.00	3.83	166.80	4.83	214.25
DIAMOND	M ct	30.33	246.52	35.22	302.50	37.51	427.45	31.18	429.93
GOLD	tonnes	78.44	1,622.47	107.29	1,913.15	147.28	2,295.58	176.35	2,794.00
HEAVY MINERAL SANDS									
ilmenite	Mt	1.00	62.18	0.94	68.29	0.96	77.07	0.99	86.20
synthetic rutile	kt	134.87	49.99	183.50	69.15	261.60	115.53	249.27	120.77
rutile	kt	85.63	51.06	91.19	54.01	88.97	58.36	76.07	57.91
zircon	kt	320.16	69.35	368.16	123.87	343.82	187.95	224.46	126.68
IRON ORE	Mt	84.12	1,737.65	98.32	1,757.28	106.47	2,122.07	103.85	2,426.81
MANGANESE ORE	kt	0.00	0.00	0.00	0.00	11.74	0.05	364.58	57.93
NICKEL	kt	47.59	294.15	36.30	480.85	42.79	688.85	50.91	557.97
PETROLEUM PRODUCTS									
condensate	Gl	0.92	135.43	1.13	146.25	1.35	197.16	1.72	333.90
crude oil	Gl	1.76	314.91	2.06	246.11	2.51	369.85	5.20	1,023.22
lng	btu 10 <sup>12</sup>	0.00	0.00	0.00	0.00	37.68	113.43	153.14	508.10
lpg - butane	kt	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
lpg - propane	kt	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
natural gas	Gm3	3.45	325.89	3.65	301.43	3.74	321.73	3.70	366.43
SALT	Mt	5.28	105.72	5.85	98.53	5.90	112.38	6.12	130.77
OTHER			62.20		78.77		98.80		108.93
<b>TOTAL</b>			<b>6,330.99</b>		<b>7,132.07</b>		<b>9,543.12</b>		<b>11,794.03</b>

# 1996 STATISTICS DIGEST

1991		1992		1993		1994		1995		1996	
Quantity	Value \$m										
7.01	1,844.03	7.08	1,689.72	7.80	1,891.86	7.93	1,684.58	8.07	1,757.36	8.25	1,967.81
11.79	17.92	12.09	18.68	28.98	30.21	35.11	68.13	24.31	73.29	21.50	47.84
10.70	4.35	20.96	7.43	32.28	7.84	20.29	7.32	15.64	8.25	17.08	9.80
112.01	94.69	141.39	132.98	141.10	87.02	123.62	85.14	126.34	87.73	104.23	68.86
5.11	228.56	5.66	251.76	5.47	248.44	5.03	234.02	6.06	280.66	5.81	268.38
33.36	456.93	41.15	565.06	22.65	486.77	27.72	470.34	23.45	480.15	47.43	442.01
186.34	2,800.18	182.10	2,751.52	183.47	3,139.61	192.98	3,265.93	189.48	3,163.66	221.03	3,526.34
0.94	81.50	1.04	87.30	1.01	85.40	1.08	93.52	1.00	96.27	1.08	114.29
317.96	162.17	334.48	157.88	308.60	143.53	357.53	164.53	452.74	215.43	367.53	181.81
59.13	39.66	68.96	39.05	56.60	29.97	87.16	44.46	124.87	68.14	110.65	79.17
204.33	79.16	265.17	51.46	299.76	46.26	444.26	99.00	458.44	152.54	372.70	197.54
114.17	2,978.72	108.15	2,921.98	116.34	2,996.73	124.26	2,630.61	135.97	2,980.69	133.65	2,924.48
209.64	37.77	402.84	72.20	247.86	43.40	202.52	22.74	227.90	28.42	296.81	33.53
55.76	569.24	48.04	461.54	55.46	437.74	77.00	630.13	101.36	1,094.17	112.11	1,033.88
1.87	313.74	2.06	366.70	2.17	359.86	2.34	331.19	3.83	564.91	4.97	773.72
5.21	901.42	5.05	917.36	4.05	709.32	8.75	1,299.75	8.68	1,384.83	11.26	1,958.82
204.80	957.95	237.64	966.47	264.75	997.88	335.11	1,080.17	375.37	1,390.75	377.82	1,391.20
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	19.42	4.73	158.96	37.44
0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	14.14	3.44	150.84	36.93
3.74	372.20	3.78	368.96	4.21	422.96	4.92	441.96	5.83	421.92	6.62	494.68
6.83	149.36	6.67	155.39	6.53	159.57	6.86	153.49	7.29	155.81	7.20	143.28
	96.82		142.49		119.26		156.25		190.86		224.04
<b>12,186.38</b>		<b>12,125.92</b>		<b>12,443.63</b>		<b>12,963.30</b>		<b>14,604.03</b>		<b>15,955.87</b>	

**TABLE 3 QUANTITY & VALUE OF MINERALS & PETROLEUM BY LOCAL GOVERNMENT AREA**

MINERAL	LOCAL GOVERNMENT AREA	QUANTITY TONNES	METALLIC CONTENT	VALUE \$A	Ref.
<b>BASE METALS</b>					
Copper By-Product	Coolgardie		Cu Tonnes 4,721.391	7,452,720	(a),(b)
Copper Concentrates	East Pilbara	4,878	15.90	1,517,153	
	Yalgoo	30,589	20.30	10,436,100	
		35,467		11,953,253	(a)
Copper Cathode Total Copper	East Pilbara		Cu Tonnes 9,788.618	28,434,634	(a)
				47,840,607	
Lead	Derby-West Kimberley	22,364	Pb % 76.39	9,803,853	(a)
Zinc	Derby-West Kimberley	102,030	Zn % 56.24	39,579,679	
	Yalgoo	111,034	42.19	29,279,117	
		213,064		68,858,796	(a)
<b>TOTAL BASE METALS</b>				<b>126,503,256</b>	
<b>BAUXITE - ALUMINA</b>					
Alumina	Boddington	1,704,805		420,219,772	
	Murray	3,130,573		740,564,596	
	Serpentine-Jarrahdale	1,748,278		413,583,687	
	Waroona	1,666,004		393,440,006	
		8,249,660		1,967,808,061	(c)
Gallium	Murray		Ga kg 24,308.508	6,563,297	
<b>TOTAL BAUXITE - ALUMINA</b>				<b>1,974,371,358</b>	(j)
<b>CLAYS</b>					
Attapulgitic	Mullewa	17,173		4,180,355	(a)
Clay Shale	Collie	14,559		179,079	(a)
Fire Clay	Chittering	104,850		125,820	
	Northam	12,000		120,000	
		116,850		245,820	(d)
Kaolin	Bridegetown-Greenbushes	400		57,874	(d)
White Clay	Swan	13,003		130,030	(d)
<b>TOTAL CLAYS</b>		<b>161,985</b>		<b>4,793,158</b>	
<b>COAL</b>	Collie	<b>5,814,923</b>		<b>268,381,210</b>	(e)
<b>CONSTRUCTION MATERIALS</b>					
Aggregate	Broome	22,004		355,430	
	Collie	270		18,000	
	Exmouth	4,952		33,597	
	Kalgoorlie-Boulder	163,909		996,463	
	Nannup	120		2,400	
	Port Hedland Town	250,612		1,503,672	
	Roebourne	21,884		131,306	
	Wyndham-East Kimberley	41,999		251,994	
			505,750		3,292,862
Gravel	Broome	5,597		27,134	
	Coolgardie	90,241		540,231	
	Kalgoorlie-Boulder	400		2,400	
	Port Hedland Town	18,000		90,000	

