



Australian Government

Geoscience Australia

Applying Geoscience to Australia's Most Important Challenges

Australia's national minerals inventory, discoveries and some strategic issues for sustaining a strong resources sector

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**With acknowledgements to Aden McKay,
Yanis Miezitis, Keith Porritt and Mike Huleatt**

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Outline

- **How we get a long term (strategic) view of what is likely to be available for mining**
- **Applications of the national minerals inventory**
 - Comparison of long term and short term estimates
 - Trends for Australia's identified mineral resources
 - The importance of quality of resources
 - Consideration of “peak minerals”
- **Concluding remarks on strategic issues in relation to sustaining a strong minerals sector**

Estimating and reporting the national mineral inventory

- In 1975, Australia adopted the McKelvey resource classification system
 - Used for national and international reporting by the (then) USBM and USGS
- Australia's national system remains comparable with the current USGS system
 - As published in its *Mineral Commodity Summaries*
 - But uses different nomenclature

Australia's National Resource Classification System

Decreasing degree of geological assurance →

		IDENTIFIED RESOURCES	
		DEMONSTRATED	INFERRED
ECONOMIC	SUBECONOMIC		
SUBMARGINAL	PARAMARGINAL		
	SUBMARGINAL		

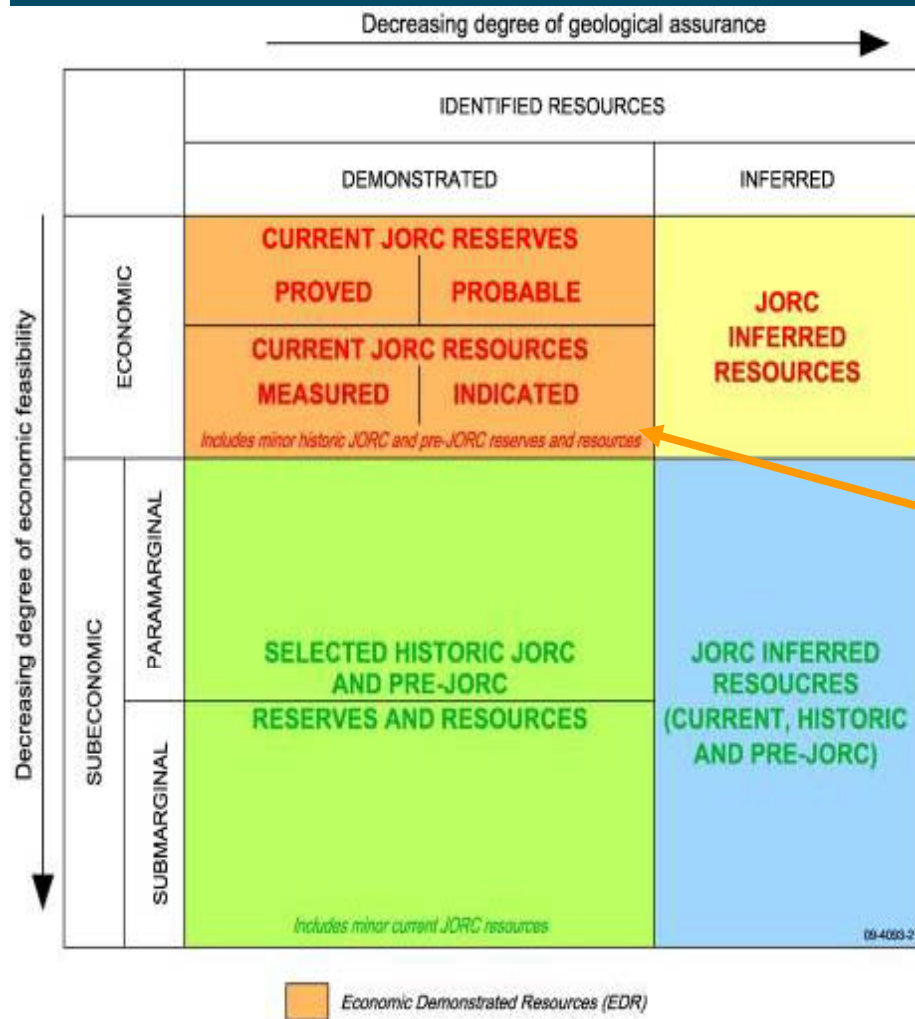
Commercial mineral resource reporting in Australia

- For the past two decades, companies listed on the Australian Securities Exchange (ASX) have been required to report publicly on Ore Reserves and Mineral Resources under their control, using the Joint Ore Reserves Committee (JORC) Code (<http://www.jorc.org/>)
 - JORC Reserves → commercial (relatively short term) view of what is to be mined
 - JORC Resources have “reasonable prospects for economic extraction”
- JORC Code compatible with the national system

National minerals inventories: Not a precise science

- **Estimating the total amount of each commodity likely to be available for mining in the long term is not a precise science**
 - **JORC ‘Reserves’, will in general all be mined, but they only provide a short term view of what is likely to be available for mining**
 - **Most current JORC ‘Measured’ and ‘Indicated’ Resources are also likely to be mined**
 - **Some current JORC ‘Inferred’ and ‘Subeconomic’ Resources will also be mined**
 - **New discoveries (including extensions to known deposits) will add to the resource inventory**

Mapping Australia's National Resource Classification system to JORC Code



The highest category used in the national inventory is 'Economic Demonstrated Resources' (EDR)

– 'Reserve' not used because of specific meaning under JORC

– **EDR** = 'Proved Reserves' + 'Probable Reserves' + 'Measured Resources' + 'Indicated Resources'

• 'Subeconomic' Resources mainly from

old reports

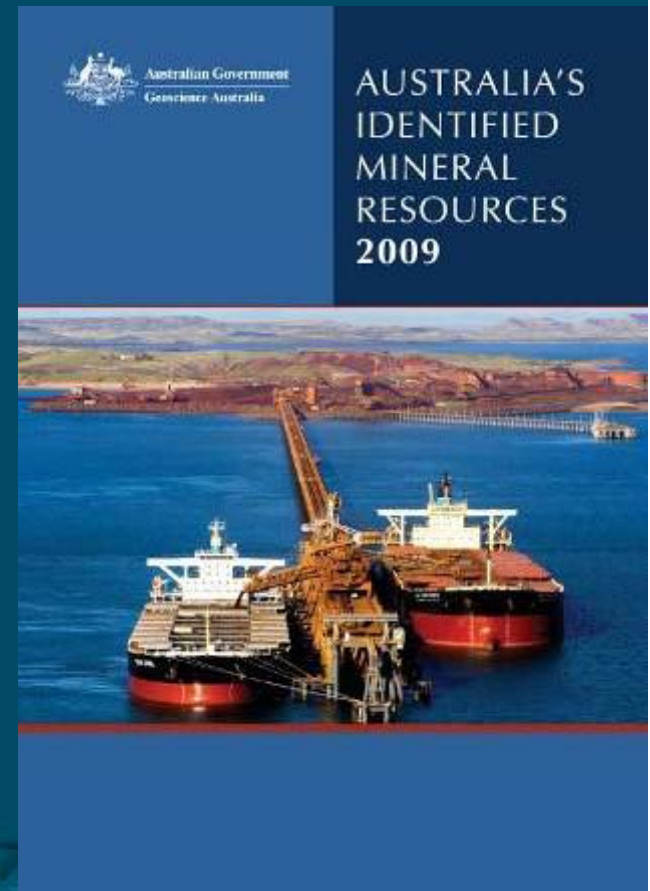
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EDR = key indicator

