Australia's National Classification System for Identified Mineral Resources and Mapping to UNFC-2009

Ian Lambert & Yanis Miezitis
Geoscience Australia

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Introductory remarks

- Mineral resources are an important component of the Australia's current and future wealth and well-being
  - A strategic (long term) perspective of what is likely to be available for mining is a prerequisite for formulating sound policies on resources and land access
- Like a number of other countries with significant mining sectors Australia has established a national minerals inventory
  - Covering a range of mineral commodities
- National reporting categories are commonly "coarser" than, and aggregated from, those used for commercial reporting of individual deposits
  - A variety of different systems are in use worldwide

Introductory remarks

- For meaningful comparisons between countries' inventories, and therefore for estimating total global stocks, it is necessary to map the various classification and reporting systems to a common base
  - This can be done by mapping the various national classifications/reporting systems in current use to UNFC-2009
  - It is not necessary to change the classification/reporting systems used in individual countries

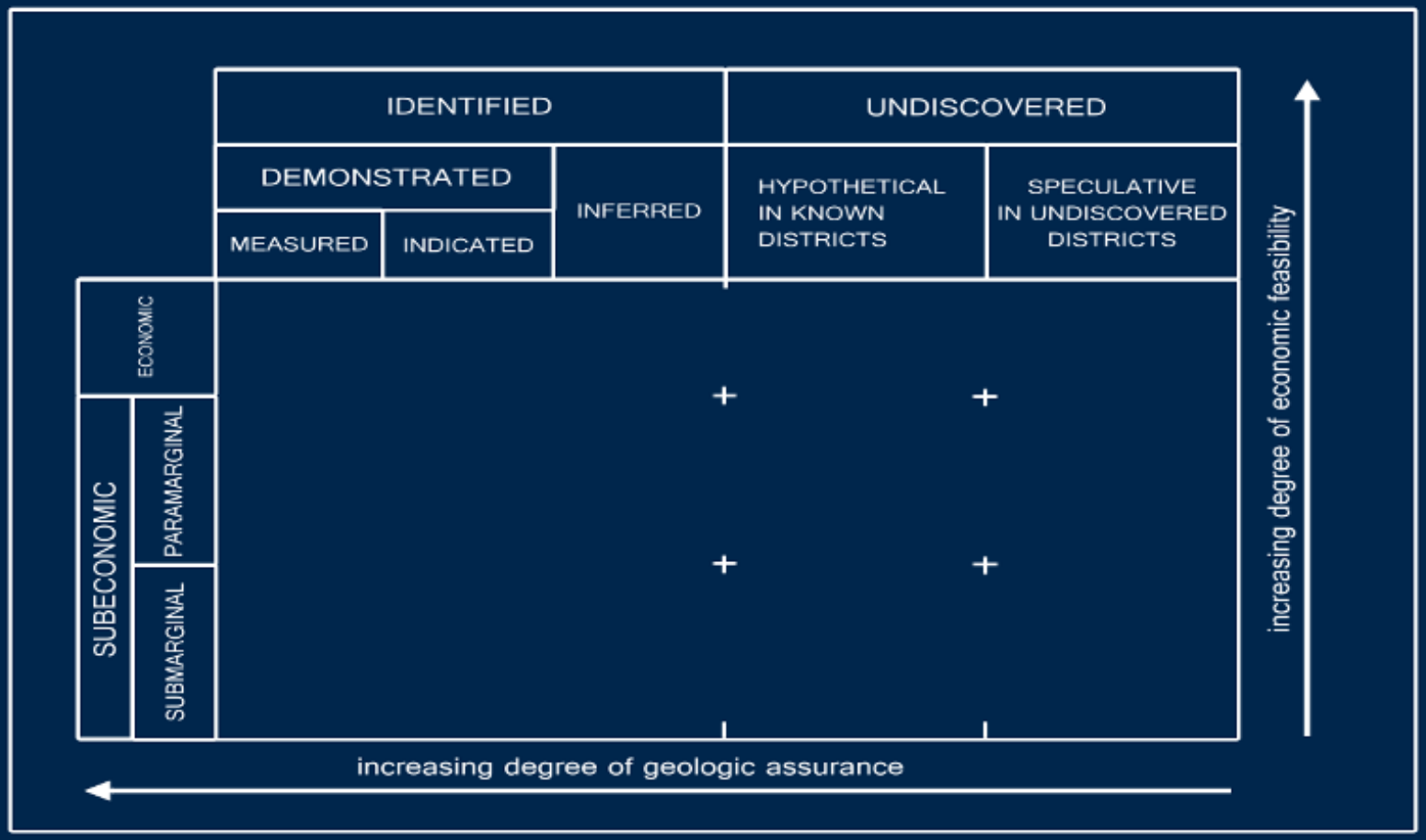
Introductory remarks

- This presentation summarises Australia's national classification system for identified mineral resources and how this relates to the UNFC. It:
  - Describes how data from company reports on individual Australian mineral deposits are aggregated into larger categories for national mineral resource reporting
  - Maps the Australian national mineral resources reporting system (and our commercial reporting system) to the UNFC-2009
  - Concludes with comments on the benefits of mapping other mineral classification systems in use around the world to the UNFC

