



# Minerals and Petroleum in Australia.

West Angelas iron ore open cut mine, Western Australia (Rio Tinto)

## 01 MINERALS AND PETROLEUM AND THE AUSTRALIAN ECONOMY A GUIDE FOR INVESTORS

The resources sector (petroleum and minerals industries) in Australia makes a significant economic and social contribution to the Australian economy.

Australia's vast natural resources, social stability, human and intellectual capital and economic strengths have created a strong global market position which has proven highly attractive to international resource investment. Australia's resource industries are based on world-class expertise and technology in exploration, development, production, processing and environmental management.

The industry is entrepreneurial, innovative and highly successful. Large international companies continue to operate successfully in Australia alongside small and medium sized Australian companies. These companies continue to be active in both exploration and mining both individually or in partnership with each other.

The industries clearly recognise the need to operate in a way to address the three pillars of sustainable development (economic, social and environment).

### Overview of mineral and petroleum industries in Australia, 2008–09

#### Contributes 8% of Australia's GDP

This figure would increase significantly if downstream mining related activities in industries such as manufacturing, construction, transport and storage, property and business services and electricity and gas were included.

#### Exports of A\$161.2 billion 2008–09

(Forecast to fall to \$123 billion in 2009–10).

- › 86% of commodity exports (at current prices)
- › 69% of merchandise exports (at current prices)
- › 56% of total exports of goods and services (at current prices)

#### Direct Employment – 157,000 (August 2009)

In minerals and petroleum exploration and extraction – 1.6% of national employment.

In manufacturing 211,200 jobs, 3.7% of total employment, in the areas of metal products, non-metallic mineral products and petroleum, coal and chemical products, are based on Australia's minerals and energy inputs.

#### Capital Expenditure Mining \$35.7 billion in 2008–09

(an increase of 30.3% from \$27.14 billion in 2007–08).

- › **Metal Products** \$4.5 billion
- › **Non-Metallic Minerals** \$0.9 billion
- › **Petroleum, Coal & Chemicals** \$2.3 billion

In April 2009 there were 74 advanced projects with the estimated capital cost of \$80 billion.

- › **Energy projects 42 projects** \$43.4 billion
- › **Mining projects 25** \$29.4 billion
- › **Minerals processing 7** \$7.2 billion
- › **247 less advanced projects** \$277.3 billion

#### Exploration Expenditure

\$6.0 billion in 2008–09 (an increase of 9.8% from \$5.5 billion in 2007–08)

- › **Petroleum** \$3,811 million
- › **Iron ore** \$589 million
- › **Coal** \$297 million
- › **Base Metals** \$519 million
- › **Gold** \$438 million

#### Volume of Production

119.3 in 2008–09 (reference year of 1997–98 = 100).

Source: ABARE; Employment statistics – ABS, The Labour Force, Australia, cat. no. 6291.0 Canberra; – Capital Expenditure statistics – ABS cat no. 5625.0 Canberra.

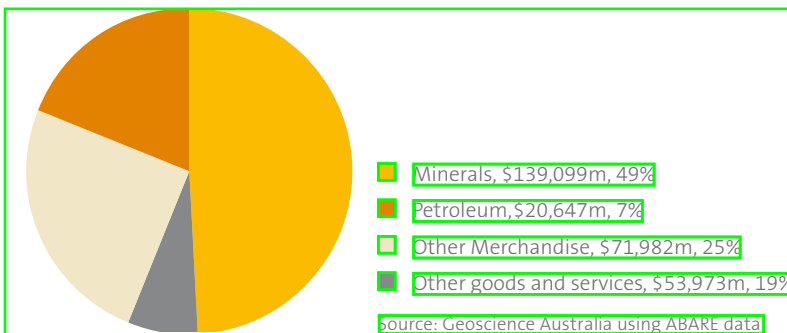
#### Minerals and Petroleum in Australia and Minerals and Petroleum exports.