- The EDR category is considered to provide a reasonable and objective indication of what is **likely to be available for mining in the long term**
 - If anything → conservative estimate
 - Does not consider undiscovered resources

Online publication: *Australia's Identified Mineral Resources*

- Australia's resource stocks for all major and several minor mineral commodities are published in the annual online report by Geoscience Australia: *Australia's Identified Mineral Resources*



What is reported in the national inventory?

COMMODITY	UNITS	AUSTRALIA						WORLD		
		Demonstrated Resources			Inferred Resources (a)	Accessible EDR (AEDR)(b)	JORC Reserves(c) % of AEDR	Mine Production(d) 2007	Economic Demonstrated Resources(e)	Mine Production(f) 2007
		Economic (EDR)	Subeconomic							
			Para-marginal	Sub-marginal						
Antimony	kt Sb	136	43	36	60	136	96 (70%)	-	2100	135
Bauxite	Gt	6.2	0.2	1.4	0.69	5.4	1.9 (35%)	0.062	25	0.190(e)
Black coal in situ recoverable	Gt	56.4	4.1	9.8	97.7					
	Gt	38.9	2.2	6.7	61.6	38.8	12.5 ^(g) (30%)	0.421 ^(h)	687 ⁽ⁱ⁾	5.5 ^{(j)(j)}
Brown coal in situ recoverable	Gt	41.4	43.4	18.1	112					
	Gt	37.3	39	16.3	100.8	32.3	4.9 ^(g) (15%)	0.066 ⁽ⁱ⁾	148 ⁽ⁱ⁾	0.86 ⁽ⁱ⁾
Cadmium	kt Cd	60.8	10.0	10.2	0.3	60.8	51.3 (84%)	0.46	490	19.9(m)
Cobalt	kt Co	1521	183	106	1519	1521	462 (38%)	4.74	7075	60
Copper	Mt Cu	59.4	6.9	1.6	38.5	59.4	18.3 (31%)	0.87	525	15.7
Diamond gem & near gem industrial	Mc	97.3	98.2	0.2	13.1	97.3	95.7 (98%)	9.4	-	106
	Mc	101.3	102.3	0.3	13.7	101.3	99.6 (98%)	9.8	590	69
Fluorine	Mt F	-	0.2	23.7	21.3	-	-	-	117 ^(k)	2.6
Gold	t Au	5839	1272	138	4336	5780	3284 (56%)	245	42 000	2476

Available through Australian mines atlas

www.australianminesatlas.gov.au



Australian Government

australian atlas of minerals resources, mines & processing centres

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Mapping

Quick Search

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Mineral Resources

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Interactive Mapping

Create a map showing Australia's mines. You can use the **Quick Search** tool to locate a mine by name, or for more in-depth research, the **Advanced Search** tool has a wider selection of search options. The mapping application also allows you to view points in Google Earth and print maps in PDF format.

- [Create a Map](#)
- [Quick Search](#)
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Information about Mineral Resources

Read in-depth information about **Gold**, **Bauxite**, **Iron Ore**, **Copper** and other major mineral commodities in the annual Australia's Identified Mineral Resources report.

View **Fact Sheets** and **Rock Files** about some of Australia's key metals and minerals in our **Education** section. Also available is **Minerals Downunder** - a student resource with information about **Gold**, **Copper**, **Silver**, **Mineral Sands** and **Iron**, as well as interactive quizzes.

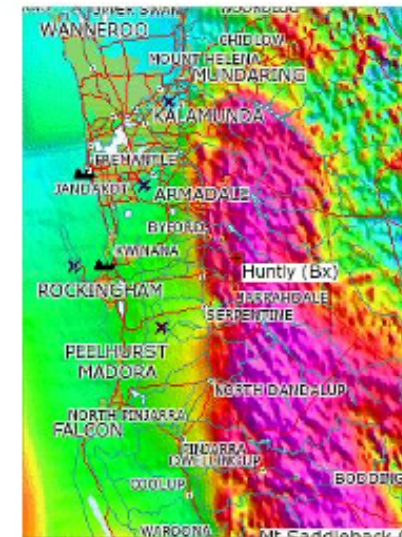
- [Australia's Identified Mineral Resources](#)
- [Mineral Fact Sheets](#)
- [Mineral Rock Files](#)
- [Minerals Downunder](#)
- [Geoprovince-Scale Assessment of Mineral Potential](#)

History of the Minerals Industry

View a history of the minerals industry in Australia in Google Earth and read about its role in Australia's economic development.

- [History of the Minerals Industry in Australia](#)

Your Feedback



Airborne Magnetics image of Darling Range Bauxite - www.australianminesatlas.gov.au

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available sites of
minerals resources, mines
& processing centres

Quick Search | Advanced Search | Legend | Map Layers | Help | Key Map

Cadia

325835

- **Synonyms:** Cadia Hill, Cadia Extended
- **State:** NSW
- **Commodities:** Au, Cu
- **Commodity Name:** Gold, Copper
- **Operating Status:** operating mine

Location

- **Longitude:** 148.9991
- **Latitude:** -33.4550
- **Datum:** GDA94

Links of Interest

- [New South Wales Minerals Council - Cadia Hill Virtual Tour](#)
- [Newcrest Mining Ltd - Cadia](#)
- [Newcrest Mining Ltd](#)

Reserves and resources associated with this deposit
(Most should comply with the JORC Code)

Cadia Hill
30 Jun 2007
Newcrest Mining Limited, 2007, Resource and Reserves Statement 17 August 2007

