

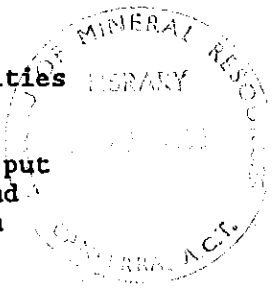
Australia's Identified Mineral Resources

as at 31 December 1990

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Estimates of Australia's identified resources of major mineral commodities in the accompanying table have been prepared in the Minerals Resource Assessment Branch of BMR using published and unpublished information. Unless stated otherwise, the estimates are for in-situ resources. To put the resources totals in perspective, data for Australian production and for world resources and production are included. World data have been obtained from various sources, mainly US Bureau of Mines publications. Some comments on the 1990 estimates are noted on the next page.



The classification used in the table was adopted by BMR in 1975 (Australian Mineral Industry Quarterly, 28(1), 11-13) and refined in 1983 (Australian Mineral Industry Quarterly, 36(3), 73-82) and reflects both the geological certainty of occurrence of mineral resources and the economic feasibility of their extraction (see Terminology & Definitions on page 4). The term 'economic resources' is used instead of 'reserves' in national resources totals because the latter term is used by different groups to describe different resource categories. The 'paramarginal' and 'submarginal' subdivisions of subeconomic resources refer to current feasibility of extraction: paramarginal resources border on being economically producible, whereas extraction of submarginal resources would require a substantially higher commodity price or a major cost-reducing advance in technology.

Uranium resources are classified by BMR in categories adopted by the NEA-IAEA classification. For the purposes of this tabulation, 'Reasonably Assured Resources' of the NEA-IAEA classification are equated with 'demonstrated resources' of the BMR classification, and 'Estimated Additional Resources-category 1' with 'inferred resources'; resources recoverable at a cost of less than \$US80/kg U are equated with 'economic resources' and resources recoverable at a cost of \$US80-130/kg U with 'paramarginal resources'.

Further work is needed to show whether the resources here classified as 'inferred undifferentiated' are economic or subeconomic.

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Comment

Wider use by companies of the Australasian Code for Reporting of Identified Mineral Resources and Ore Reserves (adopted in 1988) continued in 1990. Most totals are therefore comparable with 1989 figures but are not strictly comparable with totals for earlier years.

Gold resources increased in 1990 through additions to resources at some major deposits and inclusion of newly reported resources discovered in recent years. However, the increase in EDR from 1486t to 2129t mostly resulted from demonstrated subeconomic resources being upgraded.

Resources of platinum group metals (platinum, palladium, osmium, iridium, rhodium and ruthenium) and rare earths (rare earth oxides and yttrium oxide) are assessed for the first time. Economic demonstrated resources are small compared to world EDR; less than 1% for both groups. Economic resources of platinum group metals (mainly platinum and palladium) are predominantly contained in nickel deposits and rare earths in placer and hardrock deposits.

The increase in EDR for nickel of 170% mainly reflects reclassification and inclusion of resources at Leinster and Mount Keith in Western Australia.

In Queensland, the inclusion of a new resource at Dugald River and additional resources at Hilton resulted in a 74% increase in demonstrated paramarginal resources of zinc. A substantial increase in the inferred subeconomic resources of lead and zinc followed from the newly discovered Century deposit.

TERMINOLOGY AND DEFINITIONS

RESOURCE - A concentration of naturally-occurring solid, liquid, or gaseous materials in or on the earth's crust and in such form that its economic extraction is presently or potentially (within a 20-25 year timeframe) feasible.

CATEGORIES OF RESOURCES BASED ON DEGREE OF ASSURANCE OF OCCURRENCE

IDENTIFIED RESOURCES - Specific bodies of mineral-bearing material whose location, quantity, and quality are known from specific measurements or estimated from geological evidence. Identified resources include economic and subeconomic components. To reflect degrees of geological assurance, identified resources can be subdivided into the following categories:

MEASURED - Resources for which tonnage is computed from dimensions revealed in outcrops, trenches, workings, and drill holes, and for which the grade is computed from the results of detailed sampling. The sites for inspection, sampling, and measurement are spaced so closely, and the geological character is so well defined, that size, shape, and mineral content are well established.

