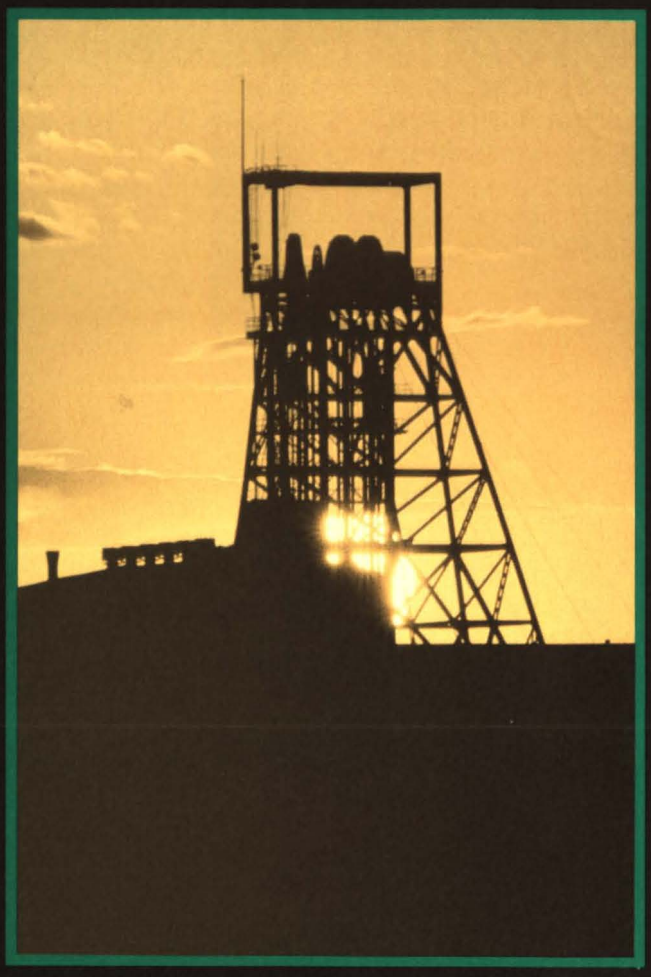
Australia's Identified Mineral Resources 1992



BRS

Bureau of Resource Sciences

The diversity and quality of Australia's mineral endowment is recognised worldwide. This wealth of resources ranks Australia as one of the world's most important suppliers of minerals and the high potential for future mineral discoveries provides incentive for further exploration. The Bureau of Resource Sciences (BRS) will publish assessments of Australia's identified mineral resources each year as input into Government policy decisions relating to resource and environment management for sustainable development.

Estimates of Australia's identified resources of major (and a number of minor) mineral commodities for 1992 are presented in Table 1. The estimates have been prepared by the Mineral Resources Branch of BRS using published and unpublished information. To put resource totals in perspective, data for Australian mine production and for world resources and mine production are included. Australia's mine production data have been provided by the Australian Bureau of Agricultural and Resource Economics (ABARE), and petroleum production by the Petroleum Resources Branch of BRS. World data have been obtained or calculated from various sources, mainly US Bureau of Mines publications.

Australia's position in world rankings and trends in Economic Demonstrated Resources (EDR) of some major commodities (Figure 1) are discussed. Changes in exploration expenditure since 1989-90 are summarised in Figure 2.

The classification used in Table 1 was adopted by the former Bureau of Mineral Resources, Geology and Geophysics (BMR) in 1975 (*Australian Mineral Industry Quarterly*, **28**(1), 11-13) and refined in 1983 (*Australian Mineral Industry Quarterly*, **36**(3), 73-82). It reflects both the geological certainty of occurrence of mineral resources and the economic feasibility of their extraction (see Terminology and Definitions). EDR is used instead of 'reserves' for national resources totals in Australia because the latter term is used by various groups to describe different resource categories. The 'paramarginal' and 'submarginal' subdivisions of subeconomic resources refer to feasibility of extraction at current prices. 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 (Table 2) are classified by BRS in categories adopted by the Organisation for Economic Co-operation and Development Nuclear Energy Agency (OECD/NEA) and the International Atomic Energy Agency (IAEA). 'Reasonably Assured Resources' of the OECD/NEA and IAEA classification can be equated with 'demonstrated resources' of the BMR classification (above), and 'Estimated Additional Resources-Category I' with 'inferred resources'. In previous years resources recoverable at a cost of less than $US80/kg uranium (U) were equated with EDR and resources recoverable at a cost of $US80-130/kg U with 'paramarginal resources'. In 1992 most uranium was sold at prices below $US80/kg U and hence resources recoverable at a cost of less than $US80 /kg U are not necessarily EDR.