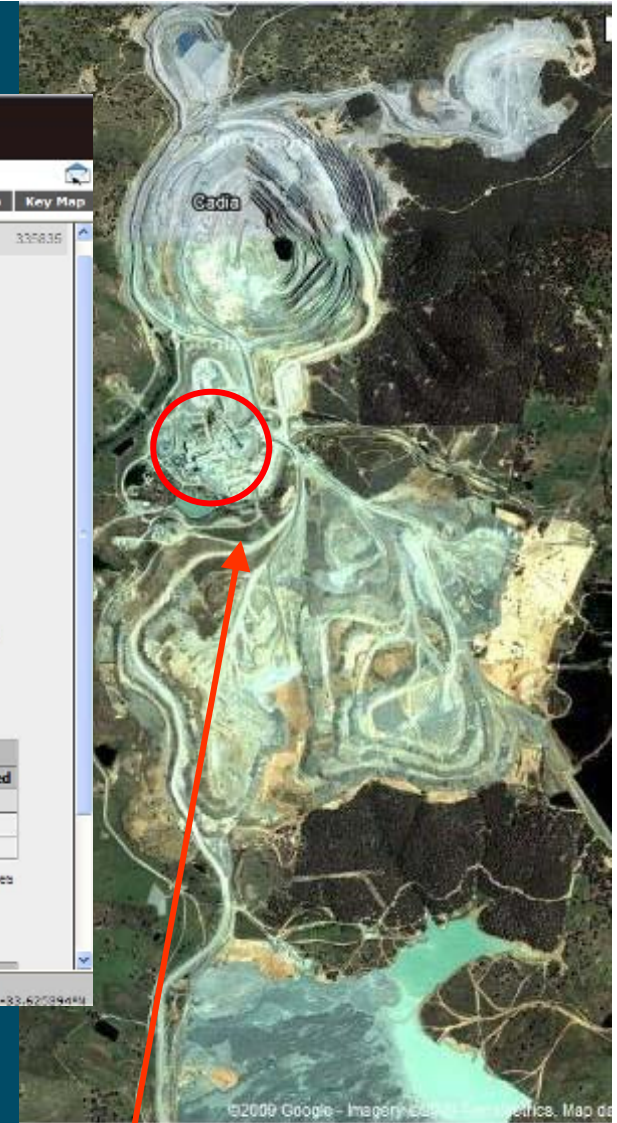
		Ore Reserves ¹		Mineral Resources ¹		
		Proved	Probable	Measured	Indicated	Inferred
Tonnage	(Mt)	116	1.7	189.7	27.4	40.8
Au Grade	g/t	0.8	0.4	0.7	0.5	0.5
Cu Grade	%	0.16	0.19	0.15	0.17	0.11

¹Measured and Indicated Mineral Resources are inclusive of the Ore Reserves

Cadia Extended
30-Jun-2007
Newcrest Mining Limited, 2007, Resource and Reserves Statement 17 August 2007

Scale: 1:166,466 | Quick View: Select a location | Map Tool: Zoom In

Map Centre: 149.0029149E, -33.4547735S | Top Left: 148.9306450E, -33.2681014N | Bottom Right: 149.1971999E, -33.6203949S



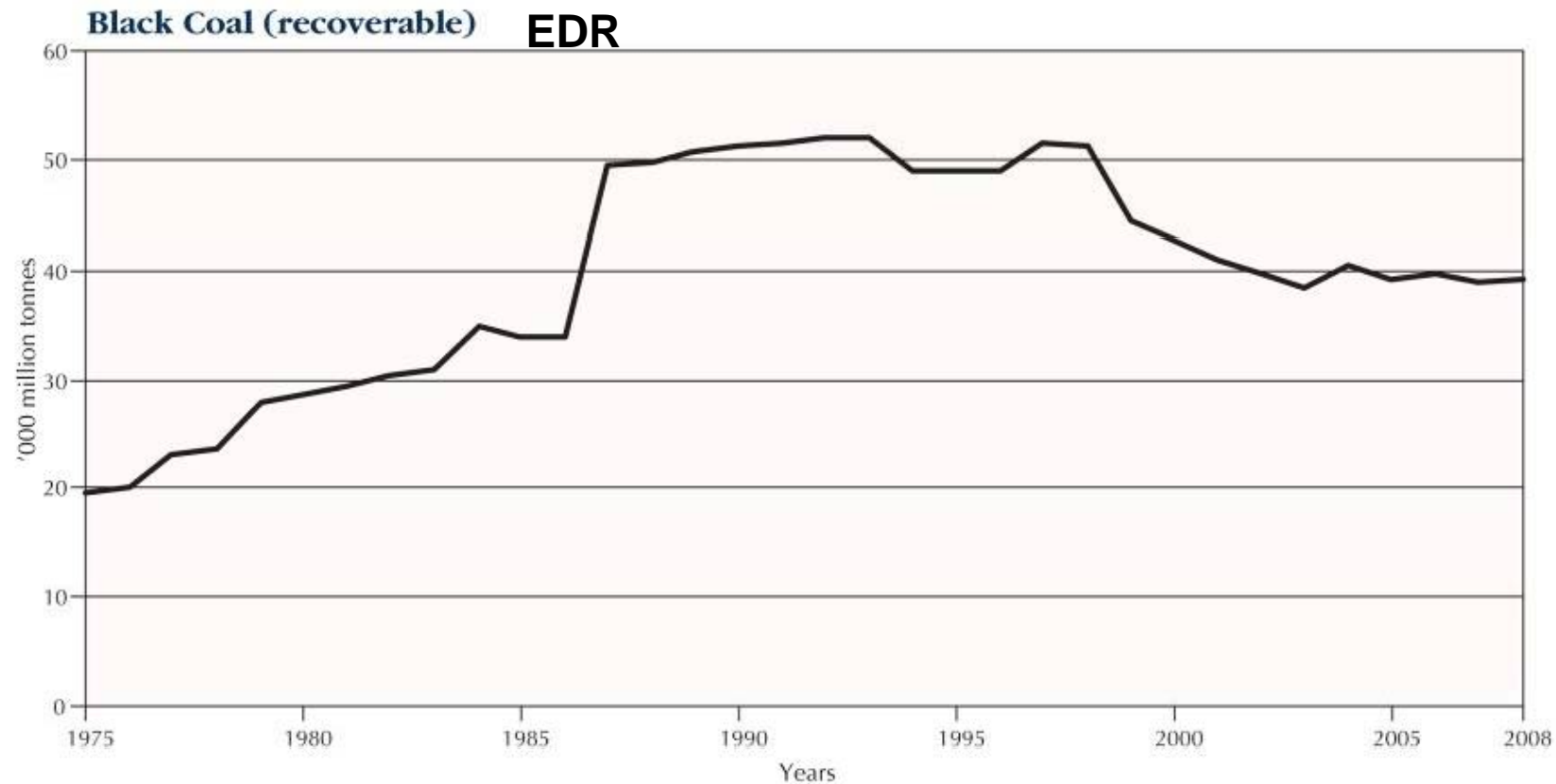
Mapping Resources
Links to companies
Detail in Google Maps

