Australian Government
Geoscience Australia

Australia's Identified Mineral Resources 2015

In 2014, Australia's mineral exports (excluding petroleum products) amounted to approximately $157 billion which was almost 59% of all export merchandise, 48% of all exported goods and services and approximately 10% of gross domestic product. Given the importance of mineral resources to the Australian economy, Geoscience Australia publishes mineral resource estimates for all major, and some minor, commodities (Table 1). This assessment provides useful long-term indicators of resource life, future supply capability and a broad outlook for policy makers and planners that will assist with government policy decisions and programs associated with the minerals sector and the sustainable development of resources.

Australia's Identified Mineral Resources is an annual national assessment that takes a long-term view of mineral resources likely to be available for mining. The highest category in the national inventory is Economic Demonstrated Resources (EDR) which, in essence, combines the Joint Ore Reserve Committee (JORC) Code categories of Proven and Probable Ore Reserves and most of Measured and Indicated Mineral Resources. For comparison, the JORC Code Ore Reserves are shown individually in Table 1 as they provide a short- to medium-term view of mineral stocks. The assessment also includes evaluations of long-term trends in mineral resources, world rankings and a snapshot of resource to production ratios.

Geoscience Australia and its predecessors have prepared annual assessments of Australia's mineral resources since 1975. Australia's Identified Mineral Resources 2015 presents estimates of Australia's mineral resources as at 31 December 2014. This national minerals inventory is based on published company reports of Ore Reserves and Mineral Resources. Mine production data are based on figures from the Office of the Chief Economist at the Department of Industry, Innovation and Science. World rankings of Australia's mineral resources have been calculated mainly using information published by the United States Geological Survey (USGS).

National Resource Classification System

The mineral resource classification system used for Australia's national inventory is based on two general criteria:

- the geological certainty of the existence of the mineral resource, and
- the economic feasibility of its extraction over the long term.

The National Resource Classification System uses reports on mineral resources published by companies using the JORC Code and, to a lesser extent, confidential information, to compile national total resources for the classification categories set out in Table 1. EDR is the category used for the national totals of economic resources and provides a basis for meaningful comparisons of Australia's economic resources with those of other nations. Long-term trends in EDR for bauxite, black coal (recoverable), iron ore, gold, copper, lead, zinc, nickel, mineral sands and uranium (recoverable) are presented in Figure 1 and the reasons for significant changes in resource trends are noted.

Accessible Resources

Some mineral deposits are not currently accessible for mining because of government policies or various environmental and land access restrictions, such as location within national and state parks and conservation zones, military training areas or environmental protection areas, as well as areas over which mining approval has not been granted by traditional owners. Accessible Economic Demonstrated Resources (AEDR), as shown in Table 1, represent the resources within the EDR category that are accessible for mining.

Table 1 Australia's resources of major minerals and world figures as at December 2014.

Commodity	Unit	Australia							World	
		JORC Reserves (a) (% of Accessible EDR)	Demonstrated Resources			Inferred Resources (c)	Accessible EDR (d)	Mine Production 2014 (e)	Economic Resources 2014 (f)	Mine Production 2014 (g)
			Economic (EDR) (b)	Subeconomic						
				Para-marginal	Sub-marginal					
Antimony	kt Sb	62.6 (45%)	138.8	8.8	0	62.8	138.8	5.8	1800	160
Bauxite	Mt	2087 (34%)	6195	144	1429	2065	6195	78.6	28 000	234
Black Coal										
In situ	Mt		79 345	1395	4278	93 812				
Recoverable	Mt	19 816 (36%)	62 623	1260	3849	67 905	55 741	565*	690 530*	7212*
Brown Coal										
In situ	Mt		49 075	37 465	16 873	123 813				
Recoverable	Mt	n.a.	44 164	33 402	15 186	103 017	34 095	60.7*	201 000*	810.5*
Copper	Mt Cu	25.94 (29%)	88.48	1.28	0.43	50.77	88.48	0.97	700	18.7
Diamond	Mc	99.15 (45%)	219.51	0	0	35.99	219.51	9.288	730	138.1
Gold	t Au	3550 (39%)	9112	244	95	4562	9082	274	55 000	3114*
Iron										
Iron ore	Mt	20 487 (38%)	54 412	1569	1727	82 167	54 412	735	190 000	3220
Contained iron	Mt Fe	9665 (39%)	24 639	799	570	36 173	24 639	424	87 000	
Lead	Mt Pb	12.82 (37%)	34.72	3.35	0.14	20.21	34.72	0.73	87	5.46
Lithium	kt Li	854 (56%)	1533	0	0	179	1533	n.a.*	13 533	36*
Manganese Ore	Mt	121 (53%)	226.9	23.1	167	311.9	226.9	7.67	1520	51
Mineral Sands										
Ilmenite	Mt	41.3 (25%)	256.9	26.2	0.03	255.1	139.3	1.000	1279.85	12.17
Rutile	Mt	8.0 (31%)	32.1	0.3	0.06	40.7	22.4	0.212	57.41	0.77
Zircon	Mt	15.3 (36%)	71.5	1.1	0.07	70.3	38.3	0.798	115.14	1.54
Molybdenum	kt Mo	3.7 (2%)	190	1220	0.5	609	190	0	10 830	266
Nickel	Mt Ni	7.0 (37%)	19.0	4.0	0.1	20.0	19.0	0.246	81	2.46
Niobium	kt Nb	115 (56%)	205	82	0	418	205	n.a.*	4300	59.4
Oil Shale	GL	0	0	213	2074	1272	0	0	760 934*	n.a.
Phosphate										
Phosphate rock*	Mt	289 (27%)	1072	312	0	2459	1072	*	67 000	220
Contained P_2O_5	Mt P_2O_5	51 (28%)	183	53	0	399	183			
Potash	Mt K_2O	0	7.105	13.204	0	35.2	7.105	0	3500	35
Silver	kt Ag	28.05 (33%)	85.21	2.98	0.49	38.87	85.21	1.847	530	26.1
Tantalum	kt Ta	29 (43%)	67	11	0.2	31	67	n.a.*	>100	0.786
Tin	kt Sn	215 (52%)	413	65	31	316	413	6.9	4843	297
Tungsten	kt W	225.6 (57%)	392	0.8	5	231	392	0.48*	3486	82.3
Uranium	kt U	371 (34%)	1151	9	14	704	1082	4.976	3699*	65.3*
Vanadium	kt V	1208 (63%)	1910	14 640	1687	16 412	1910	0	15 000	78
Zinc	Mt Zn	25.31 (40%)	62.57	0.97	0.75	28.44	62.57	1.56	230	13.3
Figures as at December 2013										
Cobalt	kt Co	385 (36%)	1068	285	29	1228	1068	6.40*	7271	110
Chromium	kt Cr	0	0	302.2	0	3780	0	94.2*	>480 000	28 800
Fluorine	kt F	0	304	504	6.2	2285	304	0	117 000*	>3285*
Magnesite	Mt $MgCO_3$	37.5 (12%)	318	22	35	850	318	*	8300	>23.96*
PGE (Pt, Pd, Os, Ir, Ru, Rh)	t metal	0	3.5	139.0	1.4	202.8	0.8	0.786	66 000	386
Rare Earths (REO & Y_2O_3)	Mt	2.15 (67%)	3.19	0.58	31.10	23.24	3.19	n.a.	143.0	0.117
Thorium	kt Th	0	0	101	0	585	0	0	n.a	n.a

Abbreviations

t = tonne; **kt** = kilotonnes (1000 t); **Mt** = million tonnes (1 000 000 t); **Mc** = million carats (1 000 000 c); **GL** = gigalitre (1 000 000 000 L); **n.a.** = not available.

Notes

a. Joint Ore Reserves Committee (JORC) Proved and Probable Ore Reserves as stated in company annual reports and reports to the Australian Securities Exchange.

b. Economic Demonstrated Resources (EDR) includes JORC Reserves, Measured and Indicated Resources.

c. Total Inferred Resources in economic, subeconomic and undifferentiated categories.

d. Accessible Economic Demonstrated Resources (AEDR) is the portion of total EDR that is accessible for mining. AEDR does not include resources that are inaccessible for mining because of environmental restrictions, government policies or military lands.

e. Source: Office of the Chief Economist, Department of Industry, Innovation and Science unless otherwise stated.

f. Source: Geoscience Australia and the United States Geological Survey (USGS).

g. Source: USGS unless otherwise stated.

The JORC Code is specified in The Australasian Code for Reporting of Exploration Results, Mineral Resources and Ore Reserves (*www.jorc.org*).

For a full description of the National Resource Classification System see Appendix 1 in Australia's Identified Mineral Resources 2013 (*http://www.ga.gov.au/corporate_data/78988/78988_AIMR_2013.pdf*).