Major Mineral Commodities

Australia's mineral resources have been sustained at adequate levels, relative to production, through continued exploration at known deposits and successful exploration in greenfield regions. At a number of mines, resources have increased progressively despite mining over an extended period. Increased efficiencies in mining and processing, achieved through application of new technology, have resulted in higher recoveries of minerals from many deposits.

Trends in EDR for black coal, bauxite, iron ore, gold, copper, lead, zinc, nickel and mineral sands since 1975 are shown Figure 1. The export value of these commodities and value added products totalled more than $20 000 million in 1991-92 (*ABARE Agriculture and Resources Quarterly*, 1992, **4**(3), 437-8).

Black coal

Australia is the world's largest exporter of black coal and on the basis of EDR has about 8% of black coal resources, ranking fifth in the world behind the US, the former USSR, China and South Africa. EDR increased sharply in 1986 as result of a major reassessment of resources in New South Wales by its Department of Mineral Resources.The remaining minor fluctuations were changes resulting from additions due to exploration and losses to production. Minor increases in both *in situ* and recoverable EDR occurred in 1992.

In recent years Australia's recoverable EDR has remained steady at about 51 000 million tonnes (Mt), 97% of which is in Queensland and New South Wales. Locally important but relatively small resources occur in Tasmania, South Australia and Western Australia. A consequence of the large EDR relative to annual production (ABARE reports 216.6 Mt in 1991/92) is that exploration expenditure is low and is not likely to rise significantly in the short term.

Bauxite

Australia currently produces 41% of the world's bauxite and 33% of the world's alumina, making it the world's largest producer of bauxite and alumina. It is also a major low-cost producer of primary aluminium (8% of the world's aluminium metal). Its prominent role in the world aluminium industry is underpinned by substantial resources of bauxite in Queensland (Cape York Peninsula), the Northern Territory (Gove Peninsula) and Western Australia (Darling Ranges and Admiralty Gulf). Bauxite is mined from all regions except Admiralty Gulf. World bauxite reserves and resources plus alternative sources of alumina are adequate to satisfy world demand for the foreseeable future.

Bauxite EDR remained virtually unchanged between 1975 and 1987. The increase in 1988 resulted from delineation of additional resources and the decrease in 1992 from reclassification of some resources on Cape York Peninsula.

Iron ore

Australia's identified iron ore resources are very large. On a world scale they are exceeded only by those of the former USSR. EDR represent slightly more than 35% of total identified resources (additional EDR are delineated from total resources when required for development). A reduction in EDR between 1975 and 1976 resulted from a reclassification of some phosphorus-bearing resources. Since then EDR have shown a gradual upward trend. The increase between 1990 and 1991 reflects the results of additional exploration, which upgraded inferred resources to EDR. EDR increased marginally in 1992.

A number of projects, mainly in the Pilbara, have recently been commissioned or proposed for future development. Their combined production capacity exceeds 30 Mt a year. These projects are largely in response to the substantial rise in export demand for Australian iron ores since the mid-1980s particularly from northern Asian countries. Many of the projects represent a progressive replacement of existing mines. Some will provide a significant extension in mine life (through blending practices) of the higher grade premium deposits upon which the industry has largely depended to date.

Gold

With 3% of the world's EDR, Australia ranks fifth in the world after South Africa, the former USSR, US and Canada. South Africa's reserves (broadly equivalent to EDR) total 20 000 tonnes and the US 4 770 tonnes. The former USSR had reserves of over 6 000 tonnes. Australia's EDR of gold have grown substantially in recent years and in 1992 stand at a record 2 466 tonnes. Despite this growth, the ratio of EDR to annual gold production remains at a level similar to that of the early 1980s. In addition to EDR more than 2 000 tonnes are not recoverable under current economic conditions or have not been adequately explored to allow an assessment of economic viability. A steady increase in EDR in the 1980s resulted from the success of carbon-in-pulp extraction technology for treating lower grade ores and a subsequent surge in exploration.

Western Australia has 60% of EDR and accounts for about 75% of annual gold production. In 1991/92 Australian gold production was 240.1 tonnes, with exports of 230.79 tonnes valued at $3 316 million.