Major trends shown by national inventory

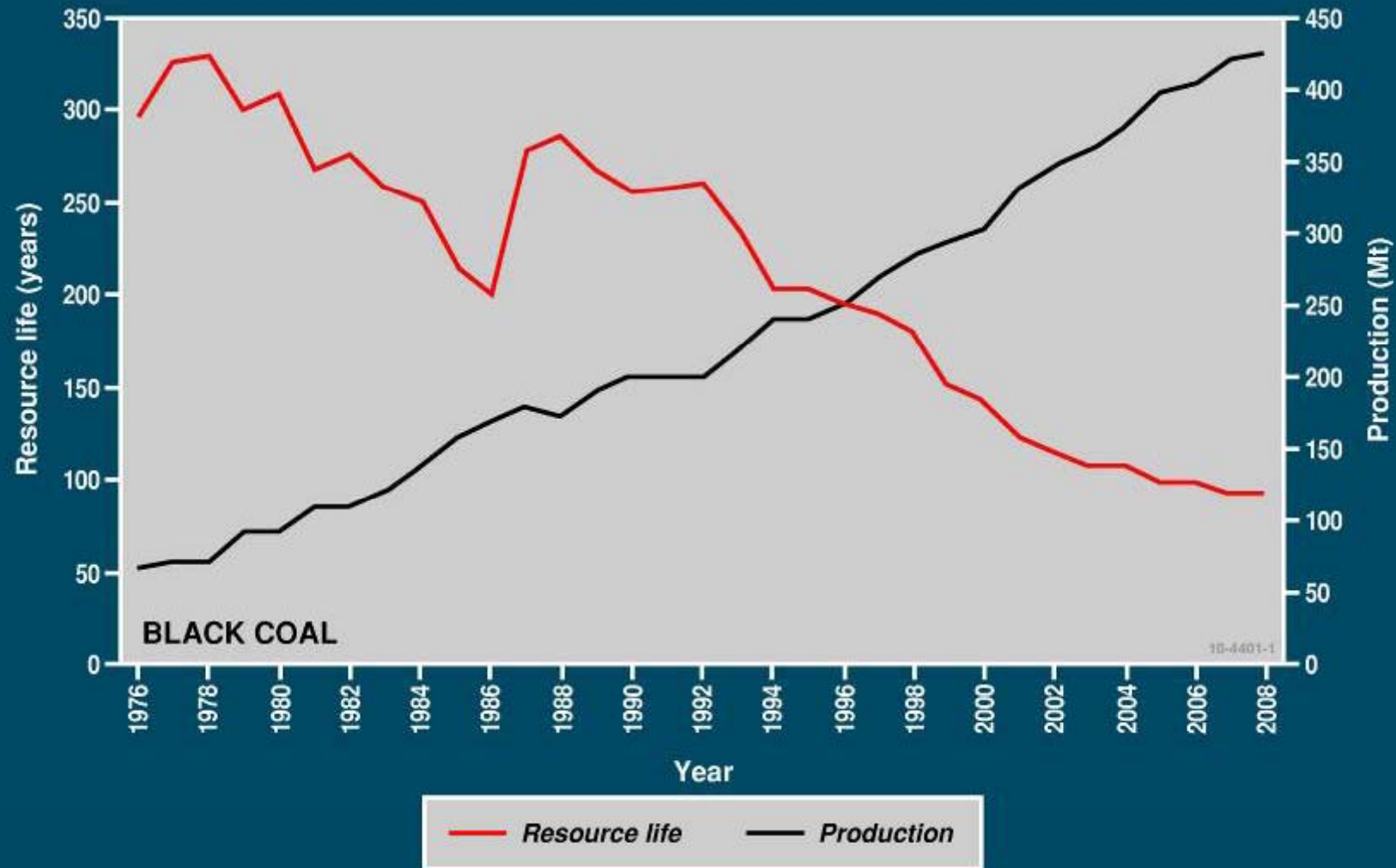
1. Comparison of long term and short term (commercial) estimates of minerals inventory
 - For bauxite, JORC Ore Reserves amount to only about 35% of EDR
 - But 81% of EDR in established mining areas
 - For gold, JORC Reserves amount to 56% of EDR
 - But 80% of EDR associated with existing or committed mines
 - For some commodities (eg. mineral sands) very high proportions of deposits included in EDR are well removed from existing mines

Major trends shown by national inventory

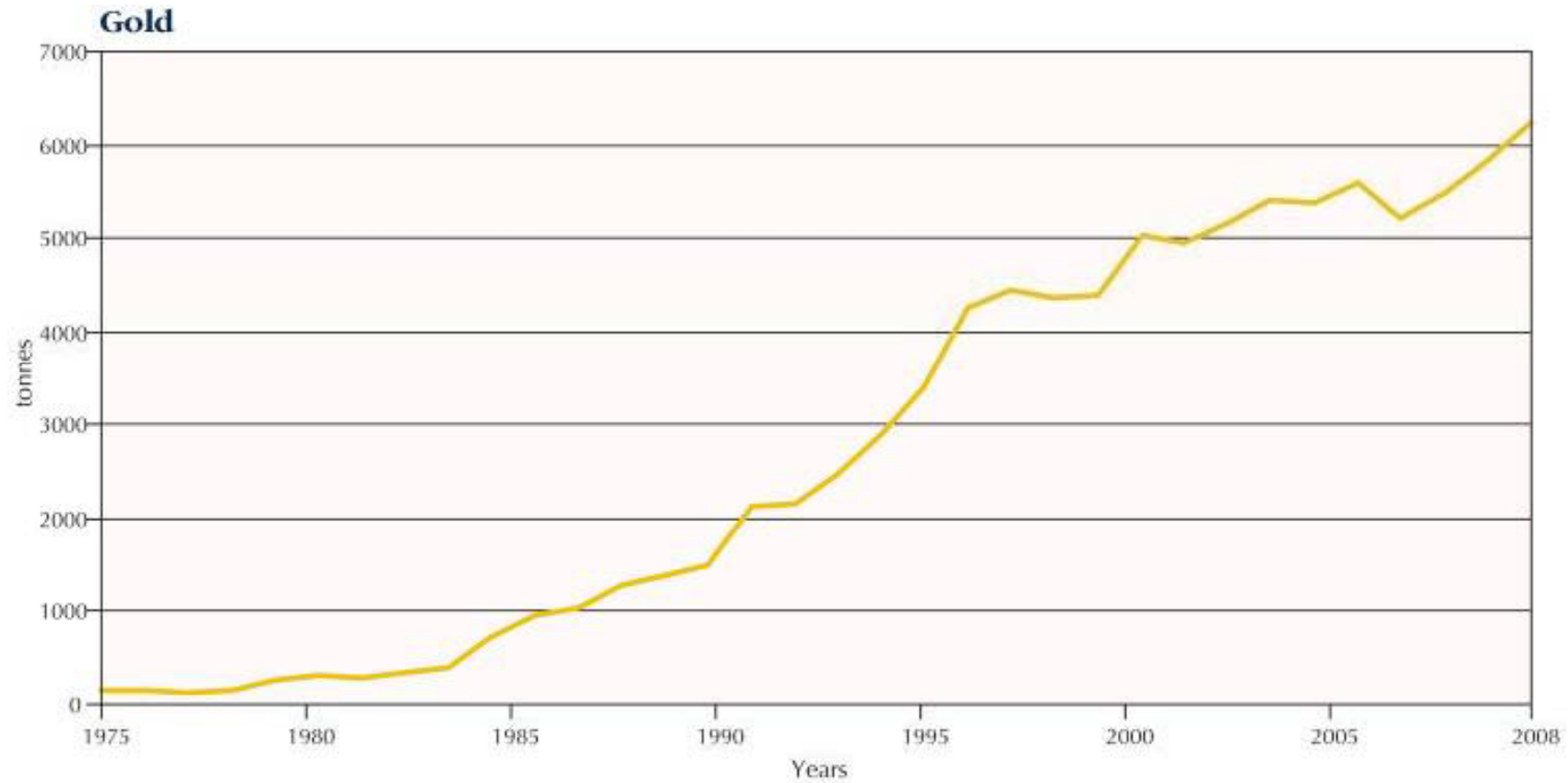
2. EDR, production and resource life trends