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Black Coal: Mine production refers to raw coal. World economic resources dated 2011, sourced from World Energy Council (Survey of Energy Resources 2013). World mine production sourced from International Energy Agency 2015.

Brown Coal: Australian mine production 2014 and world mine production sourced from International Energy Agency 2015. World economic resources dated 2011, sourced from World Energy Council (Survey of Energy Resources 2013).

Cobalt: Mine production 2013 sourced from the Western Australian Department of Mines and Petroleum.

Chromium: Mine production 2013 sourced from the Western Australian Department of Mines and Petroleum as 137 646 t of chromite expressed as Cr_2O_3.

Diamond: World resource figures are for industrial diamonds only, no data provided for resources of gem diamonds.

Fluorine: World economic resources 2013 and mine production 2013 exclude the USA.

Gold: World mine production 2014 sourced from the World Gold Council.

Lithium: Australian mine production is not publically reported by mining companies. However, the Western Australian Department of Mines and Petroleum reported combined tin, tantalum and lithium production of $167 211 172 in 2014. World mine production excludes the USA.

Magnesite: Mine production for 2012–13 was 503 735 t (Queensland Department of Natural Resources and Mines). World mine production 2013 excludes the USA.

Niobium: Mine production not publically reported by mining companies.

Oil Shale: World resources estimate from World Energy Council (World Energy Resources Survey 2013).

Phosphate: Phosphate rock is reported as being economic at grades ranging from 8.7% to 30.2% P_2O_5. Christmas Island produced 539 591 t in 2014. The Queensland Department of Natural Resources and Mines reported that Phosphate Hill produced 1 948 626 t in 2013–14. Minor production (1709 t) was recorded in South Australia.

Tantalum: Australian mine production is not publically reported by mining companies. However, the Western Australian Department of Mines and Petroleum reported combined tin, tantalum and lithium production to the value of $167 211 172 in 2014.

Tungsten: Mine production 2014 estimated at approximately 477 t based on figures released for the Kara operation (Tasmania) and by the Queensland Department of Natural Resources and Mines for 2013–14.

Uranium: World economic resources 2014 sourced from the International Atomic Energy Agency estimate for Reasonably Assured Resources recoverable at costs of less than US$130/kg U.

Commodity Overview

Australia's EDR for the following ten mineral commodities increased during 2014 – antimony, black coal, iron ore, ilmenite, phosphate, potash, tin, vanadium, zinc and zircon. EDR for brown coal, nickel, niobium, rutile, oil shale, silver and tantalum remained at levels similar to those reported in 2013. During the same period, the EDR of 10 commodities decreased: bauxite, copper, diamond, gold, lead, lithium, manganese ore, molybdenum, tungsten and uranium.

Australia's EDR of diamond, gold, iron ore, lead, nickel, rutile, tantalum, uranium, zinc and zircon are the world's largest, while antimony, bauxite, black coal, brown coal, copper, ilmenite, lithium, manganese ore, niobium, silver, tin, tungsten and vanadium all rank in the top four worldwide.

Bauxite: Australia's EDR of bauxite were estimated to be 6195 Mt in 2014, slightly down from 6464 Mt in 2013 and 6281 Mt in 2012. Australia ranks second in the world behind the Republic of Guinea and ahead of Brazil, Vietnam, Jamaica and Indonesia. Australia was the world's leading producer of bauxite in 2014, the second largest producer of alumina and the seventh largest producer of aluminium. Australia's aluminium industry is underpinned by vast resources of bauxite at Cape York in Queensland (3345 Mt, 54% of national EDR), Gove in the Northern Territory (194 Mt, 3%) and a large number of deposits in the Darling Range southeast of Perth in Western Australia (2616 Mt, 42%).

Australia's aluminium industry continues to be a highly integrated sector of mining, refining, smelting and semi-fabrication and is of major economic importance nationally and globally. In recent years, however, processing costs have made some operations unviable, leading to the closure in 2012 of the Kurri Kurri aluminium smelter in New South Wales and in 2014, the Gove alumina refinery in the Northern Territory and the Point Henry aluminium smelter in Victoria. Conversely, there has been a move by industry to Direct Shipping Ore and bauxite mines aimed at supplying alumina refineries in China are in development in Tasmania, the Darling Range and Cape York.

Black Coal: In 2014, the estimate of Australia's recoverable EDR of black coal was revised upwards to 62 623 Mt, an increase of less than 1% on the previous year. Globally, Australia is ranked fourth (behind the United States, Russia and China) in terms of recoverable economic coal resources and also fourth (behind China, the United States and India) as a coal producer.

Most of Australia's black coal EDR is located in Queensland (60%) and New South Wales (37%) with the Bowen Basin (Queensland) and the Sydney Basin (New South Wales) dominating black coal production in Australia. At 2014 rates of production, Australia's black coal Accessible EDR will support more than 100 years of production.

Significant black coal resources are found also in the Surat, Clarence-Moreton and Galilee basins in Queensland and in the Gunnedah Basin in New South Wales. Recent exploration has led to significant increases in black coal resource estimates associated with the Galilee Basin where several large, new, greenfield developments are proposed. During 2014, EDR increased at 49 black coal deposits and decreased at 57 deposits, according to published mining company reports. This resulted in a modest overall increase in recoverable EDR of 528 Mt. Of these changes in EDR, 11 increases and 8 decreases were of a size greater than 100 Mt, whilst 1 increase and 3 decreases were of a size greater than 400 Mt. In addition, there were 14 maiden black coal resources reported by companies for the 2014 calendar year.

Brown Coal: The 2014 estimate of Australia's recoverable brown coal EDR (44 164 Mt) remains unchanged from 2013. Approximately 19% of the world's recoverable brown coal resources are located in Australia, with the nation ranked second behind Germany in terms of brown coal (lignite) reserves. Nearly all of Australia's recoverable brown coal EDR is located in Victoria with approximately 93% in the Latrobe Valley. During 2014, brown coal production in Australia was estimated at 60.7 Mt, ranking Australia sixth in the world behind Germany, the United States, Russia, Poland and Turkey. Brown coal mined in Australia is used almost exclusively for domestic electricity generation and at current rates of extraction the accessible resource base will support approximately 562 years of production.

Copper: Australia's EDR of copper fell by 4.6 Mt in 2014 to 88.5 Mt. Australia has the second largest economic resources of copper at 13% after Chile's 28%. South Australia has 68% of the national total of EDR, mainly in the Olympic Dam deposit, followed by New South Wales with 15% and Queensland with 13%. In 2014, mine production fell by 3% and exports totalled 1086 kt with a value of $9180 million up from $8 262 million in 2013. Spending in copper exploration in 2014 fell by 27% to $163.7 million. The bulk of copper exploration took place in South Australia ($52.8 million) and Western Australia ($43.1 million).

Diamond: In 2014, Australia's total EDR of diamond resources was 219.5 Mc, down from 250.5 Mc in 2013. Total production fell over the same period from 11.5 Mc to 9.3 Mc owing to the transition from open-cut mining at Argyle to underground block cave mining. In 2014, Australia was the fifth largest producer of rough diamonds after Russia, Democratic Republic of Congo, Botswana and Canada. Of Australia's two producing diamond mines, the Argyle AK1 lamproite pipe in the East Kimberley region of Western Australia was responsible for the bulk of production. The Ellendale E9 Lamproite pipe in the West Kimberley was a small producer primarily producing rare yellow rough diamonds. The Ellendale mine closed in June 2015.

Diamond exploration in 2014 continued at the Merlin kimberlite pipe mines in the Northern Territory and at a new kimberlite field, which was discovered in late 2013, in the West Arunta region of Western Australia near the Northern Territory border. There are around 280 discrete magnetic anomalies in the region and micro diamonds have been discovered during soil sampling. To date, drilling has intersected 50 kimberlite bodies out of 64 tested.

Gold: National EDR of gold fell nearly 700 t or 7% in 2014 to 9112 t. Within Australia, reductions in EDR were most severe for Western Australia (-356 t) and South Australia (-288 t). Only two jurisdictions recorded rises: Victoria (+50 t) and the Northern Territory (+2 t). The loss of EDR in South Australia was largely due to a revised resource estimate for Olympic Dam which outweighed resource growth elsewhere in the state. USGS figures for world gold resources have not changed substantially in recent years and, even though Australian AEDR fell again in 2014, it continued to hold the largest resources by country with just less than 17% of the total, ahead of South Africa (6000 t) and Russia (5000 t).

Inferred Mineral Resources of gold in Australia were maintained during 2014 with a marginal rise of about 42 t, or 1%, to total 4562 t. The largest rise in this resource category was seen in South Australia (115 t) with lesser rises and falls across the other states and the Northern Territory. Over the past 20 years, total JORC Resources of gold have generally grown by between 200 t and 400 t per annum. Falls in total JORC resources of about 200 t in 2013 and 740 t in 2014 are the most significant over the period. Across the country, many operating gold companies raised cut-off grades in the face of the lower average gold prices experienced since March 2013 with consequential reductions to resource inventories.