Copper

Australia has about 2% of the world's EDR. Copper resources are contained mainly in the Olympic Dam and Mount Isa deposits.Two smaller but significant deposits scheduled to come into production are Nifty (WA) in late 1993 and Northparkes (NSW) within the next four years. The Osborne deposit in Queensland may contribute to EDR in the future. The discovery of a potentially significant copper-gold deposit 40km north of Cloncurry (Queensland), the Ernest Henry Prospect, was announced in late 1991 and exploration is continuing.

Lead and Zinc

EDR of lead and zinc rank third after the US and the former USSR, and the US and Canada, respectively. Most lead and zinc EDR are contained in the Hilton, Mount Isa, Broken Hill, Elura and Hellyer deposits. Development of an underground mine and construction of processing facilities at the very large McArthur River deposit (NT) is to start in early 1993 and a substantial proportion of this resource is expected to be transferred to EDR in due course.

Variations in EDR before 1983 for copper and 1984 for lead and zinc were mainly the result of changes to resources at Mt Isa (copper, lead, zinc) and Broken Hill (lead, zinc). The steady decline in trends for lead and zinc in the early 1980s reflects, at least in part, low metal prices. The subsequent sharp increase was due mainly to additional resources at the Olympic Dam deposit (copper) in South Australia and Hilton deposit (lead, zinc) in Queensland. The reduction in EDR for copper, lead and zinc between 1988 and 1989 resulted from reclassification of some resources following changes in resource classification systems used in Australia.

Nickel

EDR rank sixth in the world after Cuba, Canada, the former USSR, Indonesia and New Caledonia. Almost all EDR (98%) are in sulphide deposits in Western Australia, where the main mines are in the Kalgoorlie region: Kambalda, Carnilya Hill and Leinster. Development of open cut and underground mines at Forrestania, west of Norseman, began in early 1992 and consideration is being given to open pit development of low grade disseminated sulphide deposits at Mount Keith and Yakabindie.

EDR remained relatively unchanged until the mid-1980s. A reduction at that time resulted from reclassification of resources at mines that were shut down. The increase from 1990 resulted from reclassification of resources at a reopened mine and at projects where open cut mining was assessed to be economically viable. A 20% decrease in EDR in 1992 resulted mainly from the reclassification of disseminated sulphide resources in the light of more recent data.

Mineral sands

EDR of ilmenite, rutile, and zircon account for about 31%, 15%, and 27% respectively of the world's EDR. Australia is the world's leading producer of ilmenite and rutile (both titanium-bearing minerals), and zircon.

Resources of these minerals (collectively referred to as mineral sands) are all in alluvial deposits: present-day and ancient beach and dune deposits (on the east and west coasts), and inland marine deposits (such as WIM150) in the Murray Basin. Monazite, which contains various rare-earth elements (mainly cerium, lanthanum and neodymium), is sometimes a minor accessory mineral. Of Australia's EDR of ilmenite, rutile, and zircon located in coastal zones, 8%, 30%, and 18% respectively are currently quarantined in national parks and not available for mining; most of these resources are on the east coast.

Increases in EDR (principally ilmenite) from 1988 to 1990 resulted from delineation of further resources at mines in Queensland, New South Wales and Western Australia. The increase from 1990 to 1991 reflects reclassification of some resources in Queensland, and in 1992 delineation of further resources at mines in Western Australia.

Diamond

All of Australia's diamond production is from the Kimberley area in Western Australia. The Argyle mine is the world's largest diamond producer by volume—35 million carats (Mc) or 7 tonnes—but not value. Argyle's EDR totalled 820 Mc in 1992, which accounted for virtually all of Australia's EDR.

EDR published by BMR in 1991 have been revised following clarification and receipt of additional information concerning previously published data. The revised EDR estimates are gem and cheap-gem 391 Mc and industrial 488 Mc.