The resources sector is the nation's largest single export sector. Over 80% of its output is exported, accounting for around 56% of Australia's total goods and services exports. See Figure 1.

In 2008–09, the minerals and petroleum industries produced 8% of Australia's GDP and earned 69% of Australia's merchandise exports income. Australia is the world's largest exporter of coal, accounting for 30% of world trade, and a major exporter of gold, iron ore, rutile, zinc, lead and uranium. Australia is also a large exporter of aluminium and the fifth largest exporter of liquefied natural gas (LNG).

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**Figure 1: Contribution to Australian Exports of goods and services by Sector 2008-09**  
(Balance of Payments Basis)



Overall combined earnings from Australia's minerals and energy exports rose by 37% in 2008–09 to \$161.2 billion. Export earnings of energy commodities are forecast to fall by 36% to \$50 billion in 2009–10. The value of LNG export earnings is forecast to fall by 29%, to \$7.2 billion while crude oil export value is expected to remain unchanged at \$1.0 billion. Reduced prices for thermal coal are likely to cause a reduction in export income of 37.9% to \$11.1 billion.

## Exploration Expenditure

The ability of Australia's minerals and energy sector to sustain its growth and expand its contribution to national economic performance in the medium and longer terms depends critically on the amount of investment in minerals exploration. Most of the strong growth in the minerals and energy sector of recent years is underpinned by past minerals exploration expenditure.

In 2008–09, total Australian minerals and petroleum exploration expenditure rose by 9.8% to \$6.0 billion following a 41% rise in 2004–05. The overall growth in 2008–09 was the result of strong growth in Petroleum exploration spending which increased by 25% to \$3.8 billion. In contrast mineral exploration expenditure fell by 9.6% to \$2.2 billion as demand and prices for mineral commodities fell as a result of the global financial crisis. Iron ore exploration spending went against the trend and achieved a record expenditure of \$589 million in 2008–09.

Over the medium term, exploration expenditure in each of the main exploration

sectors is expected to be influenced by different factors. In the petroleum sector, Australia's prospectivity for crude oil and gas together with the long term outlook for global demand and prices for both oil and gas will be influential in determining future levels of exploration activity and expenditure. For gold, the prime determining factor will be the international gold price and factors affecting returns to the Australian producer such as the US dollar/Australian dollar exchange rate.

More information on exploration including prospectivity and resources is contained in Leaflets 2 (Minerals) and 3 (Petroleum).

## New and Committed Projects

The strength of the resources sector is evident by the level of investment in minerals and energy projects. In the six months to end April 2009, 18 major minerals and energy projects were completed at a combined capital expenditure of \$5.2 billion. While the project completion rate in the six months to the end April 2009 was lower than the record established in the six month period ended April 2008 (29 projects with a total capital cost of \$7.8 billion), it was still high in historical terms. The average value of projects completed in the six month period to April 2009 (\$291 million) was a little higher than the long term average value of \$238 million.

The number of projects currently committed in Australia remains high (see Figure 2) but is below record levels. At the end of April 2009, there were 74 projects at advanced stages

of development with estimated capital expenditures totalling \$80 billion:

- › 42 were energy projects totalling \$43.4 billion with 12 large petroleum projects accounting for \$31.1 billion of the total planned expenditure. The largest is Woodside's Pluto LNG project with a capital cost of \$12 billion. The North West Shelf joint venture (Woodside, BHP Billiton, Shell, Chevron, BP, Japan Australia LNG) approved US\$1.5 billion to allow continued production from some existing fields. In addition the joint venture is also undertaking the US\$5.1 billion North Rankin B project. Coal mine and infrastructure projects account for \$10.4 billion of the total.
- › 25 were minerals mining projects totalling \$29.4 billion with 10 iron ore projects accounting for \$20.4 billion of this total. The largest is BHP Billiton's Rapid Growth 5 iron ore project valued at US\$5.7 billion. Other iron ore projects include CITIC Pacific Mining's Sino iron project (US\$3.5 billion) and Rio Tinto's Brockman 4 project (US\$1.5 billion). Newcrest's expansion of the Ridgeway Deeps gold-copper mine in New South Wales has a capital cost of \$545 million.
- › 7 minerals processing projects totalling \$7.2 billion. The two largest projects accounting for 80% of the anticipated capital expenditure are: Worsley Alumina Refinery Efficiency and Growth project (WA) and joint venture between BHP Billiton, Japan Alumina and Sojitz Alumina and Rio Tinto's Yarwun alumina refinery expansion (Qld) with a capital cost expected to be US\$1.8 billion including Alcan's Gove, NT, alumina refinery expansion.