Australian mine production of gold rose by 10 t or about 4% in 2014 to 274 t. World production, according to the Thompson Reuters/World Gold Council, rose 92 t or 3% to 3114 t for the year. By these figures, Australia accounts for about 9% of world production. Using USGS estimates of production by country, Australia's gold production continued to rank second in the world behind that of China (450 t). Imports of primary and secondary gold into Australia in 2014 totalled about 77 t or about 9 t less than in 2013. Total refined gold amounted to 304 t, down 2 t from 2013. While exports of gold increased about 6 t to 287 t, the value of that exported in 2014 decreased by about $770 million to $14.2 billion.

The price of gold in US dollars generally declined over 2014 commencing the year at US$1251/oz and concluding it at US$1206/oz. Monthly fluctuations saw the price reach a high of US$1326/oz in February 2014 and a low of US$1164/oz in October 2014. The average price over the year was about US$140/oz less than that in 2013. Due to the prevailing exchange rates, the price of gold in Australian dollars fluctuated between a high of $1508/oz (February 2014) and a low of $1325/oz (October 2014), finishing the year at $1470/oz. Overall the average price of gold in Australian dollars for 2014 was about $50/oz lower than in 2013.

Equity markets remained difficult throughout the year and resulted in reduced exploration expenditures across nearly all commodities. In 2014, exploration expenditure on gold fell again to $377 million. It declined by $188 million, or 25%, in 2013 and by $176 million, or 32%, in 2014. Industry activity in 2014 included the opening of the Hera and Tomingley mines in New South Wales; approvals for the Portia mine in South Australia and the expansion of the Northparkes mine in New South Wales; the opening of a hoist shaft at Ernest Henry in Queensland; suspension of mining at Mount Lyell in Tasmania and Tuckabianna in Western Australia; and significant resource announcements for Khamsin in South Australia and Gruyere in Western Australia.

Iron Ore: Because of major changes in Australia's iron ore mining industry and the development of large magnetite deposits in Australia, Geoscience Australia estimates national resources of iron in two categories: (1) iron ore and (2) contained iron.

Australia's EDR of iron ore increased by 3.5% to 54 412 Mt during 2014 with the EDR of contained iron estimated to be 24 639 Mt. Magnetite resources increased by 1% to 24 104 Mt in 2014, accounting for approximately 44% of iron ore EDR. Western Australia has the largest share of iron ore with 89% of Australia's EDR, the majority of which is in the Pilbara region. Australia has the world's largest EDR with 29% of the world's iron ore followed by Brazil with 16%. Western Australia produced 720 Mt, or 98%, of Australia's total production of iron ore in 2014. Iron ore-exploration expenditure in Australia during 2014 totalled $592.2 million, a 31% decrease on the $858.8 million spent in 2013. Exploration for iron ore in 2014 accounted for 32% of Australia's total mineral exploration expenditure.

Lithium: Australia's EDR of lithium was 1533 kt in 2014, slightly down from 1538 kt in 2013. Australia ranks third globally, behind Chile and China, with just over 11% of the world's economic resources. All of Australia's EDR of lithium occur within hard rock pegmatite deposits in Western Australia. The Greenbushes deposit, which is the world's largest and highest grade spodumene deposit, contains 86% of Australia's lithium EDR with other resources occurring at Mount Cattlin, Mount Marion and Pilgangoora. Industry activity in 2015 has seen the Pilgangoora and Mount Marion projects advancing with Pilgangoora now regarded as the world's second largest lithium deposit.

Manganese Ore: Australia's EDR of manganese decreased slightly by 1.7 Mt in 2014 to 226.9 Mt, ranking Australia's resources as the world's third largest. All EDR occur in the Northern Territory and Western Australia. Australia's mine production of manganese ore reached record levels of 7.7 Mt in 2014, ranked third behind China and South Africa.

Mineral Sands: The regions containing the major proportion of Australia's mineral sands resources (ilmenite, rutile and zircon) are the Perth Basin north of Perth (WA), the Murray Basin (NSW, Vic and SA) and the Eucla Basin (WA and SA), with major economic resources more recently identified in the Canning Basin (WA). Changes in commercial reserves and AEDR from 2013 to 2014 for zircon, rutile and ilmenite, reflect updates to accessibility and subsequent reclassification. A small decline in heavy mineral sands mine production was recorded for the period, despite maintained private exploration expenditure in the sector. Australia's EDR of rutile and zircon are the largest in the world, followed by China and South Africa, and Australia's EDR of ilmenite are the second largest in the world after China.

Molybdenum: Australia's EDR of molybdenum in 2014 was 190 kt, down 6% from 203 kt in 2013. Australia ranks seventh globally but has less than 2% of the world's economic resources. Decreases in EDR occurred at Molyhil in the Northern Territory and at Wolfram Creek and Mount Dore in Queensland. Mount Mulgine in Western Australia added to Australia's molybdenum EDR in 2014. The bulk of Australia's EDR of molybdenum occurs in Queensland (69%), followed by Victoria (26%) and the Northern Territory (3%). New South Wales and Western Australia also have molybdenum deposits but less than 1% of Australia's EDR. Western Australia does, however, contain Australia's largest molybdenum deposit at Spinifex Ridge, but the owners have indicated that it is uneconomic at this time.

Niobium: Australia's EDR of niobium remained stable at 205 kt in 2014, ranking Australia's resource as the second largest in the world behind Brazil. The bulk of the EDR is associated with the Toongi deposit, 20 km south of Dubbo in New South Wales.

Nickel: Australia's EDR of nickel are unchanged from 2013 and is estimated again at 19.0 Mt for 2014, which is still down from the peak EDR of 26.4 Mt recorded in 2008. Australia continues to contain the world's largest economic resources of nickel with 23%. Western Australia remains the largest holder of nickel resources with 95% of total Australian EDR, made up of both sulphide and lateritic deposits. Nickel production is projected to increase as developing mines in Western Australia, Tasmania and Queensland commence production, with the Bureau of Resources and Energy Economics (now the Office of the Chief Economist) forecasting an increase from 243 kt to 268 kt by 2019–20.

Oil Shale: Resources of oil shale predominantly occur in a series of sedimentary basins around Gladstone, Mackay and Proserpine in central Queensland. Australia currently has no EDR of oil shale, with all resources being assessed as subeconomic. Exploration activity in the sector has returned with the lifting of Queensland's moratorium on oil shale development. Queensland Energy Resources Ltd's Paraho II™ oil shale technology demonstration plant at the Stuart deposit, near Gladstone, produced its first crude oil in September 2011 and operated successfully for two years.

Phosphate: Geoscience Australia assesses both phosphate rock (phosphorite and guano) and contained P_2O_5 which, as well as being a component of phosphate rock, can be found in other rock types in which alternative minerals are the primary target. Australia's EDR of phosphate rock was 1072 Mt in 2014, slightly up from the 2013 figure of 1035 Mt owing to an increase in resources at the Ammaroo phosphate project in the Northern Territory. Contained P_2O_5 EDR concurrently increased by almost 4% to 183 Mt in 2014, up from 176 Mt in 2013. The phosphorites of the Georgina Basin (Queensland and the Northern Territory) account for almost all of Australia's EDR of phosphate rock and 91% of Australia's EDR of contained P_2O_5. The remaining phosphate rock occurs at Christmas Island. The rare earth deposits at Mount Weld (Western Australia) and Nolans Bore (Northern Territory) also have an EDR of contained P_2O_5. Australia has less than 2% of the world's economic resources of phosphate rock.

Potash: Potash is a generic term covering a variety of potassium-bearing ores, minerals and refined products. Until recently, Australia has not had an EDR of potash but positive results from the Karinga Lakes deposit in the Northern Territory and the Dandaragan project in Western Australia have resulted in an EDR of 7.1 Mt in 2014. Australia's potash resources are minor by world standards with Canada and Russia being the leading suppliers. Potash was not mined in Australia in 2014. Other Australian resources have been estimated for Lake Mackay on the Western Australia-Northern Territory border and within Western Australia at Lake Chandler, Lake Disappointment and Oxley, the latter being a new type of potash deposit hosted in ultrapotassic microsyenite lava flows. In 2015, Lake Disappointment was the subject of a positive scoping study.