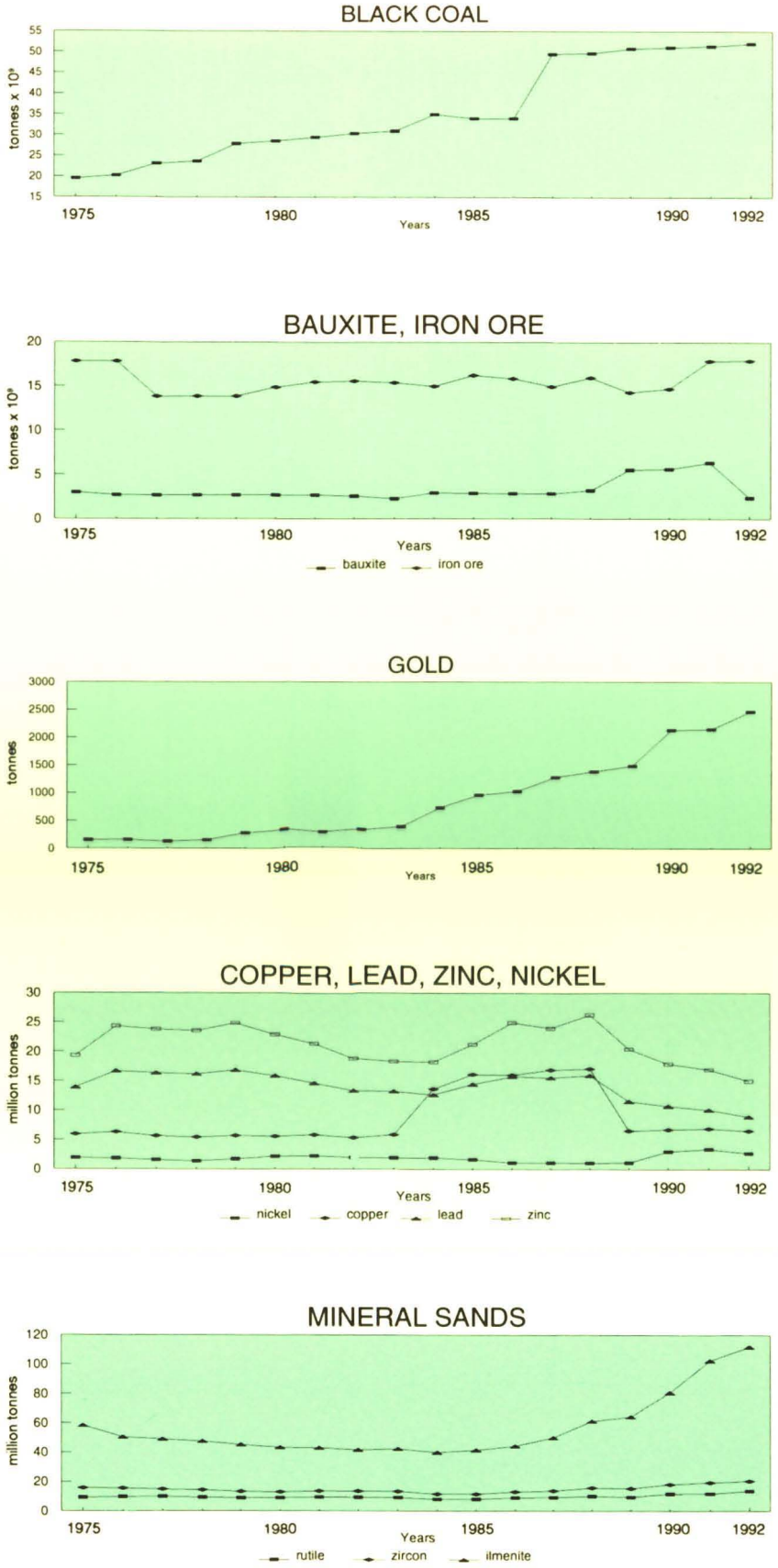


Fig. 1 Trends in Economic Demonstrated Resources (EDR) for major commodities since 1975.