Black coal production and resource life



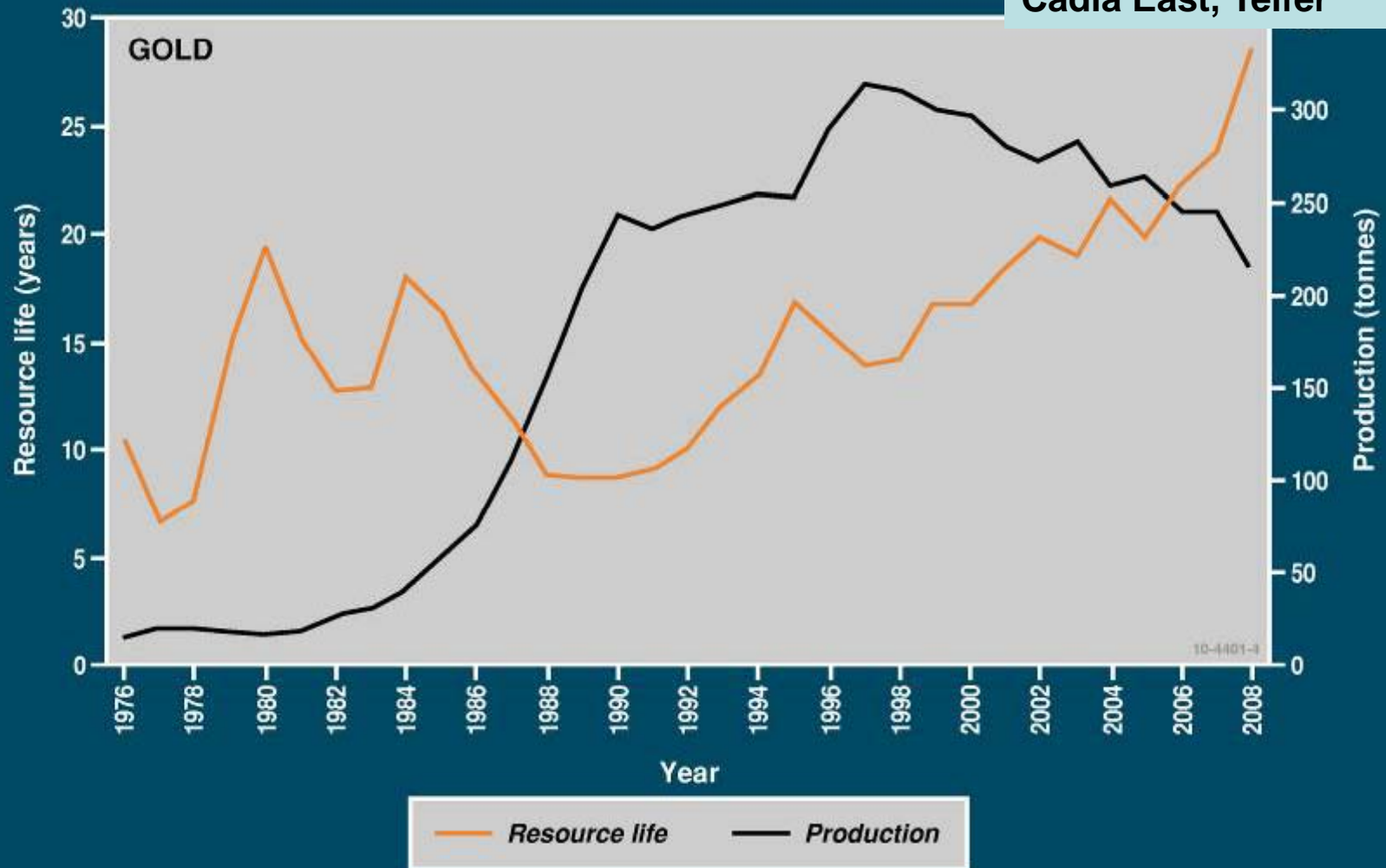
Gold EDR



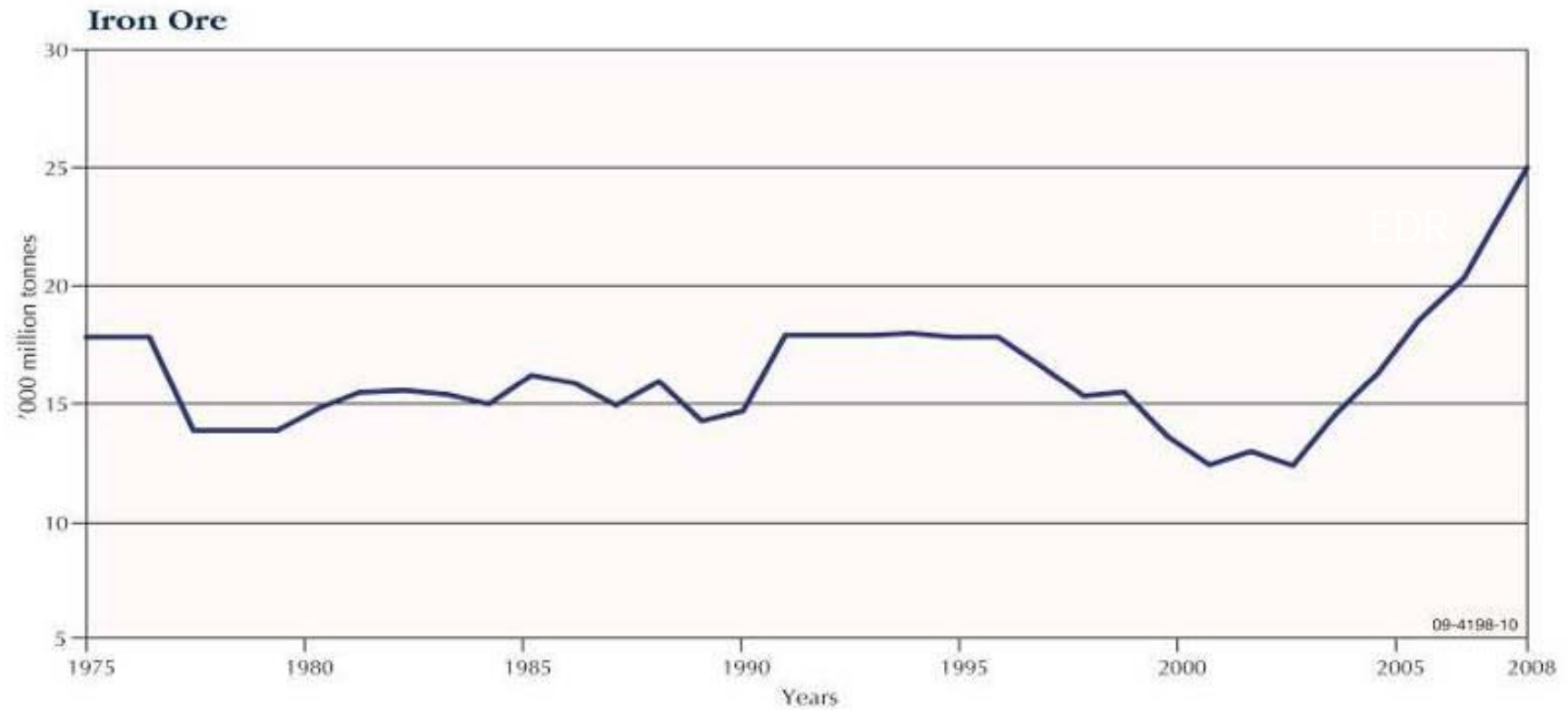