These will add significantly to the sector's production and export capacity in the short to medium term. Further, there are a significant number of large projects at the less advanced planning stage that are under active consideration. Their ultimate development is, of course, subject to a range of economic and commercial factors.

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Figure 2: Advanced projects, October 2009 – number and estimated capital cost, by state

	Energy projects		Mineral projects		Minerals processing		Total	
	Number	Cost (\$m)	Number	Cost (\$m)	Number	Cost (\$m)	Number	Cost (\$m)
New South Wales	10	4325	3	975	0	0	13	5300
Victoria	5	3456	0	0	0	0	5	3456
Queensland	13	5208	3	1180	3	2912	19	9300
Western Australia	8	67194	21	23029	2	2751	31	92974
South Australia	1	118	3	429	0	0	4	547
Tasmania	0	0	0	0	0	0	0	0
Northern Territory	1	843	1	41	0	0	2	884
Australia	38	81144	31	25654	5	5663	74	112461

## Current Projects

### Key Petroleum Regions/Areas of Exploration and Development in Australia

The major areas of petroleum activity are in offshore Australia (contributing around 90% of production). The primary offshore regions are in Bass Strait of Victoria, the Carnarvon Basin of Western Australia and the Bonaparte Basin (Timor Sea) of Northern Australia, while the Cooper Basin in Central Australia is the primary onshore project area. Major gas projects are planned for the Browse Basin, off the coast of north-western Australia.

As of April 2009, energy project developments accounted for 42 of the 74 advanced projects on ABARE's major development projects list and around 54% (or \$43.4 billion) of committed capital expenditure. Estimated capital expenditure on energy projects has increased by around 13% since October 2008 and 12% since April 2008.

A map identifying the "Major Australian Petroleum Resources and Pipelines" is enclosed.

### Bass Strait (Gippsland, Otway and Bass Basins)

Over the past 30 years more than 3.5 billion barrels of oil as well as sizeable quantities of natural gas, LPG and ethane have been produced from this region and development and exploration are continuing.

- › The Casino gas field, about 30 kilometres from Port Campbell, began production in March 2006. Initial rates of production were approximately 96 terajoules a day of gas and around 96 barrels a day of condensate. Estimated recoverable reserves are 290 billion cubic feet of dry natural gas.
- › The Basker Manta Gummy oil field in the Gippsland basin commenced production in mid-November 2005, with production of crude oil at around 15,000 barrels a day. Production was ramped up to around 20,000 barrels a day by late 2006 with current production of about 5,000 barrels per day.
- › The BassGas project in the Bass basin began operation in July 2006. It is currently producing around 20 PJ a year of natural gas, 80,000 tonnes a year of LPG, and 3,300 barrels a day of condensate.
- › The Thylacine gas field in the Otway basin began producing in late 2007, at a total of 60 PJ a year of natural gas, 950,000 barrels a year of condensate and 125,000 tonnes a year of LPG. Expansion of the gas plant is being planned.
- › The US\$1.25 billion Turrum natural gas and condensate field in Bass Strait is due for completion in 2011. The Turrum redevelopment included construction of a production platform (Marlin B) that will be tied to West Tuna and in turn linked to Snapper.
- › The Kipper field is located approximately 45 km from shore in about 100 m water, and has a confirmed resource of approximately 620 Bcf recoverable gas and 30 MMbbl condensate/oil. Estimated field life is 15 years and first production is expected in 2011.
- › The Minerva Gasfield contains estimated Proven and Probable gas reserves of 301 billion cubic feet of gas and 1.24 million barrels of liquid condensate. The gas plant has a gross design production rate of 150 terajoules of sales gas and up to 500 barrels of stabilised condensate per day.
- › The Longtom gas field project in the Gippsland has proved and probable reserves of about 350 petajoules of gas and 4 million barrels of condensate. Longtom gas field came on stream in October 2010. The \$300 m Longtom gas project will link into the existing Patricia Baleen plant
- › To allow connection of potential near-field exploration success, the \$275 million Henry Gas project has been expanded to incorporate drilling and connection of the Netherby field.