Table 1. Identified resources of major minerals and fuels 1992

COMMODITY	UNITS	AUSTRALIA							WORLD 1991	
		Demonstrated			Inferred			Mine production 1991	Economic demonstrated resources	Mine production
		Eco-nomic	Subeconomic		Eco-nomic	Sub-economic	Undifferent-iated			
			Para-marginal	Sub-marginal						
Antimony	kb Sb	63.5	76.7	64.4	5.4	15.0	-	1.6	4200	59
Asbestos										
Chrysotile ore	Mt	-	46	-	-	-	75	-	110	3.9
Crocidolite fibre	Mt	-	0.4	-	-	-	2.1	-		
Bauxite	Mt	2379	-	5230	-	-	2393	40.5	21800	109
Black coal										
In situ	Gt	72	1	6	-	-	very large			
Recoverable	Gt	52	1	4	-	-		0.20 (2)	650	3.1 (3)
Brown coal										
In situ	Gt	46	1	2	-	-	184			
Recoverable	Gt	41	1	2	-	-	165	0.051	270	1.4
Cadmium	kt Cd	50.2	63.8	10.6	1.8	1.4	-	2.1	535	20.3
Chromite	Mt	-	2.37	0.52	-	20	-	-	1361	13
Cobalt	kt Co	53	17	254	-	36	-	1.2	3310	34
Copper	Mt Cu	6.5	13.9	1.0	0.6	24.6	-	0.3	321	9.1 (1)
Diamonds										
Gem & near gem	10^6 c	366	0.6	-	-	-	}94	}36.0	300	47.5
Industrial	10^6 c	485	0.6	-	-	-			980	51.7
Fluorine	Mt F	-	24.1	5.8	-	-	0.7	-	102 (4)	2.2
Gold	t Au	2466	680	91	-	-	1469	236.1	43000	2060
Iron ore	Gt	17.9	12.9	0.2	7.2	10.9	-	0.118	151	0.906
Lead	Mt Pb	8.9	18.9	7.4	0.5	11.1	-	0.6	70	3.4 (1)
Lithium	kt Li	160	-	3	-	-	7	2.3	2210	5.4
Manganese ore	Mt	108	74	311	69	42	-	1.390	816	22
Mineral sands										
Ilmenite	Mt	111.8	67.2	0.1	-	-	72.5	1.5	364	5.3 (8)
Rutile	Mt	13.5	33.4	0.2	-	-	24.6	0.19	89	0.4 (8)
Zircon	Mt	20.3	24.3	0.2	-	-	18.8	0.29	75	0.6
Nickel	Mt Ni	2.7	0.8	5.0	-	1.3	-	0.069	48	0.95
Niobium	kt Nb	3.4	68	-	-	-	1997	-	3538	12.4
Petroleum (recoverable) (6)										
Crude oil	GL	285	-	33	-	-	-	27.6	158589	3500
Natural (sales) gas	10^9 m^3	888	-	1127	-	-	-	22.5 (9)	119179	2142
Condensate	GL	118	-	54	-	-	-	3.5	-	-
LPG naturally occur.	GL	129	-	82	-	-	-	3.6	-	-
Phosphate rock	Mt	-	2095	-	-	-	1947	0.003	11990	160
PGM (Pt, Pd, Os, Ir, Ru, Rh)	t metal	17	20.8	16.4	3.5	71	-	0.9	56000	287
Rare earths										
REO & Y_2O_3	Mt	0.3	4.1	-	-	-	3.9	-	84 (5)	0.06 (7)
Shale oil	GL	-	-	4564	-	40468	-	-	-	-
Silver	kt Ag	17.0	38.4	5.8	0.5	12.5	-	1.18	280	14.2
Tantalum	kt Ta	5.9	6.5	0.09	-	-	66	0.20	22	0.4
Tin	kt Sn	99.7	129.8	76.6	-	417	224	5.7	5900	210
Tungsten	kt W	1.1	125	74	-	88	42	0.24	2350	39
Uranium (see Table 2)										
Vanadium	kt V	24	1488	8425	-	2314	-	-	4268	33.5
Zinc	Mt Zn	15.0	48.0	9.8	1.3	10.0	-	1.02	150	7.4 (1)

Abbreviations: t = tonne; c = carat; m^3 = cubic metre; L = litre; kt = 10^3t; Mt = 10^6t; GL = 10^9L.

(1) Western world only.
(2) Raw coal.
(3) Saleable coal.
(4) USBM 'reserves' occurring as fluorspar only.
(5) Rare-earth oxides only.
(6) Source: Petroleum Resources Branch, BRS (as at 1 Jan. '91)
(Mine Production as at 31 Dec. '91).
(7) Excludes USA production of Y_20_3.
(8) Excludes USA.
(9) Includes ethane.

Table 1 Identified resources of major minerals and fuels 1992.