Tantalum: Australia's EDR of tantalum was 67 kt in 2014, unchanged from the previous year. Australia ranks first in the world ahead of Brazil for tantalum resources. The bulk of tantalum EDR in 2014 was located in Western Australia, mainly at the Greenbushes (45%) and Wodgina (28%) deposits with comparatively small deposits at Tabba Tabba, Mount Deans, Mount Cattlin and Dalgaranga. The Toongi deposit in New South Wales contains 23% of Australia's tantalum EDR. In the Pilbara region of Western Australia, industry activity in 2015 has seen an Indicated and Inferred Resource announced for the Pilgangoora lithium-tantalum deposit and tantalite mining is expected to begin at the Tabba Tabba deposit.

Tin: Australia's EDR of tin increased by 13% to 413 kt in 2014, up from 366 kt in 2013. Australia's resources are the world's fourth largest. The majority of Australia's EDR of tin are contained in the Renison Bell (54%) and Cleveland (11%) deposits in Tasmania and the Taronga (11%) deposit in New South Wales. All of Australia's EDR of tin occur in Tasmania (79%), New South Wales (11%) and Queensland (10%), although some tin is produced as a by-product from Western Australian tantalum deposits.

Tungsten: Australia's EDR of tungsten was 392 kt in 2014, largely unchanged from 2013. Australia has 11% of the world's economic resources, ranking second behind China. Half of Australia's EDR is contained within the O'Callaghans multi-commodity deposit in Western Australia. Australia's EDR of tungsten occur in Western Australia (58%), Tasmania (26%), Queensland (13%), the Northern Territory (2%) and New South Wales (<1%).

Uranium: Australia's Reasonably Assured Resources (RAR) of uranium that can be produced at costs of less than US$130/kg of uranium were estimated to be 1151 kt at December 2014, representing a minor decrease on the December 2013 estimate. Market prices for uranium progressively decreased from February 2011 through to May 2014, when a moderate rebound commenced. Mineral resource assessment to support development and approvals processes at potential future production centres resulted in reclassification of some resources from the Subeconomic to Economic categories. Australia's mine production for 2014 was 4976 t of uranium (5868 t U_3O_8), a 23% decrease on that reported in 2013, largely due to a decline in output from the Ranger mine in the Northern Territory. Australia's RAR of uranium is the world's largest, accounting for over 30% of the global estimate.

Vanadium: Australia's vanadium EDR increased by 3% in 2014 to 1910 kt. This represents approximately 13% of estimated global vanadium resources, ranking Australia fourth in the world. The economic impact of volatile prices and the nature of the vanadium market, which is supplied largely from secondary sources, have had a significant impact on Australia's vanadium EDR and the development of Australian vanadium projects. The bulk of Australia's vanadium is located in Western Australia at Windimurra, approximately 600 km north of Perth. Windimurra reopened in 2011 but production has temporarily ceased as the plant was damaged during a fire incident in February 2014 and is undergoing repair.

Zinc, Lead and Silver: Australia's EDR of zinc increased slightly in 2014 by 1% to 62.6 Mt, lead EDR decreased by 1% to 34.7 Mt and silver EDR was unchanged from 2013 at 85.2 kt. Australia's economic resources for both zinc and lead are the world's largest holdings at 27% for zinc and 40% for lead, and Australia has the second largest holdings of silver (16%). Queensland has 55% of the national total of EDR for zinc, 56% for lead and 55% for silver, mainly in the Mount Isa region. The Northern Territory has 31% of the national total of EDR for zinc, 24% for lead and 10% for silver, almost all of which are at the McArthur River mine. Significant EDR of silver are also found in New South Wales (16%) and South Australia (12%). Exploration expenditure on lead, zinc and silver in 2014 was $50.4 million down 22% from 2013.

Table 2 World ranking of major mineral resources and production as at December 2014.

	World Ranking for Resources	% of World Resources	World Ranking for Production	% of World Production
Antimony	4	8	4	4
Bauxite	2	22	1	34
Black Coal	4	9	4	6
Brown Coal	2	19	6	7
Copper	2	13	6	5
Diamond (Industrial)	1	31	5	7
Gold	1	17	2	9
Ilmenite	2	11	1	8
Iron Ore	1	29	2	22
Lead	1	40	2	13
Lithium	3	11	unknown	unknown
Manganese Ore	3	17	3	17
Molybdenum	7	2	0	0
Nickel	1	23	3	10
Niobium	2	4	unknown	unknown
Oil Shale	0	0	0	0
Phosphate	9	2	minor	minor
Potash	minor	minor	0	0
Rutile	1	39	1	27
Silver	2	16	4	7
Tantalum	1	67	unknown	unknown
Tin	4	9	7	2
Tungsten	2	11	minor	minor
Uranium	1	29	3	8
Vanadium	4	13	0	0
Zinc	1	27	2	12
Zircon	1	56	1	59

Sources: United States Geological Survey, Geoscience Australia, International Energy Agency, World Nuclear Organisation, World Energy Council.

Trends in Australia's Economic Demonstrated Resources of Major Mineral Commodities

The trends in EDR for Australia's major mineral commodities have undergone significant and sometimes dramatic changes over the period 1975–2014 (Figure 1a–c). The changes for each commodity can be attributed to one, or a combination, of the following factors:

- increases in resources resulting from discoveries of new deposits and delineation of extensions of known deposits;
- depletion of resources as a result of mine production;
- advances in mining and metallurgical technologies, e.g. carbon-based processing technologies for gold have enabled economic extraction from low-grade deposits that were previously uneconomic;
- adoption of the Joint Ore Reserve Committee (JORC) Code[1] for resource classification and reporting by the Australian minerals industry and the subsequent impacts on re-estimation of ore reserves and mineral resources to comply with the requirements of the JORC Code. Many companies re-estimated their mineral resources to comply with the JORC Code. The impacts of the JORC Code on EDR occurred at differing times for each of the major commodities; and
- significant changes in the prices of mineral commodities driven largely by both escalating and cooling demand from China over the past decade.

Past trends and changes in EDR for a number of Australia's major mineral commodities are discussed below.

Bauxite

EDR of bauxite increased in 1989 as a result of the delineation of additional resources in deposits on Cape York Peninsula in northern Queensland ('a' in Figure 1a). Decreases in bauxite EDR in 1992 resulted from reclassification of some resources within deposits on Cape York Peninsula to comply with requirements for the JORC Code ('b').

Black Coal

A major reassessment of New South Wales coal resources during 1986 by the NSW Department of Mineral Resources and the Joint Coal Board resulted in a large increase in black coal EDR as reported in 1987 ('c').

Between 1998 and 2007, EDR for black coal declined due to the impact of increased rates of mine production and mining companies re-estimating ore reserves and mineral resources more conservatively to comply with requirements of the JORC Code. From 2008 onwards, black coal EDR increased significantly because of the discovery and delineation of additional resources as a result of high levels of exploration and through reclassification of resources.

1. In 1988, the Australian mineral industry adopted the Australasian Code for Reporting of Identified Mineral Resources and Ore Reserves (JORC Code). Many companies first used this code for reporting their mineral resources in 1989. The requirements of the Code differed significantly from the resource classification schemes used by companies prior to 1989.

Iron Ore

Australia's EDR of iron ore declined from 1994 through to 2003 due to the combined impacts of increased rates of mine production and mining companies re-estimating reserves and resources to comply with the requirements of the JORC Code. Post 2003, EDR increased rapidly due to large increases in magnetite resources (including reclassification of some magnetite deposits to economic categories), and increases in hematite resources, mainly at known deposits. Mine production increased rapidly from 168 Mt in 2000 to 735 Mt in 2014.

Gold

The EDR of gold rose steadily from 1983 (394 t) to 2012 (9909 t) with only relatively minor falls of short duration in 1997, 2000 and 2005. This rise in EDR corresponded to a period of sustained exploration expenditure averaging about $500 million per annum and of improvements to extraction technologies including carbon in pulp, carbon in leach and the treatment of refractory ores.

However, gold EDR dropped by 101 t in 2013 and more substantially by 696 t in 2014. In 2014, the largest single impact on EDR, and accounting for more than half of the fall, was a reduction of contributing resources at Olympic Dam where gold EDR declined by 393 t. Gold production in 2014 amounted to 274 t, an increase on 2013 (265 t) and it is likely that most of this output was derived from resource categories that contribute to EDR. These two factors accounted for up to 96% of the fall in gold EDR in 2014. In addition, many companies revised and lowered their resource inventories with higher cut-off grades during 2014 in the face of continuing lower average and more uncertain gold prices relative to 2012–13.

Copper

Following the adoption of the JORC Code by the Australian mineral industry, many companies first used this code in 1989 for reporting their copper resources. These companies re-estimated mineral resources to comply with the JORC Code which resulted in a sharp fall in Australia's copper EDR in 1989 ('d' in Figure 1b).

The sharp increase in copper EDR in 1993 resulted mainly from an increase in company announced resources for the Olympic Dam deposit in South Australia. Additional resources were reported also for Ernest Henry in Queensland, Northparkes in New South Wales and other smaller deposits ('e').