<sup>1</sup> Source: courtesy of Department of Primary Industries, Victoria

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## North West Shelf (NWS) (Carnarvon Basin)

The North West Shelf Venture (NWSV) is Australia's largest natural resource development. It is located about 130 km north of Karratha in northwestern Australia. It produces LNG for export and gas for Western Australia's domestic market, and condensate and oil for export from its vast offshore fields. Gas and condensate are produced from the North Rankin, Goodwyn, Perseus–Athena, Angel and Echo–Yodel fields via the Goodwyn and North Rankin production platforms.

- › The North West Shelf Joint Venture is also undertaking the US\$5.1 billion North West Shelf North Rankin B project in Western Australia, which is due for completion in 2012. The \$2.6 billion North West Shelf project extension, adding a fifth (4.2 million tonne) LNG train on the North West Shelf, Western Australia was completed in 2008. Other significant petroleum projects include the US\$1.7 billion joint venture Pyrenees oil field, 55 kilometres north of Exmouth in Western Australia which came on stream in early 2010.
- › Proposed oil and gas development projects for the North West Shelf include the Gorgon LNG Project consisting of a 15 Mt/a (three train) development on Barrow Island, the Macedon gasfield, the Wheatstone LNG development based on the Wheatstone and Iago gasfields, and the Devil Creek Development Project producing gas from the Reindeer gasfield. In addition, crude oil is produced from Wanaea-Cossack, Lambert and Hermes fields via a floating production, storage and offloading (FPSO) vessel.
- › Other major fields currently producing crude oil from the Carnarvon Basin include Griffin, Wandoo, Barrow Island, Stag, Harriet, Legendre, Echo-Yodel and Enfield.
- › The Enfield oil project, around 50km north of Exmouth, began operations in July 2006.

- › The Stybarrow oil field, located around 55km north-west of Exmouth, started production in 2008. Stybarrow produced about 59,200 bopd in the fourth quarter of 2008.
- › The Vincent field north of Exmouth, Western Australia began production on 28 August 2008. At year-end the field was producing around 35,000 bbl/d.
- › The Angel Project began production on 2 October 2008. Gas and condensate are exported through a 50 km subsea pipeline to the NWS second trunkline.
- › The Gorgon project will access gas reserves in the Greater Gorgon region, which exceed 40 trillion cubic feet and represent 25% of Australia's total conventional gas reserves. Initial production from Gorgon is not expected until after 2015.
- › The Pluto project is developing the Pluto gasfield and constructing the new Burrup LNG Park. The field is estimated to contain 116 Gm<sup>3</sup> (4.1 Tcf) of dry gas. A smaller field, Xena, has also been discovered in this permit with an estimated 11.3 Gm<sup>3</sup> (0.4 Tcf) of dry gas. The Burrup LNG Park will include a gas processing plant, storage facilities and an export jetty. The initial LNG plant will have production capacity of five to six million tonnes a year.
- › Also completed were the Kwinana LNG plant in Western Australia, the Perseus-over-Goodwyn project and the Woolybutt Oil Field South Lobe expansion off the coast of Western Australia.