Gold production and resource life

Peak gold?

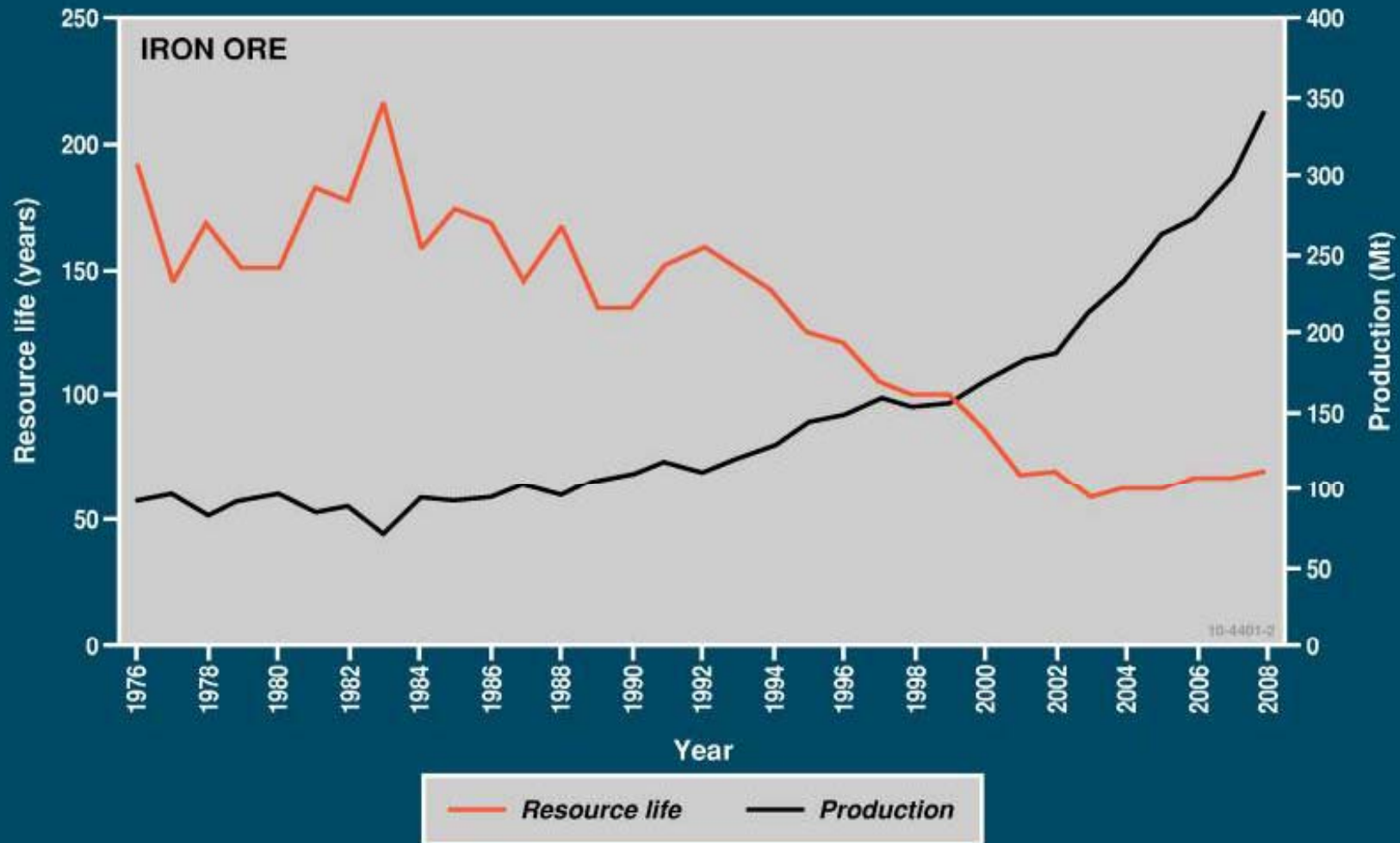
Planned new production:
ODX, Boddington, Telfer,
Cadia East, Telfer