Reassessments of copper resources by Geoscience Australia in 2002 and 2003 resulted in further transfers (reclassification) of Olympic Dam resources into EDR ('f'). In 2007 and 2008, copper resources again increased sharply, mainly because of a large increase in resources for Olympic Dam where drilling outlined large resources in the southeastern part of the deposit ('g'). Since 2008, successful exploration has continued to yield new discoveries and to delineate new resources, resulting in a steady increase of copper EDR, including the Carrapateena, Rocklands, DeGrussa, Hillside and Cadia East deposits.

Lead, Zinc

The adoption of the JORC Code in 1988 by the Australian mineral industry led to a re-estimation of mineral resources by many companies to align with the code, and some reassessments of resource data for other deposits by Geoscience Australia's predecessor, the Bureau of Mineral Resources. This resulted in a fall in Australia's lead and zinc EDR in 1989 ('h').

Increases in EDR for lead and zinc in 1993 resulted from the reclassification of paramarginal demonstrated resources into EDR for the McArthur River deposit in the Northern Territory and the George Fisher deposit in Queensland. Additional resources were also reported for the Century and Cannington deposits in Queensland ('i').

Increases in 2008 and 2009 were associated with reassessment of resources at the McArthur River mine, where an expansion from underground to open-cut mining was approved, reassessment of the Dugald River deposit in Queensland for which a new and increased resource estimate was released and reporting of additional resources for George Fisher ('j').

Nickel

The EDR for nickel increased during the period 1995 to 2001 by 18.2 Mt. This resulted mainly from progressive increases in resources of lateritic deposits at Bulong, Cawse, Murrin Murrin, Mount Margaret, Ravensthorpe, all in Western Australia, Marlborough in Queensland, and Syerston and Young in New South Wales. Australia's EDR of nickel doubled in 2000 (compared to the level at the end of 1999) – this dramatic rise was due to further large increases in resources at the Mount Margaret and Ravensthorpe deposits, and other lateritic deposits in the Kalgoorlie region of Western Australia. In addition, during the period 1995 to 2001, there were increases in Western Australian sulphide resources at Yakabindie and the discoveries of the Silver Swan and Cosmos high-grade sulphide deposits.

From 2001 onwards, the sharp rises in market prices for nickel led to increased expenditure on exploration and on evaluation drilling at many known deposits. This contributed to further increases in total EDR for sulphide deposits at Perseverance, Savannah, Maggie Hays, Anomaly 1, Honeymoon Well, deposits in the Forrestania area, as well as new deposits at Prospero and Tapinos in Western Australia, Avebury in Tasmania and remnant resources at several sulphide deposits in the Kambalda region including Otter-Juan and Lanfranchi groups of deposits.

From 2001 onwards, EDR increased at a slower rate because of the absence of further discoveries of lateritic nickel deposits and as a result of increases in resources for some deposits being offset by companies reclassifying their lateritic nickel resources to lower resource categories pending more detailed drilling and resource assessments. Decreases in nickel EDR from 2009 onwards reflect reclassification of nickel resources in response to the very sharp falls in nickel prices following the 2008–09 global financial crisis followed by only a partial recovery in nickel prices from 2009 onwards. EDR in 2014 is unchanged from 2013 at 19 Mt but is expected to increase in 2015 owing to high exploration activity driven by the trend of rising nickel prices.

Mineral Sands

Increases in EDR of ilmenite from 1996 to 2003 resulted from discovery and subsequent evaluation drilling of heavy mineral sands deposits in the Murray Basin which include the Gingko and Snapper deposits in New South Wales, Douglas-Bondi and Woornack deposits in Victoria, and the Mindarie project in South Australia. In addition, from 1998 onwards, there were progressive increases in resources at mineral sands deposits at Jacinth-Ambrosia and Cyclone in the Eucla Basin embracing parts of South Australia and Western Australia, in the North Swan Coastal Plain area north of Perth and the Blackwood Plateau region in Western Australia. The EDR of ilmenite declined from 2007 to 2012 owing to reclassification of some resources to lower resource categories but has since increased owing to new resource delineation, particularly in Western Australia.

Uranium

The majority of Australia's uranium deposits were discovered between 1969 and 1975 when approximately 50 deposits, including 15 with significant resource estimates, were discovered. Since 1975, only another five deposits have been discovered and of these, only three deposits (Kintyre in the Paterson Province of Western Australia, Junnagunna in Queensland and Four Mile in South Australia) have Reasonably Assured Resources recoverable at less than US$130/kg U (equates with EDR). As a result, the progressive increases in Australia's EDR for uranium from 1975 to the present were largely because of the ongoing delineation of resources at known deposits.

From 1983 onwards, the Olympic Dam deposit has been the major contributor to increases in Australia's EDR. The large increases shown on Figure 1c occurred:

- in 1983, when initial resource estimates for Olympic Dam and Ranger No. 3 Orebody (Northern Territory) were made by the former Australian Atomic Energy Commission ('k' in Figure 1c);
- in 1993, when further increases in EDR for Olympic Dam and first assessment of resources for the Kintyre deposit were made by Geoscience Australia's predecessor, the Bureau of Mineral Resources ('l');
- in 2000, when increases were due to continuing additions to the Olympic Dam resources; and
- from 2007 to 2009 when a major increase in EDR for Olympic Dam was made after drilling outlined major extensions to the southeast part of the deposit.

Economic resources have decreased since 2010 because of higher costs of mining and milling uranium ores. Resources in some deposits were reassigned to higher cost categories than in previous years. In previous years, resources in the cost category of less than US$80/kg U were considered to be economic. As a result of changes in uranium market prices and increases in costs, economic resources since 2009 were adjusted to include resources within the cost category of less than US$130/kg U.

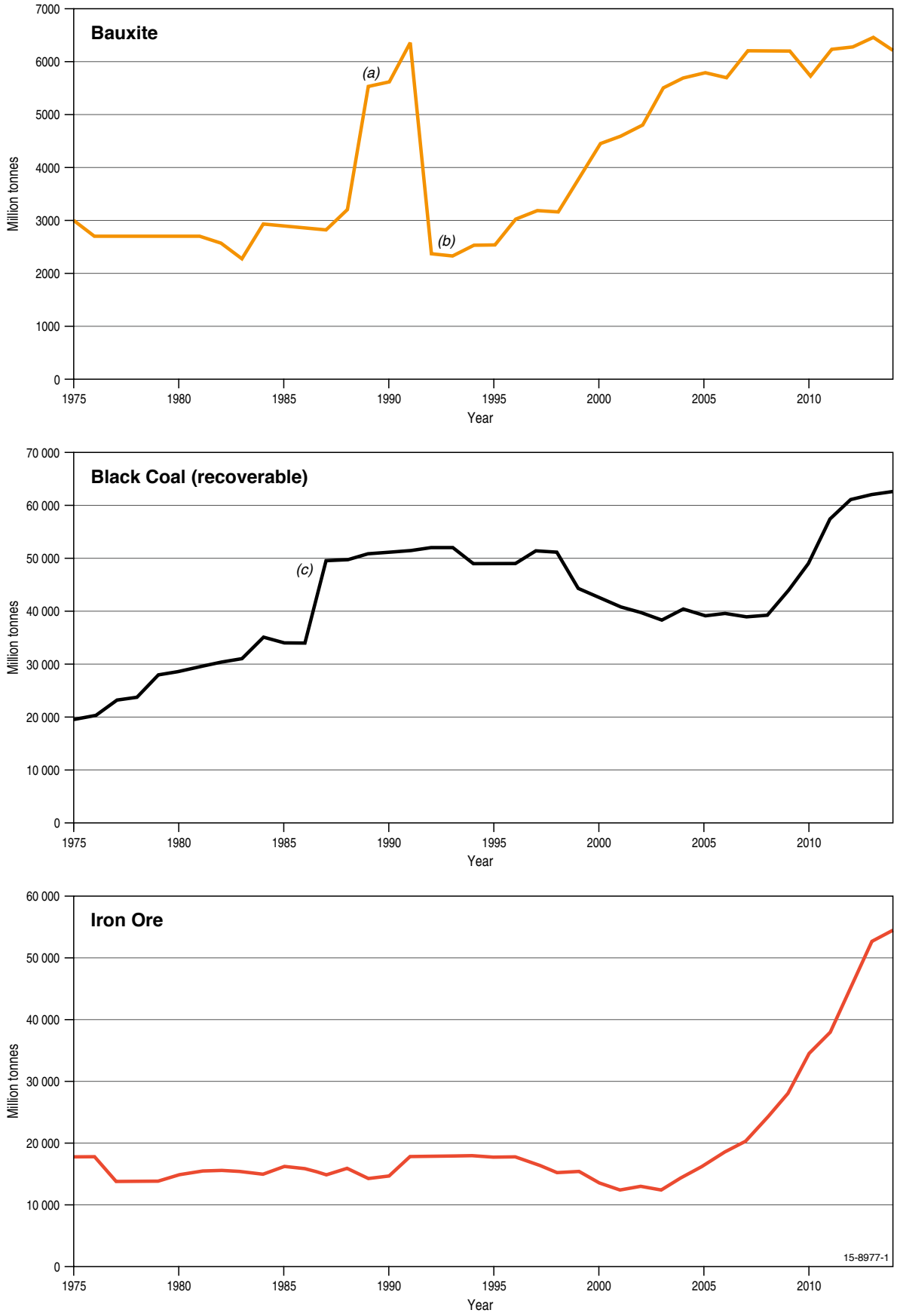

Figure 1a Trends in Economic Demonstrated Resources of major commodities since 1975.