## Timor Sea (Bonaparte Basin) in Northern Australia

- › The Bonaparte Basin is the most northerly sedimentary basin in Western Australia, straddling the border between the Northern Territory and Western Australia. Generally divided into the Northern and Southern Bonaparte basins, roughly 250,000 km<sup>2</sup> of the basin is offshore, compared to just over 20,000 km<sup>2</sup> onshore (Figure 11). To date, offshore production development has relied on standalone systems, such as those at the Challis–Cassini, Jabiru, Laminaria, Corallina, and Elang–Kakatua oilfields in the Northern Territory and Commonwealth-administered portions of the basin. In

Western Australian administered waters, an economic market is being sought for the Tern and Petrel gasfields, which are currently being appraised for future development.

- › In the Bonaparte Basin, crude oil and condensate is currently produced from fields including Jabiru, Challis/Cassini, Laminaria/Corallina, Elang/Kakatua and Buffalo.
- › Production of natural gas from the Blacktip gas field, which is located approximately 110 km off the shore of Northern Australia in the Bonaparte Basin, has commenced production. Blacktip gas will be mainly used to generate electricity in Darwin and other Northern Territory locations.
- › Development of the Sunrise gas project is currently on hold.

## Timor Sea Joint Petroleum Development Area (JPDA)

- › The area covers around 41,500 square kilometres between Australia and East Timor. Exploration and development in the area is currently governed by the Timor Sea Treaty implemented in Australian legislation in the Petroleum (Timor Sea Treaty) Act 2003. The major project in the region, Bayu-Undan, involves the extraction of gas (approximately 3.4 Tcf), the stripping of associated liquids approximately 400 Mbbls of condensate and LPG) and re-injection of dry gas. First liquids production from this project commenced in February 2004 and the first LNG exports to Japan from the Darwin LNG plant commenced in February 2006. The Darwin LNG project produces around 3.24 million tonnes of LNG per annum.

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## Browse Basin Development

The Browse basin has two major projects in development: the Browse LNG project operated by Woodside Energy Ltd; and the Ichthys LNG project operated by Inpex Corporation.

- › In 2007, 2008 and 2009, several new discoveries were made, including the Toccata, Fortissimo, Ichthys North, Ichthys West, Mimia, Cornea, Burnside and Poseidon wells.
- › The Browse LNG project is based on the Torosa, Brecknock and Calliance gas fields, located about 250 kilometres from the West Australian coastline in the Browse Basin. Development options for a 15 mtpa LNG plant are still under consideration.
- › The Ichthys Field measures approximately 40 kilometres by 20 kilometres and is one of Australia's largest undeveloped gas fields, with reserve estimates of 12.8 trillion cubic feet of gas and 527 million barrels of condensate and an expected operational life of over 40 years. The joint venture selected Middle Arm Peninsula at Blaydin Point in Darwin Harbour in the Northern Territory, to develop a liquefied natural gas processing facility. The contract for the Front End Engineering and Design (FEED) of its Offshore Facilities for the development of the Ichthys Field was awarded in 2009.
- › The Cliff Head oil field, which was discovered in 2001, is the first commercial oil development in the offshore Perth Basin. Production began at Cliff Head in May 2006, approximately 14 months after project sanction. In 2008 the Cliff Head oil project averaged 8,236 bopd for the year.

## Australia's Key Mining Regions (by State)

Australia has an abundant supply of natural resources and is a major producer of a range of mineral and energy commodities including bauxite, coal (black and brown), copper, diamond, gold, iron ore, lead, lithium, manganese, nickel, silver, tantalum, titanium minerals, uranium, zinc and zircon.

There are roughly three hundred mines across the country, of which almost half are in Western Australia.