**TABLE 3 (cont.) QUANTITY & VALUE OF MINERALS & PETROLEUM BY LOCAL GOVERNMENT AREA**

MINERAL	LOCAL GOVERNMENT AREA	QUANTITY TONNES	METALLIC CONTENT	VALUE \$A	Ref.
Gravel Cont.	Shark Bay	340		1,700	
	Swan	64,301		385,810	
	Wyndham-East Kimberley	2,621		6,159	
		<b>181,500</b>		<b>1,053,434</b>	
Rock	Broome	1,728		54,700	
	Derby-West Kimberley	15		89	
	East Pilbara	62,285		435,995	
	Exmouth	28			
	Kalgoorlie-Boulder	18,109		108,654	
	Port Hedland Town	467,375		2,703,261	
	Shark Bay	60		600	
		<b>549,600</b>		<b>3,303,495</b>	
Sand	Ashburton	2,102		8,406	
	Broome	21,542		128,260	
	Canning	975		1,463	
	Carnarvon	8		280	
	Collie	30,797		184,780	
	Coolgardie	92,140		523,427	
	Coorow	3,714		18,570	
	Dandaragan	4,476		26,856	
	Derby-West Kimberley	3,954		27,678	
	Gingin	5,973		35,835	
	Kalgoorlie-Boulder	5,042		29,766	
	Leonora	5,492		27,460	
	Meekatharra	31,354		188,118	
	Menzies	1,797		8,985	
	Port Hedland Town	98,714		517,140	
	Roebourne	27,810		185,727	
	Shark Bay	250		1,250	
Wanneroo	1,061,349		4,245,396		
Wyndham-East Kimberley	4,000		20,000		
Yilgarn	4,033		19,087		
		<b>1,405,522</b>		<b>6,198,484</b>	
<b>TOTAL CONSTRUCTION MATERIALS</b>				<b>13,848,275</b>	(d)
		Carats			
<b>DIAMOND</b>	Wyndham-East Kimberley	<b>47,425,602</b>		<b>442,006,326</b>	(a)
<b>DIMENSION STONE</b>					
Black Granite	Dundas	946		283,695	
Granite	Roebourne	220		11,000	
<b>TOTAL DIMENSION STONE</b>				<b>294,695</b>	(d)
<b>GEM &amp; SEMI-PRECIOUS STONE</b>					
Chalcedony	Carnarvon	41		20,680	
kg					
<b>GOLD</b>	Boddington		13,577.261	216,692,180	
	Coolgardie		32,800.230	524,518,232	
	Cue		10,083.941	161,611,748	
	Dundas		4,525.599	72,087,937	
	East Pilbara		12,646.105	201,472,126	
	Halls Creek		1,366.311	21,572,869	
	Kalgoorlie-Boulder		44,972.241	717,038,424	
	Katanning		495.641	7,888,862	
	Laverton		9,608.748	154,283,619	
	Leonora		31,884.708	507,741,803	
	Meekatharra		16,269.080	258,600,970	
	Menzies		2,553.431	40,530,738	
Mt Magnet		3,733.013	59,768,388		

**TABLE 3 (cont.)**
**QUANTITY & VALUE OF MINERALS & PETROLEUM BY LOCAL GOVERNMENT AREA**

MINERAL	LOCAL GOVERNMENT AREA	QUANTITY TONNES	METALLIC CONTENT	VALUE \$A	Ref.
<b>GOLD Cont.</b>	Sandstone		4,559.145	72,704,716	
	Wiluna		14,801.078	236,349,924	
	Yalgoo		2,076.981	33,292,518	
	Yilgarn		15,079.489	240,185,501	
<b>TOTAL GOLD</b>			<b>221,033.002</b>	<b>3,526,340,555</b>	(f)
<b>GYPSUM</b>	Dalwallinu	49,809		992,495	(d),(e)
	Dandaragan	27,722		277,192	(e)
	Dundas	4,965		29,792	(e)
	Esperance	5,499		32,994	(e)
	Koorda	250		2,500	(e)
	Lake Grace	64,944		367,427	(e)
	Mt Marshall	272		2,176	(e)
	Mukinbudin	7,000		28,000	(e)
	Nungarin	32,850		197,100	(e)
	Ravensthorpe	6,153		36,918	(e)
	Wyalkatchem	53,906		328,935	(e)
	Yilgarn	7,150		57,200	(e)
	<b>TOTAL GYPSUM</b>		<b>260,520</b>		<b>2,352,729</b>
<b>HEAVY MINERAL SANDS</b>					
Garnet Sand	Bunbury City	49		5,880	(g)
	Northampton	88,444		9,409,184	(e)
		<b>88,493</b>		<b>9,415,064</b>	
Ilmenite			TiO <sub>2</sub> %		
	Bunbury City	479,911	56.01	55,030,634	
	Capel	367,003	56.86	38,831,079	
	Carnamah	230,114	59.03	20,427,512	
		<b>1,077,028</b>		<b>114,289,225</b>	(a)
Upgraded Ilmenite			TiO <sub>2</sub> %		
	Capel	198,130	92.00	100,759,486	
	Carnamah	98,265	92.00	47,237,712	
	Dandaragan	71,130	92.00	33,812,532	
		<b>367,525</b>		<b>181,809,730</b>	(a)
Leucoxene			TiO <sub>2</sub> Tonnes		
	Bunbury City	6,767	6,541	5,978,449	
	Capel	10,313	8,073	6,685,316	
	Dandaragan	16,090	12,893	3,186,032	
		<b>33,170</b>	<b>27,507</b>	<b>15,849,797</b>	(a)
Rutile			TiO <sub>2</sub> Tonnes		
	Bunbury City	8,688	8,131	8,693,611	
	Carnamah	89,524	84,315	60,518,672	
	Dandaragan	12,439	7,624	9,954,966	
		<b>110,651</b>	<b>100,070</b>	<b>79,167,249</b>	(a)
Zircon			ZrO <sub>2</sub> Tonnes		
	Bunbury City	35,212	22,888	21,696,211	
	Capel	59,204	91,446	31,445,599	
	Carnamah	241,431	157,311	123,067,804	
	Dandaragan	36,857	26,973	21,330,640	
		<b>372,704</b>	<b>298,618</b>	<b>197,540,254</b>	(a)
<b>TOTAL HEAVY MINERAL SANDS</b>				<b>598,071,319</b>	

TABLE 3 (cont.)