INDICATED - Resources for which tonnage and grade are computed from information similar to that used for measured resources, but the sites for inspection, sampling and measurement are farther apart or are otherwise less adequately spaced. The degree of assurance, although lower than for resources in the measured category, is high enough to assume continuity between points of observation.

DEMONSTRATED - A collective term for the sum of measured and indicated resources.

INFERRED - Resources for which quantitative estimates are based largely on broad knowledge of the geological character of the deposit and for which there are few, if any, samples or measurements. The estimates are based on an assumed continuity or repetition, of which there is geological evidence. This evidence may include comparison with deposits of similar type. Bodies that are completely concealed may be included if there is specific geological evidence of their presence. Estimates of inferred resources should be stated separately and not combined in a single total with measured or indicated resources.

CATEGORIES OF RESOURCES BASED ON ECONOMIC CONSIDERATIONS

ECONOMIC - This term implies that, at the time of determination, profitable extraction or production under defined investment assumptions has been established, analytically demonstrated or assumed with reasonable certainty.

SUB-ECONOMIC - This term refers to those resources which do not meet the criteria of economic; sub-economic resources include paramarginal and submarginal categories.

PARAMARGINAL - That part of sub-economic resources which, at the time of determination, almost satisfies the criteria for economic. The main characteristics of this category are economic uncertainty and/or failure (albeit just) to meet the criteria which define economic. Included are resources which would be producible given postulated changes in economic or technologic factors.

SUB-MARGINAL - That part of sub-economic resources that would require a substantially higher commodity price or some major cost-reducing advance in technology to render them economic.

Table 1 Australia's identified resources of major minerals and fuels, and world figures for 1990

COMMODITY	UNITS	AUSTRALIA						WORLD 1989		
		Demonstrated			Inferred			Mine production	Economic demonstrated resources	Mine production
		Economic	Subeconomic		Economic	Sub-economic	Undifferentiated			