Iron ore EDR



Iron ore production and resource life*



* Resource life = EDR/Production

Quality of resources is important

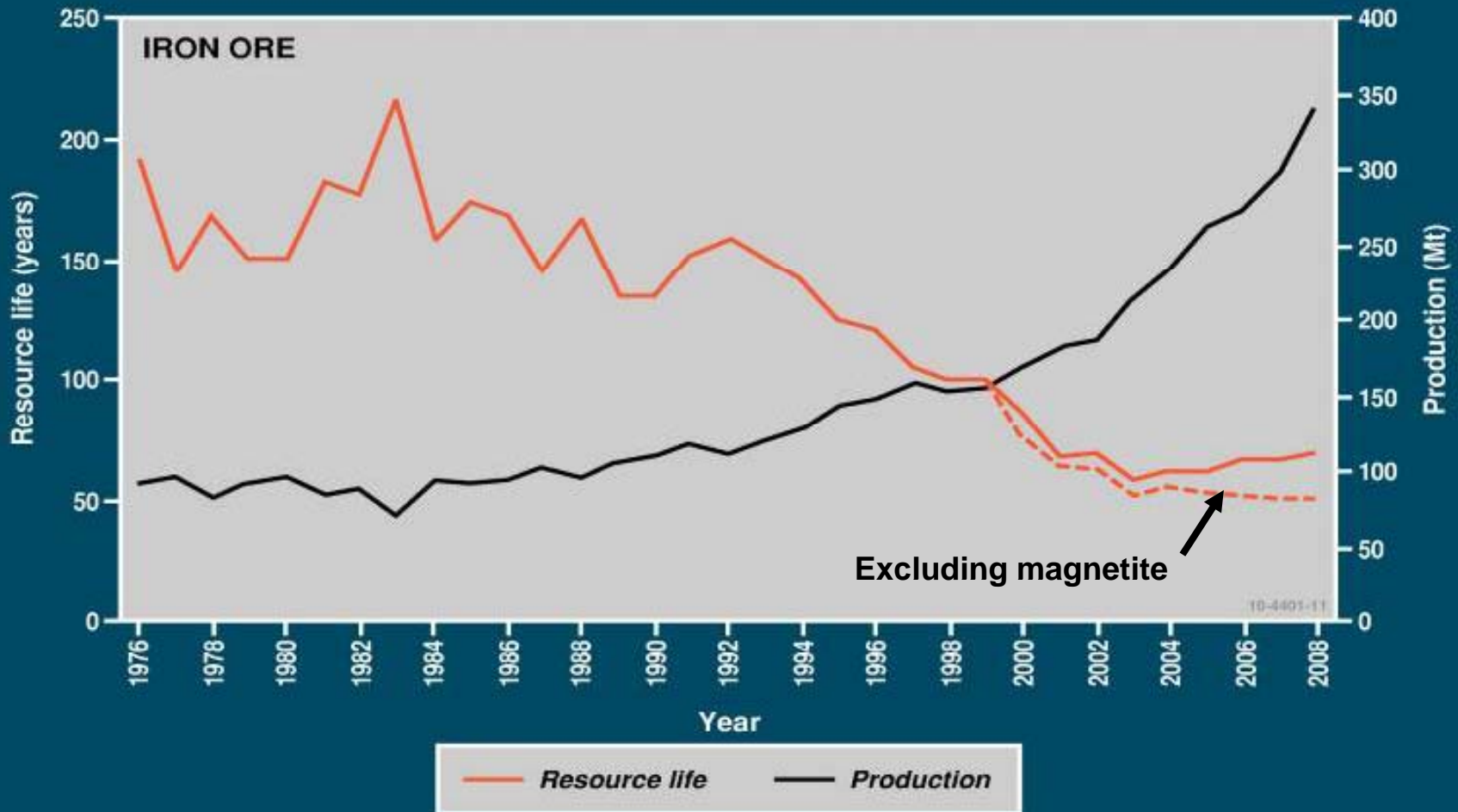
- Not all deposits included in EDR will be systematically mined
 - Deposits in Australia are increasingly competing with deposits elsewhere in the world
 - Economic deposits with **lower returns** are unlikely to be mined in short to medium term
- Energy use, water use and waste minimisation will become increasingly important components of “quality”
 - International markets will demand ongoing increases in efficiencies
 - Major technological advances are needed if we are to efficiently mine and treat lower grade ores

Analysis of quality of iron ore resources

Magnetite is not direct shipping ore – requires beneficiation



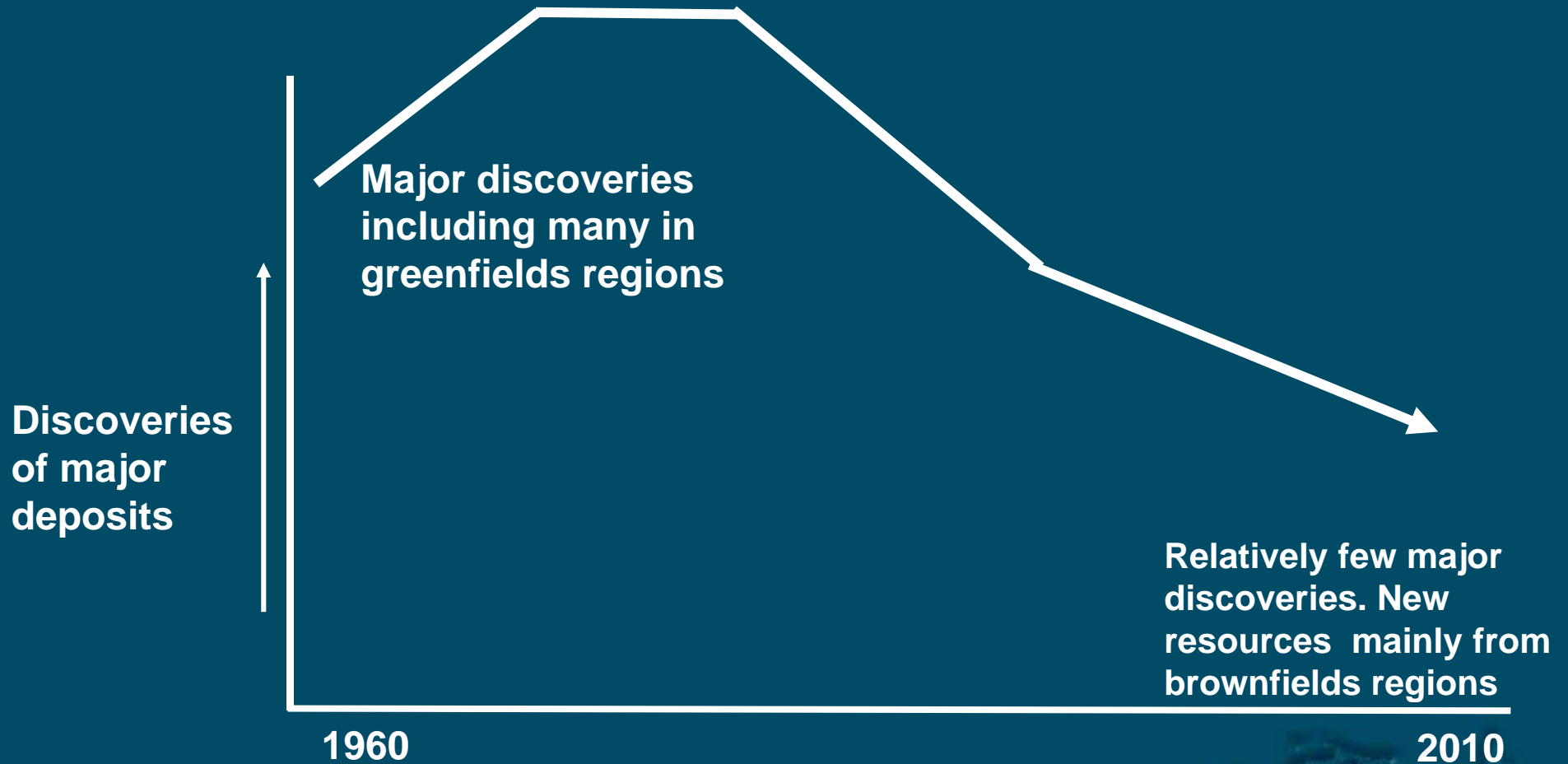
Iron ore production and resource life (with/without magnetite)