QUANTITY & VALUE OF MINERALS & PETROLEUM BY LOCAL GOVERNMENT AREA

MINERAL	LOCAL GOVERNMENT AREA	QUANTITY TONNES	METALLIC CONTENT	VALUE \$A	Ref.
<b>INDUSTRIAL PEGMATITE MINERALS</b>					
Felspar	Mukinbudin	1,943		45,230	
	Port Hedland Town	22,881		878,414	
		<b>24,824</b>		<b>923,644</b>	(h)
<b>IRON ORE</b>					
Domestic Ore	East Pilbara	5,791,703	Fe % 63.80	136,656,820	
			Fe %		
Exported Ore	Ashburton	71,827,346	61.36	1,501,631,129	
	Derby-West Kimberley	664,056	66.04	14,488,918	
	East Pilbara	53,840,067	60.16	1,240,867,999	
	Yilgarn	1,528,126	64.03	30,833,517	
		<b>127,859,595</b>		<b>2,787,821,563</b>	
<b>TOTAL IRON ORE</b>		<b>133,651,298</b>		<b>2,924,478,383</b>	(a)
<b>LIMESAND - LIMESTONE - DOLOMITE</b>					
Dolomite	Lake Grace	7,106		56,848	
	Yilgarn	236		5,192	
		<b>7,342</b>		<b>62,040</b>	
Limesand - Limestone	Cockburn	2,077,200		10,773,200	
	Dandaragan	16,998		186,852	
	Dundas	44,341		665,107	
	Exmouth	200		2,000	
	Gingin	107,562		1,283,181	
	Irwin	20,842		83,732	
	Kwinana	53,249		532,494	
	Shark Bay	949		118,572	
	Wanneroo	320,355		3,710,996	
			<b>2,641,696</b>		<b>17,356,134</b>
<b>LIMESAND-LIMESTONE-DOLOMITE</b>		<b>2,649,038</b>		<b>17,418,174</b>	(d)
<b>MANGANESE ORE</b>					
	East Pilbara	296,807	Mn % 48.79	33,529,688	(a)
<b>NICKEL INDUSTRY</b>					
Cobalt By-Product	Coolgardie		Co Tonnes	942,281	63,521,086 (a),(b)
			Ni %		
Nickel Concentrates	Coolgardie	221,297	14.98	281,841,192	
	Kalgoorlie-Boulder	29,354	12.13	34,331,818	
	Leonora	281,757	12.46	334,090,775	
	Wiluna	165,914	19.42	309,508,083	
	Yilgarn	65,959	12.26	74,111,840	
		<b>764,281</b>		<b>1,033,883,708</b>	(i)
Palladium By-Product	Coolgardie		Pd kg 558,786	2,416,416 (a),(b)	
Platinum By-Product	Coolgardie		Pt kg 119,314	1,584,578 (a),(b)	
<b>PETROLEUM</b>					
Condensate	Carnamah	242		9,886	(d)
	Irwin	3,237		374,544	(d)
	Roebourne	4,962,448		773,339,185	
			<b>4,965,927</b>		<b>773,723,615</b>

**TABLE 3 (cont.)**
**QUANTITY & VALUE OF MINERALS & PETROLEUM BY LOCAL GOVERNMENT AREA**

MINERAL	LOCAL GOVERNMENT AREA	QUANTITY TONNES	METALLIC CONTENT	VALUE \$A	Ref.
<b>PETROLEUM Cont.</b>					
		Kilolitres			
Crude Oil	Ashburton	5,134,326		922,843,201	
	Derby-West Kimberley	10,322		1,402,209	
	Irwin	19,672		2,811,084	
	Roebourne	6,094,388		1,031,768,204	
		<b>11,258,708</b>		<b>1,958,824,698</b>	(a)
		Btu 10 <sup>6</sup>			
Liquified Natural Gas	Roebourne	377,819,333		1,391,202,011	(j)
		Tonnes			
L.P.G. - Butane	Roebourne	158,962		37,441,182	(j)
		Tonnes			
L.P.G. - Propane	Roebourne	150,835		36,929,761	(j)
		'000 m <sup>3</sup>			
Natural Gas	Ashburton	342,848		27,180,576	(j)
	Carnamah	42,582		6,273,716	(j)
	Irwin	323,944		40,093,830	(j)
	Roebourne	5,913,376		421,133,243	(d),(j)
		<b>6,622,750</b>		<b>494,681,365</b>	
<b>TOTAL PETROLEUM</b>				<b>4,692,802,632</b>	
<b>PIGMENTS</b>					
Red Oxide	Cue	6,000		164,250	
<b>SALT</b>					
	Carnarvon	707,920		13,997,393	
	Esperance	14,318		520,845	
	Lake Grace	212		1,696	
	Port Hedland Town	2,270,950		45,486,533	
	Roebourne	3,266,902		65,505,477	
	Shark Bay	828,819		13,031,403	
	Wyalkatchem	226		18,053	
	Yilgarn	109,169		4,720,383	
<b>TOTAL SALT</b>		<b>7,198,516</b>		<b>143,281,783</b>	(a)
<b>SILICA - SILICA SAND</b>					
Silica	Moora	79,048		790,479	
Silica Sand	Albany	55,343		830,145	
	Canning	8,682		95,502	
	Cockburn	238,096		2,619,056	
	Coolgardie	107,993		264,583	
	Nannup	312		6,240	
	Swan	188,001		2,068,011	
	Wanneroo	21,163		141,839	
<b>TOTAL SILICA - SILICA SAND</b>		<b>698,638</b>		<b>6,815,855</b>	(a)
		Agkg			
<b>SILVER: BY-PRODUCT</b>					
	Coolgardie	226.900		48,549	(a),(b)
	Derby-West Kimberley	7,222.901		1,363,767	(a),(d)
	East Pilbara	104.383		21,281	(a),(d)
	State-Wide	28,767.417		5,309,381	
	Yalgoo	12,376.501		2,222,332	(a),(d)
<b>TOTAL SILVER BY-PRODUCTS</b>		<b>48,698.102</b>		<b>8,965,310</b>	
<b>TALC</b>					
	Meekatharra	7,293		510,510	
	Three Springs	178,963		14,417,753	
		<b>186,256</b>		<b>14,928,263</b>	(e)

TABLE 3 (cont.)

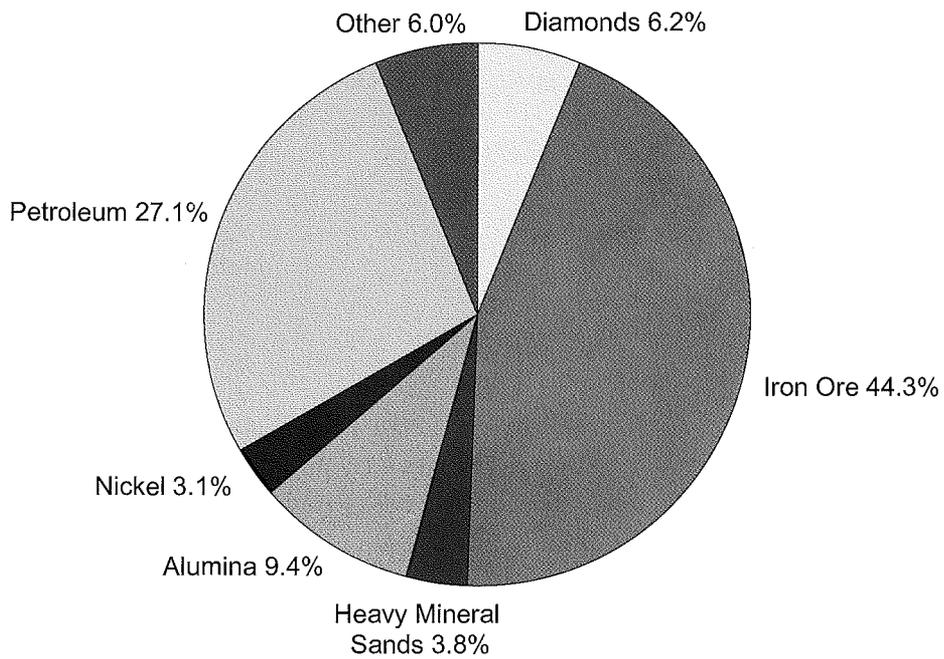
QUANTITY & VALUE OF MINERALS & PETROLEUM BY LOCAL GOVERNMENT AREA

MINERAL	LOCAL GOVERNMENT AREA	QUANTITY TONNES	METALLIC CONTENT	VALUE \$A	Ref.
<b>TIN - TANTALUM - LITHIUM</b>			Li <sub>2</sub> O %		
Spodumene	Bridegetown-Greenbushes	131,932	5.03	17,139,744	(a)
			Ta <sub>2</sub> O <sub>5</sub> kg		
Tantalite	Bridegetown-Greenbushes	286	150,150	26,016,879	
	East Pilbara	232	121,800	6,568,858	
	Yalgoo	20	10,500	1,877,640	
		538	282,450	34,463,377	(a)
			Sn Tonnes		
Tin	Bridegetown-Greenbushes	148	367	2,531,169	
	East Pilbara	n.ap.	3	34,447	
		148	370	2,565,616	(a)