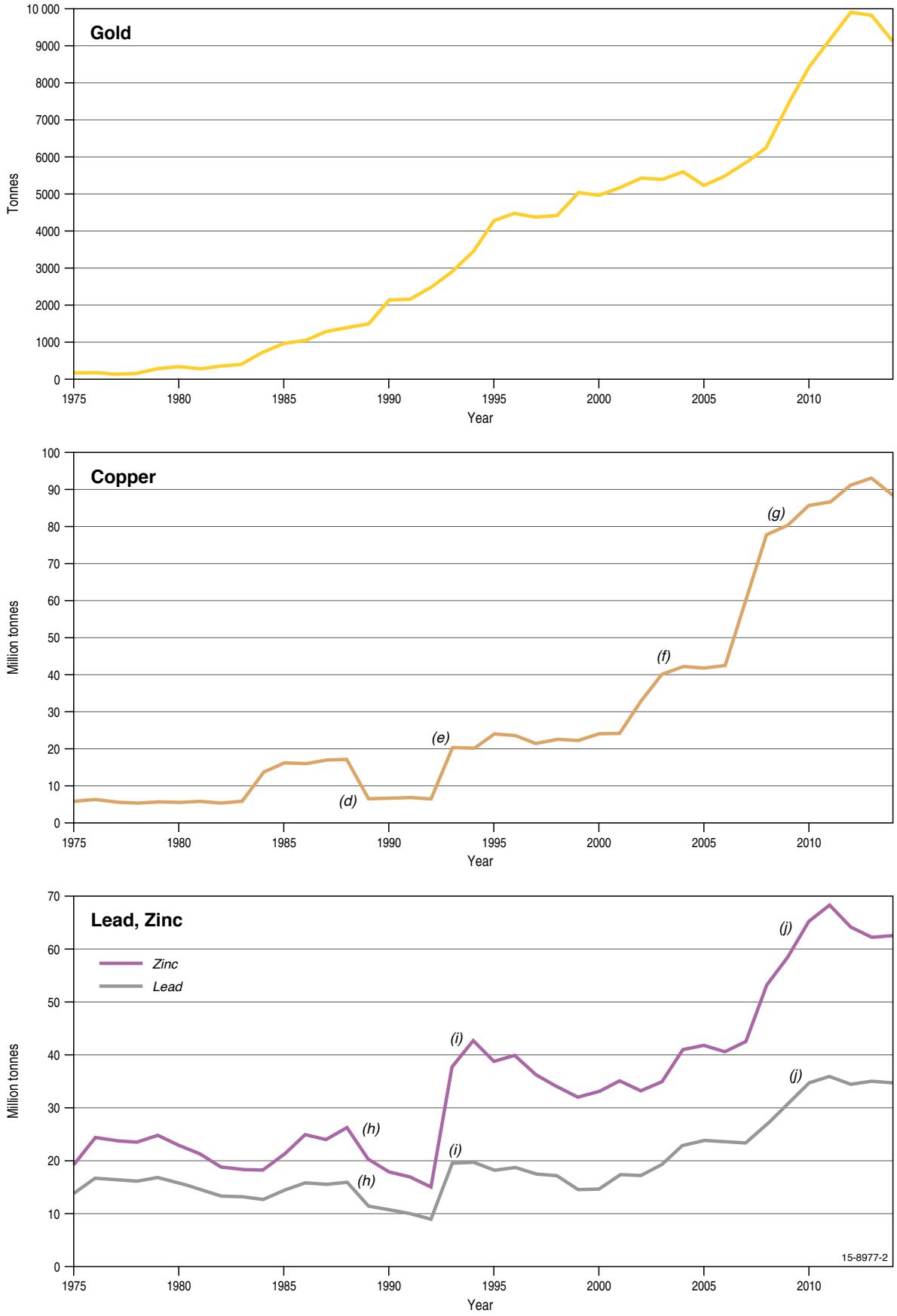

Figure 1b Trends in Economic Demonstrated Resources of major commodities since 1975.

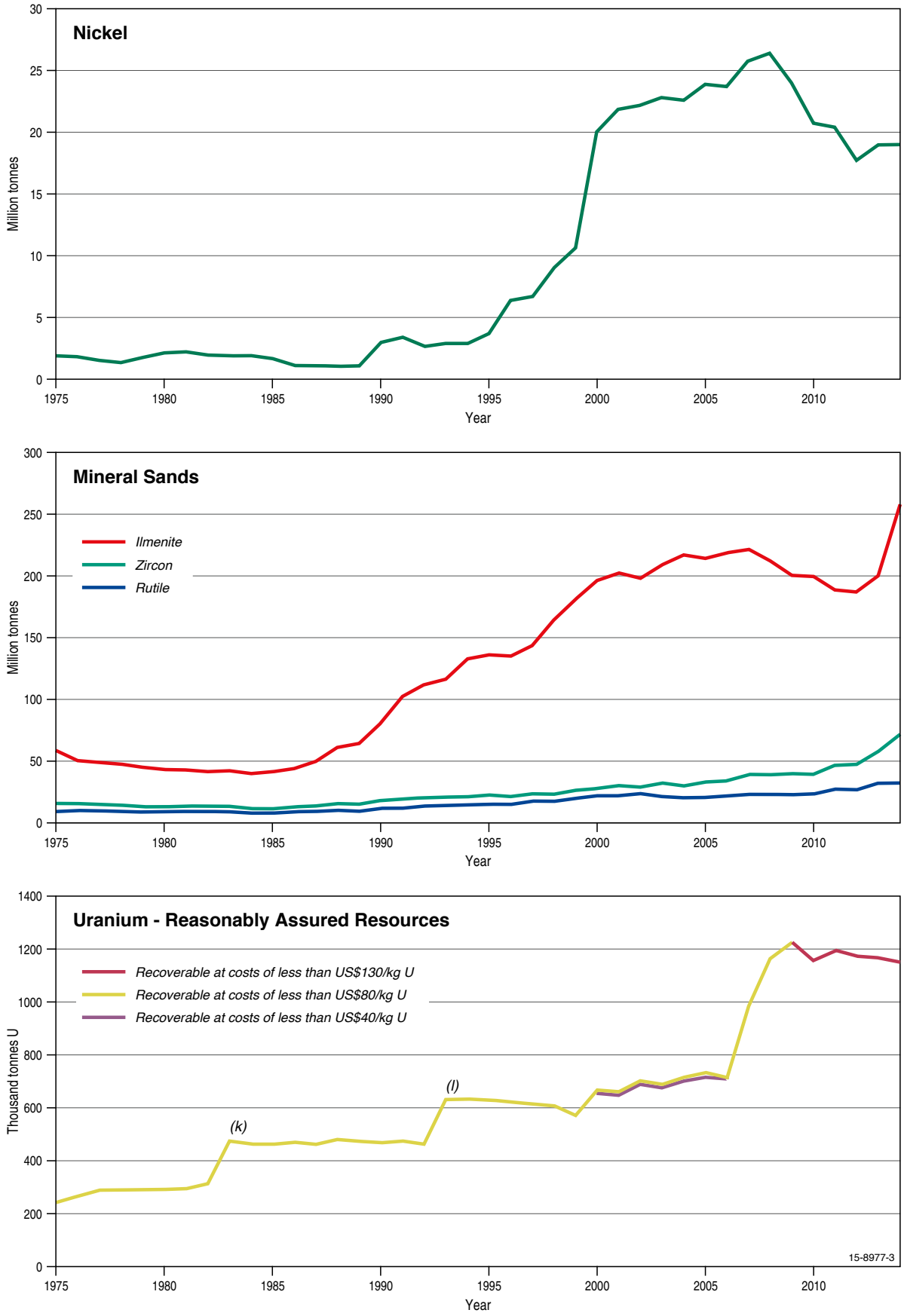

Figure 1c Trends in Economic Demonstrated Resources of major commodities since 1975.