Para-margin al	Sub-margin al									
Antimony	kb Sb	14.5(j)	4.1	--	--	87	--	1.4	4200(a)	83
Asbestos										
Chrysotile ore	Mt	--	19	69	--	--	16	--	110(a)	4.4
Crocidolite fibre	Mt	--	0.4	2.1	--	--	--	--		
Bauxite	Mt	5622(j)	2239	137	3500	--	--	38.6	21800	101
Black coal										
In situ	Gt	70.9	0.6	5.7	--	--	very large			
Recoverable	Gt	51.1	0.4	3.5	--	--		0.19(c)	650	3.4(d)
Brown coal										
In situ	Gt	46.4	--	3.3	--	--	204			
Recoverable	Gt	41.7	--	3.0	--	--	184(e)	0.048	270	--
Cadmium	kt Cd	55.7(j)	30.9	61.4	1.0	1.1	--	1.82	535(a)	20.7
Chromite	Mt Cr	--	2.37	0.52	--	20	--	--	1030(a)	12.0
Cobalt	kt Co	85	2	239	--	35	--	1.8	3310(a)	38.7
Copper	Mt Cu	6.7(j)	12.2	1.8	0.4	22.3	0.01	0.3	352(a)	8.8(b)
Diamond										
Gem & near gem	10 ⁶ c	380(j)	0.6	--	--	--	0.3	) 35.1	300	44.2
Industrial	10 ⁶ c	487(j)	0.6	--	--	--	1.0	)	980	52.7
Fluorine	Mt F	--	24.1	5.8	--	--	0.7	--	108(f)	2.7
Gold	t Au	2129(j)	588	126	--	--	1311	202.2	42000(a)	1910
Iron ore	Gt	14.7	13.1	0.2	8.3	11.8	--	0.106	147(a)	0.943
Lead	Mt Pb	10.7(j)	8.3	14.2	0.2	6.5	--	0.5	70(a)	3.5(b)
Lithium	kt Li	150	--	203	69.7	--	6.5	1.2	2177(a)	4.5
Manganese ore	Mt	111	72	311	74	45	--	2.124	816(a)	24
Mineral sands										
Ilmenite	Mt	80.7(j)	75.4	--	--	--	37.7	1.7	364(a)	6.6
Rutile	Mt	11.6(j)	39.2	--	--	--	21.3	0.24	89(h)	0.48
Zircon	Mt	18.0(j)	28.2	--	--	--	15.6	0.51	54(a)	1.0
Nickel	Mt Ni	3.0	0.5	4.3	--	2.0	--	0.065	49(a)	0.84
Niobium	kt Nb	3.4	31	--	--	--	2014	--	3538(a)	16.6
Petroleum (recoverable)										
Crude oil	GL	260(i)	--	19(i)	n.a.	n.a.	n.a.	25.5	159237	3446
Natural (sales) gas	10 ⁹ m ³	953(i)	--	1174(i)	n.a.	n.a.	n.a.	17.8	112959	2102
Condensate	GL	114(i)	--	54(i)	n.a.	n.a.	n.a.	2.9	n.a.	n.a.
LPG naturally occur.	GL	119(i)	--	48(i)	n.a.	n.a.	n.a.	3.8	n.a.	n.a.
Phosphate rock	Mt	--	2005	--	--	--	1947	0.01	13855(a)	170
PGM (Pt, Pd)	t metal	22.8	23.0	8.2	3.5	71.0	--	--	56000(a)	270
Rare earths										
REO and Y ₂ O ₃	Mt	0.3	6.8	--	--	--	1.6	--	46(g)	0.05(k)
Shale oil	GL	--	--	4564	--	40468	--	--	n.a.	n.a.
Silver	kt Ag	20.7	16.6	13.1	0.4	12.2	--	1.08	280(a)	14
Tantalum	kt Ta	11.4	3.2	--	--	--	62	0.14	22(a)	0.4
Tin	kt Sn	146.2	78.9	76.6	2	417	225	7.7	4280(a)	210(b)
Tungsten	kt W	5.4(j)	117	7	3	85	40	1.37	2566	43
Uranium (recoverable)	kt U	469	60	--	264	126	--	3.66	1519(b)	33.9
Vanadium	kt V	46	1490	8425	--	2359	--	--	4268(a)	31.8
Zinc	Mt Zn	17.9(j)	19.6	24.1	0.5	18.2	--	0.8	147(a)	7.0(b)