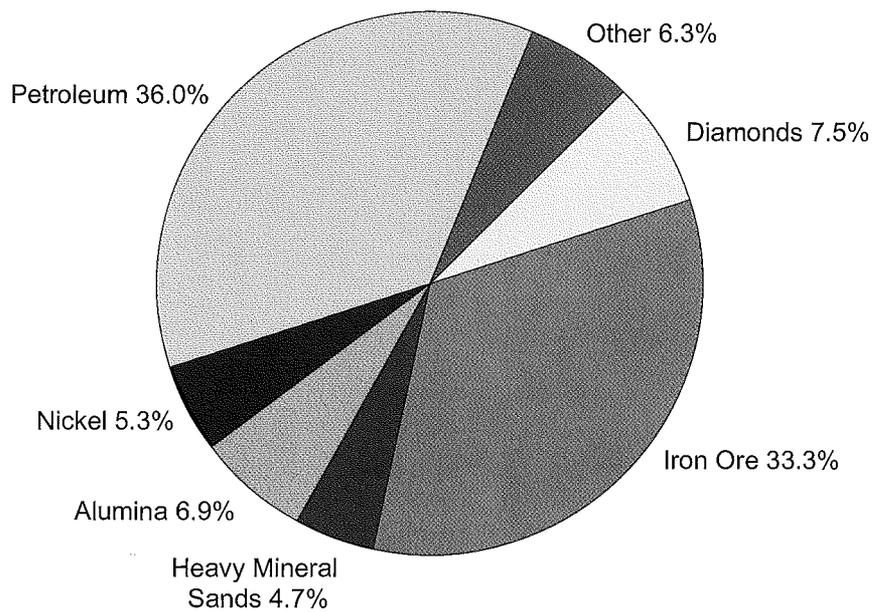
VALUE OF MINERALS	7,736,722,881
VALUE OF PETROLEUM	4,692,802,632
VALUE OF GOLD	3,526,340,555
<b>TOTAL VALUE</b>	<b>15,955,866,067</b>

**COMPARATIVE ROYALTY RECEIPTS**

**1991 Total: \$326.1 Million**



**1996 Total: \$461.3 Million**



Source: DME

**Figure 0.2**

**TABLE 4 ROYALTY RECEIPTS**

COMMODITY\Mineral	1995	1996	1996 GROWTH	
	\$A	\$A	\$A	%
<b>BASE METALS</b>				
Copper	3,320,227.21	1,882,088.89	(1,438,138.32)	(43)
Lead	531,126.77	399,615.36	(131,511.41)	(25)
Zinc	4,283,710.05	3,228,618.17	(1,055,091.88)	(25)
<b>TOTAL BASE METALS</b>	<b>8,135,064.03</b>	<b>5,510,322.42</b>	<b>(2,624,741.61)</b>	<b>(32)</b>
<b>BAUXITE-ALUMINA</b>				
Alumina	28,353,370.97	31,542,321.24	3,188,950.27	11
Gallium	0.00	56,339.17	56,339.17	n.ap.
<b>TOTAL BAUXITE-ALUMINA</b>	<b>28,353,370.97</b>	<b>31,598,660.41</b>	<b>3,245,289.44</b>	<b>11</b>
<b>CLAYS</b>	<b>249,608.22</b>	<b>275,167.16</b>	<b>25,558.94</b>	<b>10</b>
<b>COAL</b>	<b>13,726,995.42</b>	<b>13,670,806.28</b>	<b>(56,189.14)</b>	<b>0</b>
<b>CONSTRUCTION MATERIALS</b>				
Aggregate	152,582.70	165,995.63	13,412.93	9
Gravel	38,956.07	57,824.34	18,868.27	48
Rock	8,469.30	172,601.62	164,132.32	1,938
Sand	449,292.54	465,180.46	15,887.92	4
Sandstone	46.18	0.00	(46.18)	(100)
<b>TOTAL CONSTRUCTION MATERIALS</b>	<b>649,346.79</b>	<b>861,602.05</b>	<b>212,255.26</b>	<b>33</b>
<b>DIAMOND</b>	<b>32,381,879.96</b>	<b>34,781,689.90</b>	<b>2,399,809.94</b>	<b>7</b>
<b>DIATOMITE</b>	<b>3,853.09</b>	<b>0.00</b>	<b>(3,853.09)</b>	<b>(100)</b>
<b>DIMENSION STONE</b>	<b>0.00</b>	<b>1,138.41</b>	<b>1,138.41</b>	<b>n.ap.</b>
<b>GEM &amp; SEMI-PRECIOUS STONE</b>	<b>53,485.61</b>	<b>33,148.96</b>	<b>(20,336.65)</b>	<b>(38)</b>
<b>GOLD</b>	<b>372,312.47</b>	<b>375,885.38</b>	<b>3,572.91</b>	<b>1</b>
<b>GYPSUM</b>	<b>63,719.32</b>	<b>78,604.01</b>	<b>14,884.69</b>	<b>23</b>
<b>HEAVY MINERAL SANDS</b>				
Garnet	412,331.28	405,245.84	(7,085.44)	(2)
Ilmenite	6,588,768.52	7,011,884.27	423,115.75	6
Leucoxene	353,407.35	479,331.21	125,923.86	36
Monazite	1,900.00	0.00	(1,900.00)	(100)
Rutile	3,634,080.25	4,144,030.01	509,949.76	14
Zircon	7,968,601.15	9,624,691.93	1,656,090.78	21
<b>TOTAL HEAVY MINERAL SANDS</b>	<b>18,959,088.55</b>	<b>21,665,183.26</b>	<b>2,706,094.71</b>	<b>14</b>
<b>INDUSTRIAL PEGMATITE MINERALS</b>				
Felspar	100,342.82	68,225.32	(32,117.50)	(32)
<b>IRON ORE</b>	<b>153,027,087.21</b>	<b>153,742,932.16</b>	<b>715,844.95</b>	<b>0</b>
<b>LIMESAND-LIMESTONE-DOLOMITE</b>				
Dolomite	582.54	2,202.60	1,620.06	278
Limesand-Limestone	60,826.43	298,368.96	237,542.53	391
<b>TOTAL LIMESAND-LIMESTONE-DOLOMITE</b>	<b>61,408.97</b>	<b>300,571.56</b>	<b>239,162.59</b>	<b>389</b>
<b>MANGANESE</b>	<b>859,924.12</b>	<b>1,932,626.31</b>	<b>1,072,702.19</b>	<b>125</b>