Ore grade declines and efficiency gains

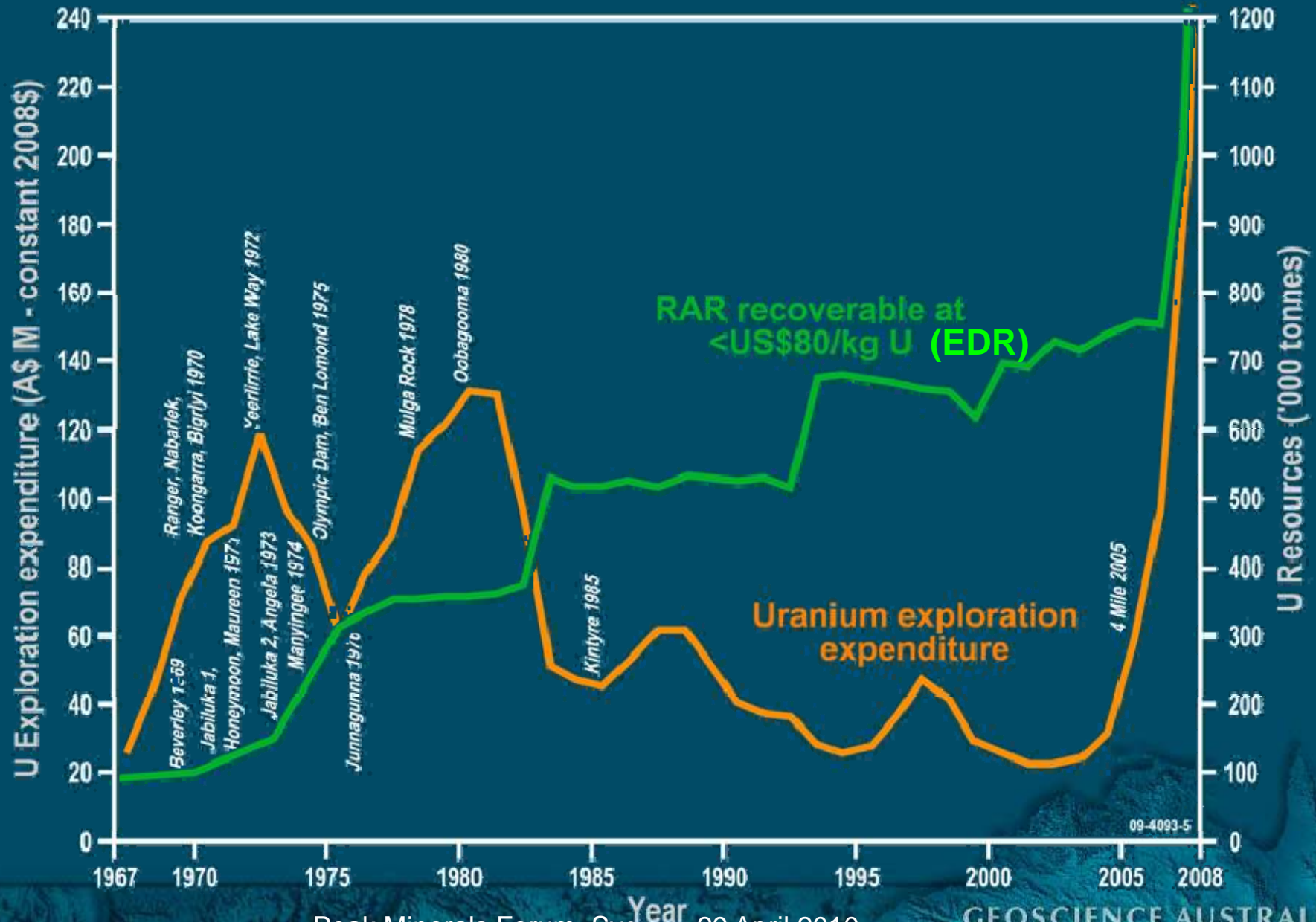
- Average grades of processed ores has been declining steadily for some commodities
 - eg. gold, copper
 - But less so for **bulk commodities**
- Efficiency gains in the use of energy and water in Australia have more or less kept pace with the decline in ore grade
 - However, production increases mean that overall water and energy use, and greenhouse emissions, have increased

Discovery trends for major mineral deposits over last five decades



Most major mines discovered more than 2 decades ago.

Example: Uranium



Peak Minerals?

- A strong minerals industry is far from a given in Australia's future despite the reasonably healthy state of current mineral resource stocks
- With rapid increases in demand over recent years, Australia's share of world production has declined as new projects have been brought into production elsewhere
 - Maintaining or increasing share of global mineral exports over coming decades will require major increases in production
 - Consequential decreases in resource life
- While current mineral resource stocks are reasonably healthy, declining resource lives show they are not adequate to sustain strong increases in production
 - **Emerging concerns about “peak minerals” are not alarmist**

Concluding remarks

- **It is essential that a new generation of large low cost mineral deposits is discovered to sustain the resource base**
 - **Requires major discoveries in greenfields regions**
 - **Underpinned by enhanced pre-competitive geoscience data**
 - Largely acquired by governments
 - **R&D to increase efficiency of remotely detecting mineral deposits and drilling**
- **Breakthroughs in mining, processing and waste management technologies are also vital, as are adequate access to land and to finance**

Concluding remarks

- Without all of these, we are well and truly on the path to “peak minerals” for a number of key commodities

34th International Geological Congress

Brisbane, 2-10 August, 2012

On behalf of the Oceania region