		AUSTRALIA							WORLD 1991	
		Demonstrated			Inferred					
			Subeconomic							
		Economic	Para-marginal	Sub-marginal	Economic	Subeconomic	Undifferent-iated	Mine production 1991	Economic demonstrated resources	Mine production
Antimony	(kt Sb)	63.5	76.7	64.4	5.4	15.0	-	1.6	4200	59
Asbestos									110	3.9
Chrysotile ore	(Mt)	-	46	-	-	-	75	-		
Crocidolite fibre	(Mt)	-	0.4	-	-	-	2.1	-		
Bauxite	(Mt)	2379	-	5230	-	-	2393	40.5	21800	109
Black coal	(Gt)									
in situ		72	1	6	-	-	very large			
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in situ		46	1	2	-	-	184			
recoverable		41	1	2	-	-	165	0.051	270	1.4
Cadmium	(kt Cd)	50.2	63.8	10.6	1.8	1.4	-	2.1	535	20.3
Chromite	(Mt)	-	2.37	0.52	-	20	-	-	1361	13
Cobalt	(kt Co)	53	17	254	-	36	-	1.2	3310	34
Copper	(Mt Cu)	6.5	13.9	1.0	0.6	24.6	-	0.3	321	9.1 (1)
Diamonds	(10^6 c)									
gem & cheap-gem		366	0.6	-	-	-	} 94	} 36.0	300	47.5
industrial		458	0.6	-	-	-			980	51.7
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Natural (sales) gas	($10^9 m^3$)	888	-	1127	-	-	-	22.5 (9)	119179	2142
Condensate	(GL)	118	-	54	-	-	-	3.5	-	-
LPG naturally occur.	(GL)	129	-	82	-	-	-	3.6	-	-
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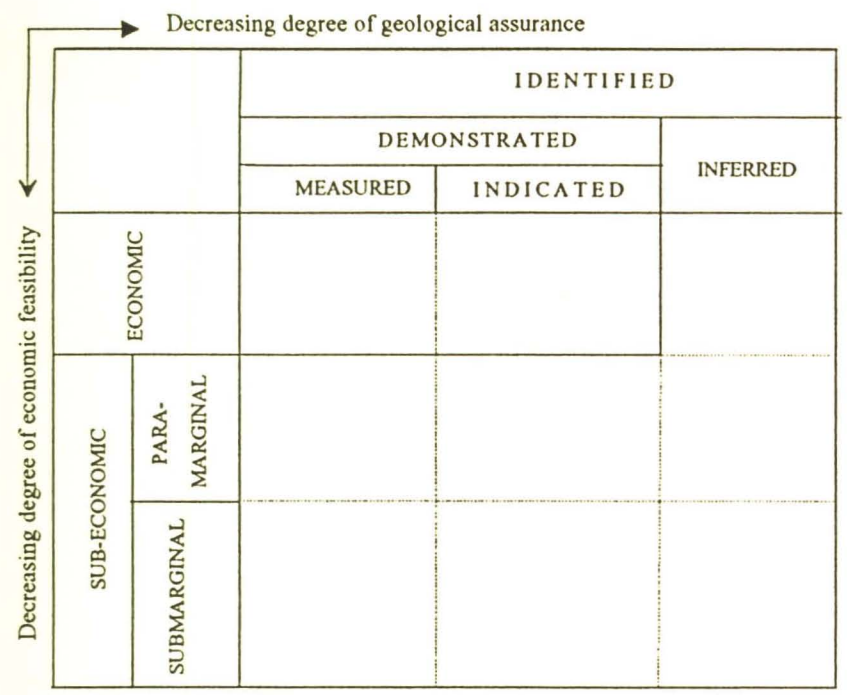


Resource classification scheme (see Terminlogy and Definitions)

Uranium

Estimates of Australia's recoverable uranium resources are set out in Table 2, together with the latest available figures for other countries. The resources are shown in categories as defined by the OECD/NEA and IAEA. The Australian estimates have been calculated by the Mineral Resources Branch using basic exploration data provided by companies. The revision of estimates for 1992 takes into account production and reassessments in the light of additional exploration, cost increases, and changes in the exchange rate of the Australian dollar.

Australia's Reasonably Assured Resources (RAR) recoverable at less than US$80/kg U are 31% of the total resources in the low cost RAR category (derived from estimates published by OECD/NEA and IAEA and adjusted as shown in Table 2). Australia's RAR in this category decreased by 12 000 tonnes during the past year.