# 1996 STATISTICS DIGEST

**TABLE 4 (cont.)**
**ROYALTY RECEIPTS**

COMMODITY\Mineral	1995 \$A	1996 \$A	1996 GROWTH \$A	%
<b>NICKEL INDUSTRY</b>				
Cobalt by-product	1,375,535.32	1,506,409.62	130,874.30	10
Nickel	22,481,707.07	24,375,885.59	1,894,178.52	8
Palladium by-product	74,433.28	59,555.54	(14,877.74)	(20)
Platinum by-product	43,167.28	67,955.28	24,788.00	57
<b>TOTAL NICKEL INDUSTRY</b>	<b>23,974,842.95</b>	<b>26,009,806.03</b>	<b>2,034,963.08</b>	<b>8</b>
<b>PEAT</b>	<b>2,291.85</b>	<b>452.54</b>	<b>(1,839.31)</b>	<b>(80)</b>
<b>PETROLEUM</b>				
Condensate	19,778,625.58	22,606,555.31	2,827,929.73	14
Liquefied Natural Gas	63,598,940.71	53,104,202.98	(10,494,737.73)	(17)
LPG - Butane	117,397.83	1,016,837.96	899,440.13	766
LPG - Propane	107,851.82	1,033,291.69	925,439.87	858
Natural gas	20,084,374.53	20,861,877.32	777,502.79	4
Oil	50,892,279.73	67,529,049.88	16,636,770.15	33
<b>TOTAL PETROLEUM</b>	<b>154,579,470.20</b>	<b>166,151,815.14</b>	<b>11,572,344.94</b>	<b>7</b>
<b>PIGMENTS</b>				
Red Oxide	0.00	8,212.50	8,212.50	n.ap.
<b>SALT</b>	<b>1,692,155.24</b>	<b>1,778,814.58</b>	<b>86,659.34</b>	<b>5</b>
<b>SILICA SAND</b>	<b>236,042.48</b>	<b>354,625.10</b>	<b>118,582.62</b>	<b>50</b>
<b>SILVER</b>	<b>248,528.59</b>	<b>187,111.58</b>	<b>(61,417.01)</b>	<b>(25)</b>
<b>TALC</b>	<b>31,387.50</b>	<b>99,921.00</b>	<b>68,533.50</b>	<b>218</b>
<b>TIN-TANTALUM-LITHIUM</b>				
Spodumene	633,653.19	745,819.29	112,166.10	18
Tantalite	816,838.23	959,428.92	142,590.69	17
Tin	70,256.38	90,173.81	19,917.43	28
<b>TOTAL TIN-TANTALUM-LITHIUM</b>	<b>1,520,747.80</b>	<b>1,795,422.02</b>	<b>274,674.22</b>	<b>18</b>
<b>TOTAL ROYALTY RECEIPTS</b>	<b>439,282,954.16</b>	<b>461,282,744.08</b>	<b>21,999,789.92</b>	<b>5</b>
<b>IRON ORE ADDITIONAL RENTAL</b>	<b>26,148,120.36</b>	<b>23,934,547.36</b>	<b>(2,213,573.00)</b>	<b>(8)</b>
<b>TOTAL REVENUE</b>	<b>465,431,074.52</b>	<b>485,217,291.44</b>	<b>19,786,216.92</b>	<b>4</b>

**TABLE 5 PERSONS EMPLOYED IN THE W.A. MINERALS & PETROLEUM INDUSTRIES**

AS AT DECEMBER 31, 1996

MINERAL/Company	PROJECT	1995	1996
<b>BASE METALS</b>			
Murchison Zinc Co. Pty Ltd	Golden Grove	255	248
Western Metals NL	Blendevale	0	43
	Cadjebut	193	250
Western Mining Corporation Ltd	Nifty	191	195
<b>TOTAL BASE METALS</b>		<b>639</b>	<b>736</b>
<b>BAUXITE - ALUMINA</b>			
Alcoa of Australia Ltd	Del Park - Huntley	300	316
	Jarrahdale	233	253
	Kwinana	1,523	1,234
	Pinjarra	1,505	1,453
	Wagerup	1,006	878
	Willow Dale	155	174
	East Rockingham	63	60
Australian Fused Materials Pty Ltd	Boddington	131	138
Worsley Alumina Pty Ltd	Worsley	1,020	988
<b>TOTAL BAUXITE - ALUMINA</b>		<b>5,936</b>	<b>5,494</b>
<b>COAL</b>			
Griffin Coal Mining Co. Ltd	Muja	351	375
Western Collieries Ltd	Central Services	26	20
	Western #5	363	219
<b>TOTAL COAL</b>		<b>740</b>	<b>614</b>
<b>DIAMOND</b>			
Argyle Diamond Mines Pty Ltd	Lake Argyle	1,089	1,367
Poseidon Ltd	Bow River	103	0
<b>TOTAL DIAMOND</b>		<b>1,192</b>	<b>1,367</b>
<b>GOLD</b>			
Australian Resources & Mining Co. NL	Gidgee	125	119
	Mt McLure	67	81
Centaur Mining & Exploration Ltd	Gimlet South	127	124
	Mt Pleasant	64	345
Central Norseman Gold Corp. NL	Central Norseman	235	258
Consolidated Gold NL	Bardoc - Davyhurst	62	75
	Orient Well	81	97
Eagle Mining Corp NL	Nimary	90	31
Equigold NL	Dalgaranga	0	112
Forrestania Gold NL	Bounty	286	225
Gold Mines of Australia Ltd	Reedy	134	117
	Youanmi	99	149
Great Central Mines NL	Bronzewing	259	175
	Jundee	250	325
Hedges Gold Pty Ltd	Hedges	96	133
Herald Resources Ltd	Three Mile Hill	307	311
Kalgoorlie Consolidated Gold Mines Pty Ltd	Kalgoorlie	1,307	1,301
Mt Edon Gold Mines Ltd	Tarmoola	220	185
Newcrest Mining Ltd	New Celebration	217	224
	Telfer	402	756
New Hampton Goldfields NL	Jubilee	181	182
Normandy Mining Ltd	Big Bell	312	350

TABLE 5 (cont.)

PERSONS EMPLOYED IN THE W.A. MINERALS & PETROLEUM INDUSTRIES

MINERAL/Company	PROJECT	1995	1996
<b>GOLD Cont.</b>			
	Golden Crown	168	80
	Kaltails	108	82
North Gold (WA) Ltd	Peak Hill	91	103
	Kanowna Belle	182	262
Oriole Resources Ltd	Mt Gibson	86	111
Pancontinental Pty Ltd	Kundana	206	254
	Paddington	295	334
Placer Pacific Pty Ltd	Granny Smith	353	352
Plutonic Operations Ltd	Bellevue	84	56
	Darlot	71	165
	Lawlers	157	189
	Mt Morgans	203	248
	Plutonic	261	449
Precious Metals Australia	Palm Springs	47	148
Resolute Ltd	Bullabulling	117	170
	Chalice	102	91
	Higginsville	169	149
	Marymia	70	98
Sons of Gwalia NL	Barnicoat	97	129
	Bullfinch	167	272
	Marvel Loch	196	144
	Sons of Gwalia	241	145
	Yilgarn Star	156	269
St. Barbara Mines Ltd	Bluebird	349	386
Western Mining Corporation Ltd	Emu	156	206
	Kambalda/St. Ives	803	769
	Mt Magnet	314	287
Westgold Resources NL	Tuckabianna	105	60
Wiluna Mines Ltd	Wiluna	218	308
Worsley Alumina Pty Ltd	Boddington	491	412
All Other Operators		925 (r)	901
<b>TOTAL GOLD</b>		<b>11,909</b>	<b>13,304</b>
<b>HEAVY MINERAL SANDS</b>			
BHP Minerals Ltd	Beenup	108	155
Cable Sands Pty Ltd	Bunbury	304	299
RGC Mineral Sands Pty Ltd	Capel	200	208
	Eneabba	438	721
	Narngulu	237	289
TiWest Pty Ltd	Chandala-Muchea	162	190
	Cooljarloo	119	123
Westralian Sands Ltd	Capel	387	683
All Other Operators		56 (r)	62
<b>TOTAL HEAVY MINERAL SANDS</b>		<b>2,011 (r)</b>	<b>2,730</b>
<b>IRON ORE</b>			
BHP Iron Ore (Goldsworthy) Ltd	Finucane Island	371	590
	Yarrie	134	108
BHP Iron Ore (Jimblebar) Ltd	Jimblebar	74	105
BHP Iron Ore (Yandicoogina) Ltd	Yandicoogina	107	153