### Western Australia

Western Australia (WA) produces a range of mineral commodities. WA produces some 65% of Australia's gold, almost all its nickel, diamond, tantalum and lithium, and major proportions of Australia's iron ore, bauxite and mineral sands (ilmenite, rutile, leucosene and zircon).

### In summary the main regions of minerals and energy commodities in WA are:

- › The Eastern Goldfields region, including Kalgoorlie, contains major gold and nickel mines;
- › The Hamersley Basin, in the Pilbara region hosts major iron ore deposits containing high-grade prime ores, and manganese is also mined in the Pilbara;
- › In the southwest, there are world class bauxite and mineral sand resources and coal is mined at Collie, mainly for local electricity generation;
- › Also in the southwest is the world's largest hard-rock tantalum resource at Greenbushes; and
- › The Argyle diamond mine is in the Kimberley region, in the far north of the State.

### The Northern Territory (NT) has:

- › Major uranium deposits, including the Ranger mine in the Alligator Rivers Region;
- › The Tanami region gold province (in the west of NT and extending into WA);
- › The McArthur River zinc-lead mine in the far north east is part of the world class zinc-lead province which extends into QLD;
- › The Gove bauxite mine on the western coast of the Gulf of Carpentaria; and
- › The Groote Eylandt manganese mine in the Gulf of Carpentaria and the Bootu Creek manganese mine in the central NT.

### South Australia (SA) has seen exploration and mining expand rapidly and now hosts:

- › The huge Olympic Dam copper-gold-uranium mine near the centre of the state;
- › The Prominent Hill copper-gold mine to the northwest of Olympic Dam;
- › The Challenger gold mine in central SA;
- › Opal fields in the north of the State;
- › Iron ore is mined in the Middleback Ranges, west of Whyalla, and active exploration and potential development is occurring further north;
- › Coal is mined at Leigh Creek; and
- › the discovery of major mineral sands resources in the Eucla Basin in the west and southwest of the State are part of a major new mineral sands province and mining will start soon.

### Queensland (Qld) has:

- › the world's leading lead-zinc-silver district, extending in a north-westerly direction from Mount Isa and Cannington, through Century to the McArthur River mine in the NT;
- › the Weipa bauxite operations on the western side of Cape York;
- › major coal deposits (thermal and metallurgical coal) in the Bowen, Surat and Clarence-Moreton Basins which also are a focus for an emerging coal seam gas industry;



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- › a major gold province around Charters Towers where production is continuing despite over 100 years of production;
- › mineral sands occurring at a number of locations along the coast, but only the North Stradbroke Island is being mined;
- › a major molybdenum-rhenium deposit near Cloncurry in the State's northwest; and
- › Oil shale deposits occur on the Central Coast.

## **New South Wales (NSW) has:**

- › the huge Broken Hill lead-zinc-silver mine, is still in production even after over 120 years of mining;
- › major coal deposits (thermal and metallurgical coal) in the Hunter, Illawarra, Lithgow and Gunnedah regions with an emerging coal seam gas industry;
- › a major gold mine at Cowal;
- › gold-copper and copper mines in the central west of the State at Northparkes, Cadia and Ridgeway;
- › base metal and gold mines in the Cobar region; and
- › heavy mineral sands in the Murray Basin in the southwest of the State.

## **Victoria (Vic) has:**

- › gold mines in the west and centre of the State, which was one of the major gold producing regions of the world in the 19th century and where there is potential for further discoveries;
- › extensive brown coal (lignite) deposits in the Latrobe Valley which are used in adjacent power stations; and
- › heavy mineral sands in the Murray Basin in the State's northwest.

## **Tasmania (Tas) has a long history of mining:**

- › Mount Lyell, Que River and Hellyer saw major base metal production
- › Rosebery is still a significant base metal producer and copper is still produced at Mt Lyell;
- › nickel deposit at Avebury on the State's west coast;
- › gold is produced at the Henty mine and tin at Renison Bell; and
- › Coal is mined for domestic consumption on the east coast.