	Cost Range to US$80/kg U [2] ($US$30/lb U_3O_8)		Cost Range US$80-130/kg U [2] ($US$30-50/lb U_3O_8)	
COUNTRY	**Reasonably Assured Resources [3]**	**Estimated Additional Resources - Category I [4]**	**Reasonably Assured Resources [3]**	**Estimated Additional Resources - Category I [4]**
Algeria	26 000	-	-	-
Argentina	8 740	540	2 190	1 950
Australia [5]	462 000	272 000	55 000	122 000
Brazil	162 000	94 000	-	-
Canada [6]	275 000	30 000	85 000	60 000
France	23 800	4 200	15 700	3 900
Gabon	11 000	1 300	4 650	8 300
Namibia	84 750	30 000	16 000	23 000
Niger	166 070	295 770	6 650	10 000
South Africa	247 600	51 800	96 800	30 800
Spain	17 850	-	21 150	9 000
Sweden	2 000	1 000	2 000	5 300
USA [7]	101 900	n.a.	254 200	n.a.
Other Countries [8]	32 330	22 270	80 130	45 590
Total (adjusted) [9]	1 511 000	680 000	637 000	311 000

Table 2 Estimated recoverable resources of uranium 1992[1](tonnes U)

Australia's Estimated Additional Resources-Category I (EAR-I) recoverable at less than US$80/kg U are 40% of the total resources in the low cost EAR-I category (derived from estimates published by OECD/NEA and IAEA and adjusted as shown in Table 2). Australia's EAR-I in this category increased by 3 000 tonnes during the past year.

Australia's RAR and EAR-I in the US$80-130/kg U cost category remained unchanged in 1992.

In addition to the RAR and EAR-I categories of resources shown in Table 2, BRS estimates that there is a 75% probability that Australia has undiscovered potential (Undiscovered Resources) amounting to more than 2 600 000 tonnes U and a 50% probability that the Undiscovered Resources may exceed 3 900 000 tonnes U.

Footnotes for Table 2

[1] Data for countries other than Australia and Canada are from the most recent OECD/NEA and IAEA publications available at 31 December 1992.

[2] The OECD/NEA and IAEA quote uranium production costs in US$ per kilogram U. These cost categories must not be confused with market prices; previous development costs or profits are not included. US$80 per kilogram U = US$30/lb U_3O_8 approximately.

[3] Reasonably Assured Resources refer to uranium that occurs in known mineral deposits of such size, grade and configuration that it could be recovered within the given production cost ranges, with currently proven mining and processing technology. Estimates of tonnage and grade are based on specific sample data and measurements of the deposits and on knowledge of deposit characteristics. RAR have a high assurance of existence and in the cost category below US$80/kg U (US$30/lb U_3O_8) are considered as Reserves.

[4] Estimated Additional Resources - Category I refer to uranium in addition to RAR that is expected to occur, mostly on the basis of direct geological evidence, in extensions of well explored deposits and in deposits in which geological continuity has been established but where specific data and measurements of the deposits and knowledge of the deposits' characteristics are considered to be inadequate to classify the resources as RAR. Such deposits can be delineated and the uranium subsequently recovered, all within the given cost ranges. Estimates of tonnage and grade are based on such sampling as is available and on knowledge of the deposit characteristics as determined in the best known parts of the deposit or in similar deposits. Less reliance can be placed on the estimates in this category than on those for RAR.

[5] Data for Australia compiled by BRS as at December 1992.

[6] Energy, Mines & Resources Canada; News Release 12 November 1992.