**TABLE 5 (cont.)**
**PERSONS EMPLOYED IN THE W.A. MINERALS & PETROLEUM INDUSTRIES**

MINERAL/Company	PROJECT	1995	1996
<b>IRON ORE Cont.</b>			
BHP Iron Ore Ltd	Mt Whaleback	1,433	1,375
	Nelson Point	888	1,033
	Orebody 25	84	91
	Railways	552	699
Hamersley Iron Pty Ltd	Brockman	123	108
	Dampier Port Operations	666	944
	Hismelt/Kwinana	135	150
	Marandoo	196	283
	Paraburdoo/Channar	637	671
	Railways	411	413
	Tom Price	933	1,008
Kooyanobbing Iron Pty Ltd	Cockatoo Island	22	42
	Kooyanobbing	30	23
Robe River Mining Co. Pty Ltd	Cape Lambert	421	461
	Pannawonica	329	421
	Railways	91	96
<b>TOTAL IRON ORE</b>		<b>7,637</b>	<b>8,774</b>
<b>NICKEL</b>			
Black Swan Nickel Pty Ltd	Black Swan	0	79
Outokumpu Australia Ltd	Forrestania	261	227
Western Mining Corporation Ltd	Kalgoorlie Nickel Smelter	506	396
	Kambalda/Blair	1,121	1,166
	Kwinana Refinery	494	426
	Leinster	431	711
	Mt Keith	685	670
<b>TOTAL NICKEL</b>		<b>3,498</b>	<b>3,675</b>
<b>PETROLEUM PRODUCTS</b>			
Ampolex Ltd	Wandoo	65	60
Apache Energy Ltd	Harriet/Rosette	131	120
BHP Petroleum (Australia) Pty Ltd	Griffin	68	111
Discovery Petroleum Ltd	Mt Horner	21	18
West Aust Petroleum Pty Ltd	North West Area/Dongara	229	197
Western Mining Corp. Ltd	North Herald/South Pepper/Chervil	27	33
Woodside Offshore Pet. Pty Ltd	Goodwyn/Rankin/Cossack/ Wanea/Burrup	872	610
	All Other Operators	15	8
<b>TOTAL PETROLEUM PRODUCTS</b>		<b>1,428</b>	<b>1,157</b>
<b>SALT</b>			
Cargill Salt Co.	Port Hedland	111	111
Dampier Salt Ltd	Dampier	175	227
	Lake MacLeod	88	178
Shark Bay Salt JV	Useless Loop	88	79
Other		10	10
<b>TOTAL SALT</b>		<b>472</b>	<b>605</b>
<b>ALL OTHER MATERIALS (including Rock Quarries)</b>		<b>1,157</b>	<b>1,201</b>
<b>TOTAL</b>		<b>36,619 (r)</b>	<b>39,657</b>

(SOURCE: AXSTAT REPORTING SYSTEM, MINING OPERATIONS DIVISION)

Table 6

PRINCIPAL MINERAL & PETROLEUM PRODUCERS 1996

Address, Telephone Number: Project

**BASE METALS**

**Copper**

Murchison Zinc Co. Pty Ltd, 100 Hutt Street, Adelaide 5000., (08) 8303 1700: Golden Grove.

Newcrest Mining Ltd, 600 St Kilda Road, Melbourne Vic, 3004, (03) 9522 5333: Telfer.

WMC Ltd, 168 Greenhill Road, Parkside 5063, (08) 8372 7200: Nifty.

**Lead - Zinc**

Murchison Zinc Co. Pty Ltd, 100 Hutt Street, Adelaide 5000, (08) 8303 1700: Golden Grove.

Westmet Metals Zinc NL, 263 Adelaide Terrace, Perth 6000, (08) 9221 2555: Cadjebut.

**BAUXITE - ALUMINA**

**Alumina**

Alcoa of Australia (WA) Ltd, cnr Davey & Marmion Streets, Booragoon 6154, (08) 9316 5111: Del Park, Jarrahdale, Willowdale.

Worsley Alumina Pty Ltd, PO Box 344, Boddington WA 6225, (08) 9734 8311: Boddington.

**CLAY**

**Attapulgit**

Mallina Holdings Ltd, 249 Stirling Highway, Claremont 6010, (08) 9384 7077: Lake Nerramyne.

**Clay Shale**

Western Collieries Ltd, 40 The Esplanade, Perth 6000, (08) 9327 4511: Collie.

**Fire Clay**

Midland Brick Co Pty Ltd, Bassett Rd, Middle Swan 6056, (08) 9273 5522: Muchea.

**Kaolin**

Gwalia Consolidated Ltd, PMB 16, West Perth 6872, (08) 9481 1988: Greenbushes.

**White Clay**

Metro Brick, Locked Bag 100, Midland 6056, (08) 9250 2111: Middle Swan.

**COAL**

Griffin Coal Mining Co. Ltd, 28 The Esplanade, Perth 6000, (08) 9325 8155: Collie.

Western Collieries Ltd, 40 The Esplanade, Perth 6000, (08) 9327 4511: Collie.

**CONSTRUCTION MATERIALS**

**Aggregate**

The Readymix Group (WA), 75 Canning Highway, Victoria Park 6100, (08) 9472 2000: Boodarrie, Boulder, Burrup-Dampier.

**Gravel**

Boral Resources (WA) Ltd, 63 Abernethy Rd, Belmont 6104, (08) 9333 3400: Gnangarra, Grosmont.

**Rock**

Boral Resources (WA) Ltd, 63 Abernethy Rd, Belmont 6104, (08) 9333 3400: Gnangarra, Grosmont.

**Sand**

Amatek Ltd, 1 Newburn Road, Kewdale 6104, (08) 9353 3030: Gnangarra, Jandakot.

The Readymix Group (WA), 75 Canning Highway, Victoria Park 6100, (08) 9472 2000: Comet

Vale, Pinnacles, Sandy Hill, Sullivan's Creek, Turner River, Warrawanda, Widgiemooltha.

Table 6 (cont.)

PRINCIPAL MINERAL & PETROLEUM PRODUCERS 1996

Address, Telephone Number: Project

**DIAMOND**

Argyle Diamond Mines, 2 Kings Park Road, West Perth 6005, (08) 9482 1166: Argyle.

**DIMENSION STONE**

**Black Granite**

Fraser Range Granite NL, 164 Burswood Road., Victoria Park 6010, (08) 9470 4487: Mt Malcolm.