Resources to Production Ratios

Resources to production ratios for major mineral commodities (Table 3) are a useful long-term indicator of resource life and assist with the assessment of future supply capability. Geoscience Australia uses a mineral commodity's ratio of AEDR compared to current mine production as an indicative estimate of long-term resource life. The AEDR of most of Australia's major commodities can sustain current rates of mine production for many decades. In addition, Geoscience Australia provides ratios based on Ore Reserves compliant with the JORC Code compared to current mine production to produce a lower number that reflects a shorter term, commercial outlook.

Geoscience Australia rounds the annual AEDR/production ratio to the nearest 5 years to provide a snapshot in time. The individual values in Table 3 are not necessarily representative of the long-term trend as variations in the rates of production in response to demand can radically change the resource/production ratio. A case in point is uranium: In Table 3, uranium has an AEDR/production ratio of 170 in 2013 which has increased to 215 in 2014. Despite a slight reduction in AEDR from 2013 (1167 kt U) to 2014 (1151 kt U), a greater decrease in production has boosted the apparent resource life of uranium in Australia.

Despite the caution needed when assessing individual resource/production ratios, the values in Table 3, taken together, provide a broad outlook for policy makers and planners. Given the importance of mineral resources to the Australian economy, strategic long-term decision-making about the nation's mineral deposits, as well as the discovery and development of new, quality mineral deposits, is essential.

Table 3 presents the long-term AEDR/production ratios from 1999 to 2014 and the short-term Reserves/production ratios in 2004, 2009 and 2014 for five-year comparisons. The AEDR/production ratios differ for various commodities over this 15 year period:

- In 2014, the AEDR/production ratios ranged between 25 years (diamonds) and 725 years (brown coal).
- The commodities with the longest resource life based on AEDR/production ratios in 2014 are brown coal (725 years at current rates of production), uranium (215 years), ilmenite (140 years), rutile (105 years) and black coal (100 years).
- Commodities with a resource life of less than 50 years at current rates of production are diamond (25 years), manganese ore (30 years), gold (35 years), zinc (40 years) and silver (45 years).
- Long-term declines for black coal and nickel reflect major increases in production and downgrading of resources.
- The decline in iron ore prior to 2010 has been partly offset by the development of large magnetite deposits in the Pilbara and mid-west regions of Western Australia.
- Long-term increases in AEDR/production ratios are evident for copper, diamond, ilmenite, gold, lead, silver and uranium.
- Increases in the AEDR/production ratios between 2013 and 2014 were recorded for brown coal, diamond and uranium. AEDR for brown coal was unchanged from 2013 but there was a significant reduction in production. Diamond and uranium had a decreases in AEDR concurrent with a greater decreases in production.
- Reductions in AEDR/production ratios during 2014 were recorded for copper, ilmenite, iron ore, nickel and rutile. For copper, ilmenite and rutile, the reduced resource life is the result of decreased resources with concurrent, but lesser, decreases in production. For nickel, production increased but AEDR was unchanged. For iron ore, AEDR increased but production increased more.

Changes in the ratios of Ore Reserves to production predominantly reflect the ongoing practice of companies replenishing Reserves depleted by mining by upgrading Measured and Indicated Resources to maintain a steady supply of mineable ore for production. Reserve/production ratios for the period 2004 to 2014 show that:

- In 2014, the Reserve/production ratios (Reserve life in years at current rates of production) ranged between 10 years for diamonds and 75 years for uranium with 11 out of 15 commodities (excluding brown coal) having a ratio of 10 years to 30 years.
- Reserve/production ratios fall within a narrower range than the AEDR/production ratios and have not changed significantly during the period between 2004 and 2014 with the shortest Reserve/production ratio of 5 years for diamonds in 2004 (10 years in 2014) and the longest at 50 years for uranium in 2004 (75 years in 2014).

It is important to note that a long resource life for a particular commodity is not a guarantee that the resource will continue to be extracted in Australia. In an increasingly globalised and competitive commodity market, multinational mining companies search for mineral deposits that offer the most attractive returns on investment. These returns are influenced by the quality of the resources (grade and tonnage), development and extraction costs, and by environmental, social and political factors as well as land access, infrastructure and the location and scale of the mining operations proposed by the company.

The global financial crisis in 2008 forced many companies to reassess their options for both existing and planned operations in Australia. In the case of black coal and iron ore, the initial impact of the global financial crisis caused some mining operations to scale back production while others delayed plans for expansion and some mines closed at the end of 2008. By mid-2009, recovery in mining operations and development plans were well underway but this trend has reversed in recent years owing to volatile and weak commodity prices, particularly for iron ore and coal.

In early 2011, the international spot price for thermal and coking coal peaked at more than US$140/t and US$330/t, respectively. Since that time, an oversupply of both thermal and coking coal on the international markets has led to a steady decline in prices. In 2014, thermal and premium coking coal averaged approximately US$69/t and US$116/t, respectively. In response to the subdued

Table 3 Number of years of resource life for major commodities calculated as the ratio of Accessible Economic Demonstrated Resources compared to the production level for each year (rounded to the nearest 5 years). The number of years of resource life calculated as the ratio of JORC Code Reserves at the production level for each year is shown in brackets for 2004, 2009 and 2014 (also rounded to the nearest 5 years).

Commodity	1999	2004	2009	2010	2011	2012	2013	2014
Bauxite	80	95 (35)	85 (35)	80	80	80	80	80 (25)
Black Coal	150	140 (35)	100 (30)	90	110	110	100	100 (35)
Brown Coal	565	440 (30)	470 (70)	495	510	510	465	725 (n.a.)
Copper	30	50 (25)	95 (25)	100	90	100	95	90 (25)
Diamond	5	5 (5)	20 (15)	30	35	35	20	25 (10)
Gold	15	20 (15)	30 (15)	30	35	40	35	35[1] (15)
Ilmenite	95	95 (20)	110 (20)	125	120	115	145	140 (40)
Iron Ore	100	60 (20)	70 (30)	80	75	85	85	75 (30)
Lead	30	35 (15)	55 (20)	50	60	55	50	50 (20)
Manganese Ore[2]	70	40 (30)	20 (35)	15	15	15	30	30 (15)
Nickel	80	120 (35)	145 (30)	120	95	70	80	75 (30)
Rutile	105	90 (25)	70 (20)	45	50	50	115	105 (40)
Silver	30	20 (10)	45 (15)	40	50	50	45	45 (15)
Uranium	105	70 (50)	140 (40)	175	180	160	170	215 (75)
Zinc	40	30 (15)	45 (15)	45	45	40	40	40 (15)
Zircon	70	50 (15)	70 (20)	60	50	70	n.a.	50 (20)

1. Average AEDR/production ratio for gold (35 years) is strongly influenced by low-grade copper-gold deposits with a ratio of over 69 years at current rates of mine production, whereas lode-gold deposits have AEDR/production ratio of less than 22 years. Source: Surbiton and Associates Pty Ltd.
2. AEDR/production ratios for manganese allow for losses that occur in beneficiating (upgrading) manganese ores.
na: data not available

prices, Australian coal producers have continued to extract greater efficiencies from their mining operations, placed several uneconomic mines on care and maintenance and deferred the expansion of several existing mines and the development of several new mines. Despite depressed prices, in 2014, production and export volumes of both thermal and coking coal reached record levels as many producers honoured take-or-pay contracts negotiated as part of export terminal expansions. In addition, the weaker Australian dollar has offered relief to many producers as it partly offsets the fall in the $US international price.

In 2014, the iron ore AEDR/production ratio was 75 years, a decrease from the 2013 value of 85 years. This reduction is a result of a 20% increase in production that was only partially offset by a minor (3.5%) increase in AEDR. Slowing demand from China has led to a downturn in the iron ore price and resulted in decreased exploration and resource definition drilling. Thus, the increase in AEDR has not kept pace with production as major producers, Rio Tinto and BHP Billiton, exceed their nameplate capacity through expansion and ramp up of existing operations. Rio Tinto's brownfield expansions are expected to increase its capacity from 290 Mt to 330 Mt in 2015.

During 2009 and 2010, some multinational companies closed sulphide and lateritic nickel mines in Western Australia and Tasmania and consolidated their operations at larger, low-cost mining operations. By 2011, a number of these nickel mines resumed production. The large Ravensthorpe lateritic nickel mine restarted operations during the second half of 2011 after being refurbished during 2010–11. Nickel production is projected to increase as output from recommissioned mines, such as Windarra in Western Australia and Avebury in Tasmania, and from the new Lucky Break mine in Queensland, come online.

Australia's nickel resources were unchanged from 2013 to 2014 but are expected to increase in 2015, reflecting the increasing price of nickel which continues to drive high exploration activity by explorers and existing producers. The Indonesian ban on nickel ore export has affected global nickel supply in 2014 and 2015 but supply is expected to recover as China, Russia and the Philippines increase capacity by 2020[2].