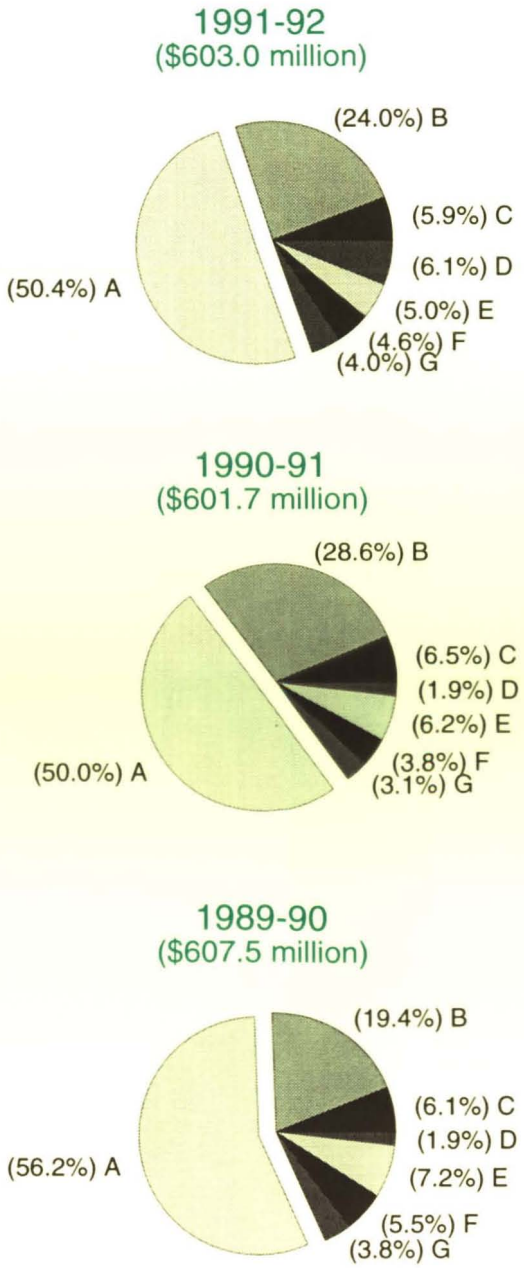
[7] The United States Estimated Additional Resources are not reported separately for EAR-I and EAR-II. n.a.: not available.

[8] Austria, Central African Republic, Denmark, Finland, Germany, Greece, Hungary, Indonesia, Italy, Japan, Republic of Korea, Mexico, Peru, Portugal, Somalia, Turkey, Vietnam, Yugoslavia, Zaire, Zimbabwe.

[9] Totals have been adjusted by OECD/NEA and IAEA to account for milling and/or mining losses not incorporated in the estimates for Algeria, Brazil, Niger, Spain and certain countries grouped under 'Other Countries'. Because of these adjustments these totals do not represent the sum of the country assessments detailed above. The former USSR, China and India have reported significant uranium resources. However, these have not been included in the above table because the estimates are either not consistent with standard OECD/NEA and IAEA resource definitions/categories, or cost categories were not assigned to the estimates.

Exploration Expenditure

Australia's mineral exploration expenditure for 1991-92 totalled $603.0 million, which was marginally higher than the 1990-91 total of $601.7 million. Gold continues to be the major single-commodity category (category A) of expenditure accounting for 50.4% of total expenditure. Base metals (category B) decreased to 24.0% of total expenditure, while iron ore (category D) increased to account for 6.1% of total expenditure as compared to 1.9% in 1990-91.



A - gold; B - copper, lead, zinc, silver, nickel, cobalt; C - diamond; D - iron ore;
E - tin, tungsten, scheelite, wolfram, mineral sands, uranium, construction materials;
F - coal; G - other.
Source: Australian Bureau of Statistics (Cat. No. 8412.0)

Fig. 2 Mineral exploration expenditure since 1989-90.

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 currently or potentially (within a 20-25 year timeframe) feasible.

CATEGORIES 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 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.

SUBECONOMIC - This term refers to those resources that do not meet the criteria of economic; subeconomic resources include paramarginal and submarginal categories.

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

SUBMARGINAL - Subeconomic resources that would require a substantially higher commodity price or some major cost-reducing advance in technology to render them economic.

MINERAL RESOURCES BRANCH

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Identified Resources and Mineral Databases

Dr Bill McKay* 249 9553 *Bauxite, tin, beryllium, gallium, mercury*

Mike Huleatt 249 9609 *Gold, tantalum, lithium, oil shale*

Aert Driessen 249 9687 *Black and brown coal, lead, zinc, silver, antimony, arsenic, bismuth, cadmium, selenium, tellurium*

Roger Pratt 249 9614 *Iron ore, manganese, nickel, platinum group, vanadium, chromium, cobalt, tungsten, molybdenum*

Lloyd David 249 9556 *Titanium, zirconium, rare earths, gem and semi-precious stones, clays, magnesite, talc, dolomite, peat, limestone, gypsum, silica, fertiliser and chemical industry minerals (e.g. phosphate, potash, sodium, sulphur, fluorine, boron), specialty minerals (e.g. barite, diatomite, felspar, graphite, mica, perlite)*

Brian Elliott 249 9502 *Mineral databases, copper*

Keith Porritt 249 9554 *Mineral databases*

Appraisal of Mineral Resource Potential

Yanis Miezitis* 249 9809

Don Perkin 249 9811

Aden McKay 249 9814 *Uranium*

Dr Mike Solomon 249 9287

Advice on Mining

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