**GOLD**

Acacia Resources Ltd, 3 Richardson St, West Perth 6005, (08) 9480 1666: Sunrise Dam.

Amalg Resources NL, 11 Keogh Way Kalgoorlie, (08) 9091 1422: Burbanks-Lady Robinson.

Australasian Gold Mines NL, 47-79 Stirling Highway, Nedlands 6009, (08) 9386 7211: Red White & Blue.

Australian Gold Fields NL, 8 The Esplanade, Perth 6000, (08) 9221 7300: Bannockburn.

Australian Resources Ltd, 5 Mill Street, Perth 6000, (08) 9481 1654: Gidgee, Mt McClure.

Camelot Resources Ltd, 46-50 Kings Park Road, West Perth 6005, (08) 9321 0616: Mt Gibson.

Centaur Mining & Exploration Ltd, 580 St Kilda Rd, Melbourne 3004, (03) 9276 7870: Mt Pleasant-Golden  
Kilometre, Ora Banda.

Central Norseman Gold Corp. NL, PO Box 56, Norseman 6443, (08) 9039 1101: Central Norseman.

Consolidated Gold NL, 10 Richardson St, West Perth 6005, (08) 9481 5870: Davyhurst. Kookynie-Orient  
Well.

Croesus Mining NL, 39 Porter Street, Kalgoorlie 6430, (08) 9091 2222: Binduli.

Eagle Mining Corporation NL, 1 Sleat Road, Applecross 6153, (08) 9316 3611: Nimary.

Elmina NL, 55 Colin St, West Perth 6005, (08) 9481 4233: Sandstone-Hancocks.

Equigold NL, 7 Sleat St, Applecross 6153, (08) 9316 3661: Dalgaranga.

Forrestania Gold NL, 15 Ord St, West Perth 6005, (08) 9481 5656: Forrestania-Bounty.

Gold Mines of Australia Ltd, 161 Great Eastern Highway, Belmont 6104, (08) 9277 9500: Reedy, Youanmi.

Great Central Mines NL, 46 Kings Park Road, West Perth 6005, (08) 9322 2044: Bronzewing, Jundee.

Hedges Gold Pty Ltd, Williams Road, Boddington 6390, (08) 9538 4500: Hedges.

Herald Resources Ltd, 40 Kings Park Road, West Perth 6005, (08) 9322 2788: Bayley's Reward-Greenfields,  
Gum Creek-Montague, Sandstone, Three Mile Hill.

International Mineral Resources NL, 26 St George's Tce, Perth 6000, (08) 9325 8599: Badgebup.

Kalgoorlie Consolidated Gold Mines Pty Ltd, Private Bag 27, Kalgoorlie 6430, (08) 9022 1100: Golden Mile.

Lynas Gold NL, 50 Colin St, West Perth 6005, (08) 9481 3400: Lynas Find.

Mt Edon Gold Mines (Aust) NL, 30 Ledger Road, Balcatta 6021, (08) 9345 1588: Tarmoola-King Of The Hills.

New Hampton Goldfields NL, 9 Havelock St, West Perth 6005, (08) 9321 0611: Jubilee, Mt Martin.

Newcrest Mining Ltd, 30 Terrace Road, East Perth 6004, (08) 9270 7070: New Celebration, Telfer.

Normandy Mining Ltd, 100 Hutt Street, Adelaide S.A., (08) 8303 1700: Big Bell, Golden Crown, Kaltails.

North Ltd, 12 St George's Terrace, Perth 6000, (08) 9268 3900: Kanowna Belle, Peak Hill.

Pancontinental Mining Ltd, 1 Alfred St, Sydney 2000, (02) 9934 8888: Kundana, Paddington.

Perilya Mines NL, 278 Stirling Highway, Claremont 6010, (08) 9385 2400: Fortnum.

Placer Pacific Ltd, 1 Alfred Street, Sydney Cove 2000 (02) 9256 3800: Granny Smith.

Plutonic Resources Ltd, 221 St George's Terrace, Perth 6000, (08) 9324 1699: Darlot, Lawlers, Mt Morgans,  
Plutonic, Sir Samuel-Bellevue

Morgans, Plutonic, Sir Samuel-Bellevue.

Precious Metals Australia Ltd, 37 St George's Terrace, Perth 6000, (08) 9221 3711: Palm Springs.

Ramsgate Resources Ltd, 229 Stirling Highway, Claremont 6010, (08) 9383 4321: Mt Monger-Randalls.

Resolute Ltd, 28 The Esplanade, Perth 6000, (08) 9261 6100: Bullabulling, Chalice, Higgingsville, Marymia  
Hill.

Table 6 (cont.)

## PRINCIPAL MINERAL &amp; PETROLEUM PRODUCERS 1996

Address, Telephone Number: Project

**GOLD (cont)**

Sons of Gwalia NL, 16 Parliament Place, West Perth 6005, (08) 9263 5555: Barnicoat, Bullfinch, Marvel Loch-Southern Cross, Nevorla, Sons of Gwalia, Yilgarn Star.

St Barbara Mines Ltd, 28 The Esplanade, Perth 6000, (08) 9324 6350: Bluebird.

St Francis Mining NL, 45 Ventnor Avenue, West Perth 6005, (08) 9321 8866: Grosmont-Norris.

Tectonic Resources Ltd, 100 Hay Street, Subiaco 6008, (08) 9388 3872: Mt Dimer.

WMC Ltd, 250 St George's Terrace, Perth 6000, (08) 9442 2000: Emu-Leinster, Hill 50-Mt Magnet, Kambalda-St Ives.

Wiluna Mines Ltd, 10 Ord Street West Perth 6005, (08) 9481 2050: Wiluna.

Worsley Alumina Pty Ltd, PO Box 48, Boddington 6390, (08) 9883 8260: Boddington.

**GYPSUM**

H.B. Brady & Co. Pty Ltd, PO Box 42, Bayswater 6053, (08) 9279 4422: Lake Brown.

Quantum Holdings Pty Ltd, 17 Hawkstone St, Cottesloe 6011 (08) 9481 4101: Jurien Bay.

Swan Portland Cement Ltd, Burswood Road, Rivervale 6103, (08) 9361 8822: Lake Hillman.

Westdeen Holdings Pty Ltd, 7 Armstrong Road, Applecross 6153, (08) 9364 4951: Lake Cowcowing.

**HEAVY MINERAL SANDS****Garnet Sand**

GMA Garnet Pty Ltd, PO Box 188, Geraldton 6530, (08) 9923 3644: Port Gregory.

**Ilmenite, Leucoxene, Rutile & Zircon**

Cable Sands (WA) Pty Ltd, PO Box 133, Bunbury 6230, (08) 9721 4111: Busselton, Jangardup, Waroona.

RGC Mineral Sands, PO Box 62, Geraldton 6530, (08) 99568 822: Capel, Encabba North, Encabba West, Narngulu.

TiWest Pty Ltd, 1 Brodie Hall Drive, Bentley 6102, (08) 9365 1390: Cooljarloo, Chandala.

Westralian Sands Ltd, PO Box 96, Capel 6271, (08) 9727 2002: Yoganup, Yoganup Extended.

**INDUSTRIAL PEGMATITE MINERALS****Feldspar**

Commercial Minerals Ltd, 26-28 Tomlinson Road, Welshpool 6106, (08) 9362 1411: Mukinbudin, Pippingarra.

**IRON ORE**

BHP Iron Ore (Goldsworthy) Ltd, 200 St George's Terrace, Perth 6000, (08) 9320 4444: Nimingarra, Yarrie.