Abbreviations: t = tonne; c = carat; m³ = cubic metre; L = litre; kt = 10³t; Mt = 10⁶t; Gt = 10⁹t; GL = 10⁹L; na = not available

- (a) USBM 'reserves'.
 (b) Western world only.
 (c) Raw coal.
 (d) Saleable coal.
 (e) Recovery rate based on that of economic demonstrated resources.
 (f) USBM 'reserves' occurring as fluorspar only; excludes about 176 Mt F contained in phosphate rock.
 (g) In terms of rare-earth oxides (RED), contained mainly in bastnasite and monazite.
 (h) USBM 'reserves'; includes anatase.
 (i) As at 31 December 1989.
 (j) Mostly resources recoverable by mining.
 (k) Excludes USA production Y₂O₃.

IDENTIFIED RESOURCES OF MAJOR MINERALS AND FUELS 31 DECEMBER 1990

	AUSTRALIA						WORLD		
	Demonstrated						Mine production 1989	Economic demonstrated resources	Mine production 1989
	Economic	Subeconomic Para-marginal	Subeconomic marginal	Inferred Economic	Inferred Subeconomic	Undifferentiated			
Antimony (kt, Sb)	(10)14.5	4.1	--	--	87	--	1.4	(1)4200	83
Asbestos								(1)110	4.4
Chrysotile ore (Mt)	--	19	69	--	--	16	--		
Crocidolite fibre (Mt)	--	0.4	2.1	--	--	--	--		
Bauxite (Mt)	(10)5622	2239	137	3500	--	--	38.6	21800	101
Black coal (Gt)									
in situ	70.9	0.6	5.7	--	--	very large			
recoverable	51.1	0.4	3.5	--	--		(3)0.19	650	(4)3.4
Brown coal (Gt)									
in situ	46.4	--	3.3	--	--	204			
recoverable	41.7	--	3.0	--	--	(5)184	0.048	270	--
Cadmium (kt, Cd)	(10)55.7	30.9	61.4	1.0	1.1	--	1.82	(1)535	20.7
Chromite (Mt)	--	2.37	0.52	--	20	--	--	(1)1030	12.0
Cobalt (kt, Co)	85	2	239	--	35	--	1.8	(1)3310	38.7
Copper (Mt, Cu)	(10)6.7	12.2	1.8	0.4	22.3	0.01	0.3	(1)352	(2)8.8
Diamonds (10 ⁶ carats)									
gem & cheap-gem	(10)380	0.6	--	--	--	0.3	) 35.1	300	44.2
industrial	(10)487	0.6	--	--	--	1.0	)	980	52.7
Fluorine (Mt, F)	--	24.1	5.8	--	--	0.7	--	(6)108	2.7
Gold (t, Au)	(10)2129	588	126	--	--	1311	202.2	(1)42000	1910
Iron ore (Gt)	14.7	13.1	0.2	8.3	11.8	--	0.106	(1)147	0.943
Lead (Mt, Pb)	(10)10.7	8.3	14.2	0.2	6.5	--	0.5	(1)70	(2)3.5
Lithium (kt, Li)	150	--	203	69.7	--	6.5	1.2	(1)2177	4.5
Manganese ore (Mt)	111	72	311	74	45	--	2.124	(1)816	24
Mineral sands									
Ilmenite (Mt)	(10)80.7	75.4	--	--	--	37.7	1.7	(1)364	6.6
Rutile (Mt)	(10)11.6	39.2	--	--	--	21.3	0.24	(8)89	0.48
Zircon (Mt)	(10)18.0	28.2	--	--	--	15.6	0.51	(1)54	1.0
Nickel (Mt, Ni)	3.0	0.5	4.3	--	2.0	--	0.065	(1)49	0.84
Niobium (kt, Nb)	3.4	31	--	--	--	2014	--	(1)3538	16.6
Petroleum (recoverable)									
Crude oil (GL)	(9)260	--	(9)19	n.a.	n.a.	n.a.	25.5	159237	3446
Natural (sales) gas (10 ⁹ m ³)	(9)953	--	(9)1174	n.a.	n.a.	n.a.	17.8	112959	2102
Condensate (GL)	(9)114	--	(9)54	n.a.	n.a.	n.a.	2.9	n.a.	n.a.
LPG naturally occurring (GL)	(9)119	--	(9)48	n.a.	n.a.	n.a.	3.8	n.a.	n.a.
Phosphate rock (Mt)	--	2005	--	--	--	1947	0.01	(1)13855	170
Platinum group (t, Pt, Pd)	22.8	23.0	8.2	3.5	71.0	--	--	(1)56000	270
Rare earths									
RED plus Y ₂ O ₃ (Mt)	0.3	6.8	--	--	--	1.6	--	(7)46	(11)0.05
Shale oil (GL) ^{2,3}	--	--	4564	--	40468	--	--	n.a.	n.a.
Silver (kt, Ag)	20.7	16.6	13.1	0.4	12.2	--	1.08	(1)280	14
Tantalum (kt, Ta)	11.4	3.2	--	--	--	62	0.14	(1)22	0.4
Tin (kt, Sn)	146.2	78.9	76.6	2	417	225	7.7	(1)4280	(2)210
Tungsten (kt, W)	(10)5.4	117	7	3	85	40	1.37	2566	43
Uranium (kt, U)									
(recoverable)	469	60	--	264	126	--	3.66	(2)1519	33.9
Vanadium (kt, V)	46	1490	8425	--	2359	--	--	(1)4268	31.8
Zinc (Mt, Zn)	(10)17.9	19.6	24.1	0.5	18.2	--	0.80	(1)147	(2)7.0

t -- tonne; kt -- 10³ t; Mt -- 10⁶ t; Gt -- 10⁹ t; GL -- 10⁹ L; n.a. -- not available.

- (1) USRM 'reserves'.
- (2) Western world only.
- (3) Raw coal.
- (4) Saleable coal.
- (5) Recovery rate based on that of economic demonstrated resources.
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