The AEDR/production ratio for copper fell in 2014 as the decrease in production was less than the decrease in AEDR. From 1999 to 2010, the AEDR/production ratio for copper has increased progressively as a result of increasing resources, particularly at Olympic Dam. Since 2010, the AEDR/production ratio has ranged between 90 years and 100 years owing to variations in the rates of production and delineation of resources. The Reserves/production ratio, however, has remained constant since 2004, reflecting steady near-term, commercial supply.

AEDR/production ratios for lead, silver and zinc in 2014 were unchanged from the previous year. AEDR and production for lead increased marginally whilst zinc decreased marginally. Silver AEDR and production were virtually unchanged.

The rounded gold AEDR/production ratio was unchanged in 2014 at 35 years. However, the raw data shows a decrease to 33 years down from 37 years in 2013 owing to both a reduced resource inventory and increased production. Production is dominantly derived from lode-gold deposits while copper-gold types host the largest share of resources. Thus it is instructive to look at the separate AEDR/production ratios of these main types of deposit rather than just the collective total.

2. Office of the Chief Economist, March 2015 Quarterly Report.

Table 4 Total mineral exports ($million) 2011–2014 and as a percentage of various economic categories.

	2011	2012	2013	2014
Total Mineral Exports (TME)	$165 405 m	$146 301 m	$160 127 m	$156 600 m
TME as a percentage of Total Resources and Energy Exports	87%	83%	86%	84%
TME as a percentage of Total Merchandise Exports	63%	59%	61%	59%
TME as a percentage of Total Goods and Services Exports	53%	49%	50%	48%
TME as a percentage of Gross Domestic Product	11%	10%	10%	10%

Source: Office of the Chief Economist and Australian Bureau of Statistics.

In 2014, attributable AEDR for lode-gold deposits fell 164 t to 3588 t while production rose by about 10 t to 182 t yielding a ratio of 20 years, 2 years less than in 2013. For copper-gold deposits, AEDR fell 176 t to 5361 t while production rose 2 t to 82 t yielding a ratio of 65 years, or 4 years less than in 2013[3]. While gold resources in copper-gold deposits are substantial, current and likely mining rates of these large, generally low-grade, deposits are unlikely to lead to substantial increases in output. The state of gold production in Australia, therefore, continues to be dominated by lode-gold deposits and exploration success for these deposit types will need to continue to assure future production rates.

For heavy mineral sands operations, some producers closed down low-grade ilmenite deposits in 2008 to concentrate on deposits that have higher zircon content or are more readily amenable to beneficiation. However, sharply lower levels of production of ilmenite, rutile and zircon in 2009, resulting from the flow-on effects of the global financial crisis in late 2008 and early 2009, led to increases in resource life in 2010. In 2012, an increase in ilmenite production decreased the ilmenite AEDR/production ratio but, in 2013, the mineral sands industry was again affected by low prices leading to a drop in production and a consequent large increase in the AEDR/production ratio for rutile and ilmenite. In 2014, ilmenite and rutile production fell again, as did AEDR owing to recategorisation of accessibility. Zircon production was not reported in 2013 but its AEDR/production ratio in 2014 is down from 2012 reflecting a similar decrease in AEDR as ilmenite and rutile, but with a converse increase in production compared to 2012.

For uranium, AEDR/production ratios increased progressively from 2003 to 2011, the result of significant increases in Australia's uranium resources. A large proportion of this increase was a consequence of ongoing mineral resource evaluation at the Olympic Dam deposit. From 2011 onwards, uranium resources have remained fairly static but operational problems affected production rates at three uranium mines (damage to a haulage shaft at Olympic Dam, flooding at the Ranger 3 pit and operating problems at Beverley), which is reflected in the AEDR/production ratios. Rectification of operational problems from 2012 onwards led to increased production, resulting in a slightly lower AEDR/production ratio. However, in 2014, Australia's mine production of uranium declined by 22% relative to production recorded in 2013.

Increases in mining and processing costs since 2011 have limited the growth of Australia's AEDR, though a significant one-off increase in AEDR of uranium resulted from the Queensland State Government lifting its 32-year ban on uranium mining in 2014. However, in 2015, the incoming Queensland Government indicated that this policy is under review. Recognising improvements in nationally endorsed safety and environmental regulation, the New South Wales State Government has also lifted its prohibition on uranium exploration.

Market prices for uranium progressively decreased from 2011 to 2014 but a changing supply to demand balance led to a slight uptick in late 2014. Prices have remained soft in 2015 but have stabilised above the lows of 2014. From 2011 to 2015, spot prices remained below the level required to stimulate exploration. Mining and exploration companies in Australia have delayed uranium projects that have become uneconomic in the soft market, focusing investment on advancing only those projects that should result in the highest return on capital investments. In addition, Energy Resources of Australia has announced the impending closure of the Ranger mine. Attendant changes in leasing arrangements are anticipated to affect future AEDR.

Value of Australian Mineral Exports

In 2014, Australian mineral exports (excluding petroleum products) amounted to approximately $157 billion, almost 59% of all export merchandise and 48% of all exported goods and services (Table 4). Gross domestic product (GDP) in 2014 was approximately $1579 billion, with mineral exports contributing about 10%. As a percentage of GDP, mineral exports are unchanged from the previous two years but still down from the 2011 level of 11%. The value of total mineral exports has increased from 2012 but is less than the value of both 2011 and 2013. Similarly, mineral exports as a percentage of resources and energy exports, merchandise exports, and goods and services exports are similar to 2012 levels, but the 2014 figures are lower than those of 2013 and significantly less than those of 2011.

Quarterly reports published by the Office of the Chief Economist (formerly the Bureau of Resources and Energy Economics) show that the main mineral export earners in 2014 were iron ore, black coal, gold, copper, alumina, aluminium and nickel (Table 5), which is unchanged from 2013. Comparing export earnings to export volume, it is clear that processed mineral commodities are worth more per unit than raw minerals or concentrates, often significantly so. Bauxite in 2014, for example, was worth $39/t whereas alumina was worth $325/t and aluminium metal was worth $2420/t, an eight-fold increase on the price of alumina and a massive 62-fold increase on the price of bauxite. Similar value-adding is seen in the copper, iron, titanium and zinc industries. Thus any appraisal of the strength of Australia's minerals industry must also include domestic downstream processes, such as refining and smelting, in addition to mineral discovery, mining and raw material exports.

3. Data for mine production figures were provided by Surbiton Associates Pty Ltd.

Table 5 Australian export volume and value of mineral commodities 2014.

Commodity	Export volume	Unit	Export earnings ($million)	Value ($/t or $/c)	Percentage of total mineral exports
Aluminium - Bauxite	16 862	kt	666	39	0.4%
Aluminium - Alumina	17 972	kt	5842	325	3.7%
Aluminium - Ingot Metal	1464	kt	3544	2420	2.3%
Black Coal - Metallurgical	186 000	kt	21 915	118	14.0%
Black Coal - Thermal	201 000	kt	16 138	80	10.3%
Copper - Ore and Concentrates	2178	kt	5459	2506	3.5%
Copper - Refined	486	kt	3720	7654	2.4%
Diamonds - Unsorted	9 707 000	c	75	8	<0.1%
Diamonds - Sorted Gem	133 000	c	235	1767	0.2%
Gold - Refined and Unrefined Bullion	287	t	13 152	45 825 784	8.4%
Iron - Ore and Pellets	716 909	kt	65 986	92	42.1%
Iron - Iron and Steel	844	kt	698	827	0.4%
Iron - Scrap	2268	kt	973	429	0.6%
Lead -Concentrates	602	kt	998	1658	0.6%
Lead - Refined	231	kt	553	2394	0.4%
Lead - Bullion	108	kt	302	2796	0.2%
Manganese - Ore and Concentrates	7249	kt	1428	197	0.9%
Nickel	253	kt	3613	14 281	2.3%
Silver - Refined	117	t	235	2 008 547	0.2%
Tin - Concentrate	14 096	t	159	11 280	0.1%
Titanium - Ilmenite Concentrate	999	kt	110	110	<0.1%
Titanium - Leucoxene Concentrate	35	kt	25	714	<0.1%
Titanium - Rutile Concentrate	212	kt	291	1373	0.2%
Titanium - Synthetic Rutile	316	kt	260	823	0.2%
Titanium Dioxide Pigment	194	kt	557	2871	0.4%
Zinc - Concentrates	2603	kt	1778	683	1.1%
Zinc - Refined	416	kt	1004	2413	0.6%
Zircon - Concentrate	798	kt	262	328	0.2%

Source: Office of the Chief Economist.

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