BHP Iron Ore (Jimblebar) Ltd, 200 St George's Terrace, Perth 6000, (08) 9320 4444: Jimblebar.

BHP Iron Ore Ltd, 200 St George's Terrace, Perth 6000, (08) 9320 4444: Newman, Yandicoogina.

Channar Mining Pty Ltd, 152 George's Terrace, Perth 6000, (08) 9327 2327: Channar.

Hamersley Iron Pty Ltd, 152 George's Terrace, Perth 6000, (08) 9327 2327: Brockman, Marandoo, Tom Price, Paraburdoo.

Koolyanobbing Iron Pty Ltd, 56 Adelaide Terrace, Perth WA 6000, (08) 9268 3388: Cockatoo Island, Koolyanobbing.

Robe River Iron Associates, 12 St George's Terrace, Perth 6000, (08) 9421 4747: Pannawonica.

**LIMESAND - LIMESTONE**

Cockburn Cement Ltd, Russell Road, East Munster 6166, (08) 9411 1000: Cockburn Sound, Coogee.

Swan Portland Cement Ltd, Burswood Road, Rivervale 6103, (08) 9361 8822: Wanneroo.

**MANGANESE**

Valiant Consolidated Ltd, 250 St George's Terrace, Perth 6000, (08) 9321 3797: Mt Sydney, Pearana.

**NICKEL**

Outokumpu Australia Pty Ltd, 141 Burswood Road., Burswood 6100, (08) 9472 3144: Forrestania

WMC Ltd, 250 St George's Terrace, Perth 6000, (08) 9442 2000: Blair, Carnilya Hill, Kambalda, Leinster, Mt Keith.

Table 6 (cont.)

PRINCIPAL MINERAL & PETROLEUM PRODUCERS 1996

Address, Telephone Number: Project

**PETROLEUM**

Ampolex Ltd, 250 St George's Terrace, Perth 6000, (08) 9429 3200: Wandoo.

Apache Energy Ltd, 256 St George's Terrace, Perth WA 6000, (08) 9422 7222: Campbell, Harriet, Rosette, Sinbad, Tanami.

BHP Petroleum Pty Ltd, 152-158 St George's Terrace, Perth 6000, (08) 9278 4800: Griffin.

Boral Energy Resources Ltd, 60 Hindmarsh Square, Adelaide SA 5000, (08) 8235 3737: Beharra Springs, Tubridgi.

Consolidated Gas Pty Ltd, 325 Churchill Avenue, Subiaco 6008, (08) 9380 4920: Woodada.

Premier Oil Australia Pty Ltd, 31 Ventnor Avenue, West Perth WA, 6005, (08) 9480 4100: Mt Horner.

Santos Ltd, 39 Grenfell Street, Adelaide SA 5001, (08) 8224 7162: Blina, Boundary, Lloyd, Sundown, West Terrace.

West Aust. Petroleum Pty Ltd (WAPET), QV1, 250 St George's Terrace, Perth 6000, (08) 9263 6000: Barrow Island, Cowle, Crest, Dongara, Mondara, Roller-Skate, Saladin, Yammaderry.

WMC Ltd, 250 St George's Terrace, Perth 6000, (08) 9442 2000: Chervil, North Herald, South Pepper, Airlie Island.

Woodside Offshore Pet. Pty Ltd, 1 Adelaide Terrace, Perth 6000, (08) 9224 4111: Cossak/Wanaea, Goodwyn, North Rankin.

**SALT**

Cargill Australia Ltd, PO Box 420, Port Hedland 6721, (08) 9140 1255: Port Hedland.

Dampier Salt (Operations) Pty Ltd, 152-158 St George's Terrace, Perth 6000, (08) 9327 2299: Dampier, Lake Macleod.

Shark Bay Salt Joint Venture, 22 Mount Street, Perth 6000, (08) 9322 4811: Useless Loop.

WA Salt Koolyanobbing Pty Ltd, Cockburn Road, Hamilton Hill 6163, (08) 9430 5495: Lake Deborah East, Pink Lake.

**SILICA - SILICA SAND**

**Silica**

Simcoa Operations Pty Ltd, P.O. Box 1389, Bunbury 6231, (08) 97912 588: Dalaroo.

**Silica Sand**

Amatek Ltd, 1 Newburn Road, Kewdale 6104, (08) 9353 3030: Jandakot, Gngangara.

Boral Resources WA Ltd, 136-138 Gt Eastern Highway, South Guildford 6055, (08) 9279 0000: Jandakot.

The Readymix Group (WA), 75 Canning Highway, Victoria Park 6100, (08) 9472 2000: Jandakot.

WMC Ltd, 250 St George's Terrace, Perth 6000, (08) 9442 2000: Mt Burgess.

**TALC**

Gwalia Minerals NL, PMB 16, West Perth 6872, (08) 9481 1988: Mt Seabrook.

WMC Ltd, PO Box 116, Three Springs 6519, (08) 9954 5047: Three Springs.

**TIN - TANTALUM - LITHIUM**

**Spodumene**

Gwalia Consolidated Ltd, PMB 16, West Perth 6872, (08) 9481 1988: Greenbushes.

**Tantalite - Tin**

Gwalia Consolidated Ltd, PMB 16, West Perth 6872, (08) 9481 1988: Greenbushes, Wodgina.

## ABBREVIATIONS, REFERENCES, UNITS AND 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.ap.	not applicable
f.o.t.	free on truck	f.o.b.	free on board
f.o.r.	free on rail	¥	Japanese Yen
A\$	Australian Dollar	US\$	United States Dollar
ABS	Australian Bureau of Statistics	GDP	Gross Domestic Product
AFR	<i>Australian Financial Review</i>	BMR	Bureau of Mineral Resources
CSO	Central Selling Organisation	HBI	Hot Briquetted Iron
DRI	Direct Reduced Iron	IMF	International Monetary Fund
RBA	Reserve Bank of Australia		
ABARE	Australian Bureau of Agricultural and Resource Economics		

### REFERENCES

- (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) Value at works.
- (e) Estimated ex-mine value.
- (f) Value based on monthly production and average gold price of that month as supplied by GoldCorp.
- (g) Estimated f.o.t value.
- (h) Estimated f.o.r value.
- (i) Estimated f.o.b value based on the current price of nickel containing products.
- (j) Delivered value.
- (k) Metallic by-product of copper mining.
- (r) Revised from previous edition.

### UNITS AND CONVERSION FACTORS

	Metric Unit	Symbol	Imperial Unit
<b>Mass</b>	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]
<b>Volume</b>	1 kilolitre	(kl)	= 6.28981 barrels (bbls)
	1 cubic metre	(m <sup>3</sup> )	= 35.3147 cubic feet (ft <sup>3</sup> ) [1 kilolitre (kl) = 1 cubic metre (m <sup>3</sup> )]
<b>Energy</b>	1 kilojoule	(kj)	= 0.94781 British Thermal Units (Btu)

#### Energy Content

Coal	19.7 GJ/t
Condensate	32.0 MJ/L
Crude oil	37.0 MJ/L
LNG	25.0 MJ/L
Natural gas	38.2 MJ/m <sup>3</sup>

#### Prefix

kilo (k)	10 <sup>3</sup>
mega (M)	10 <sup>6</sup>
giga (G)	10 <sup>9</sup>
tera (T)	10 <sup>12</sup>
peta (P)	10 <sup>15</sup>



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