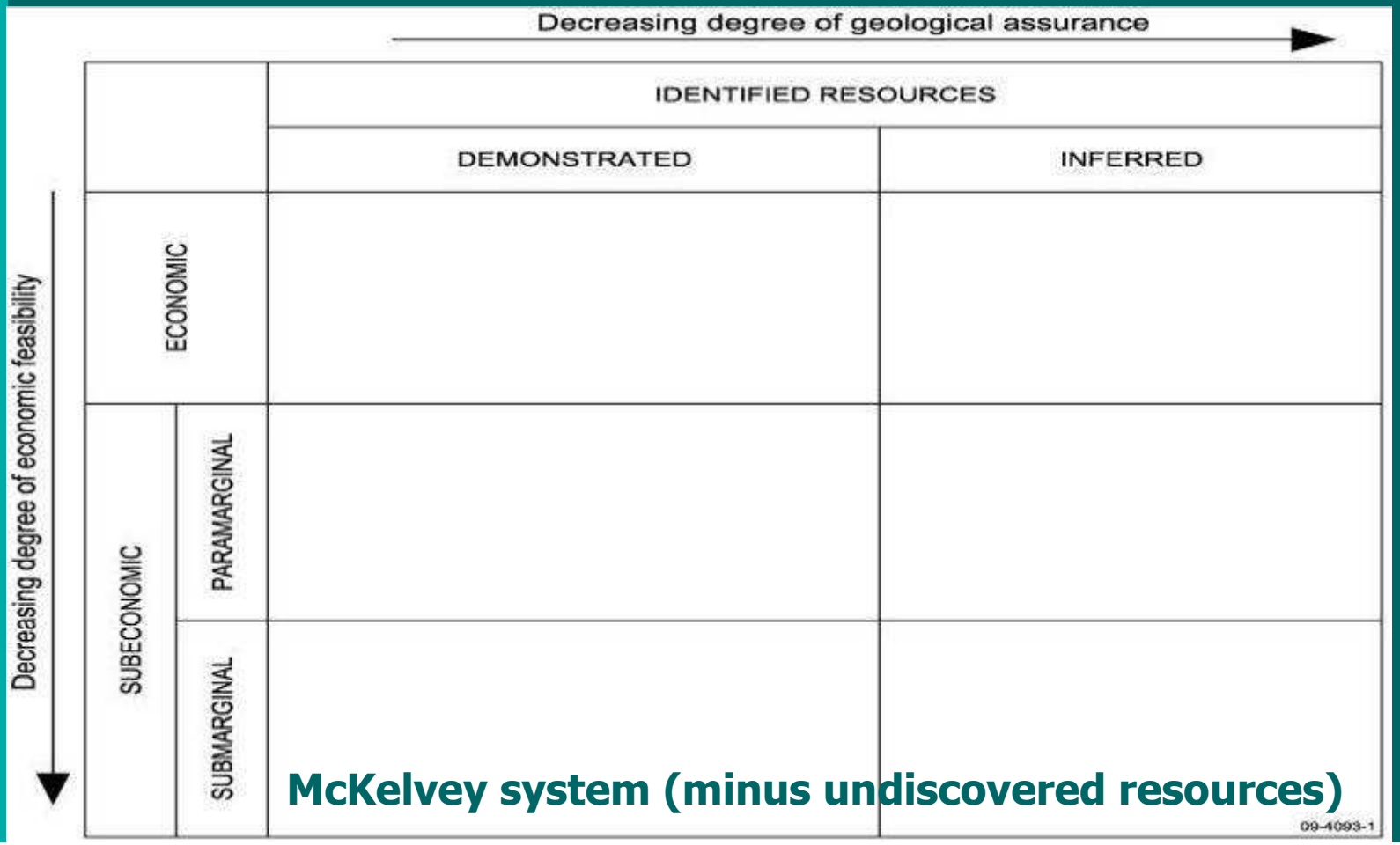
Estimating and reporting national mineral inventories: McKelvey system

- In 1975, Australia adopted the McKelvey resource classification system
  - Used for national and international reporting by the then US Bureau of Mines and USGS
- Australia's national system remains comparable with the USGS system
  - As published in *Mineral Commodity Summaries*

Estimating and reporting national mineral inventories: McKelvey system



Australia's National Resource Classification System

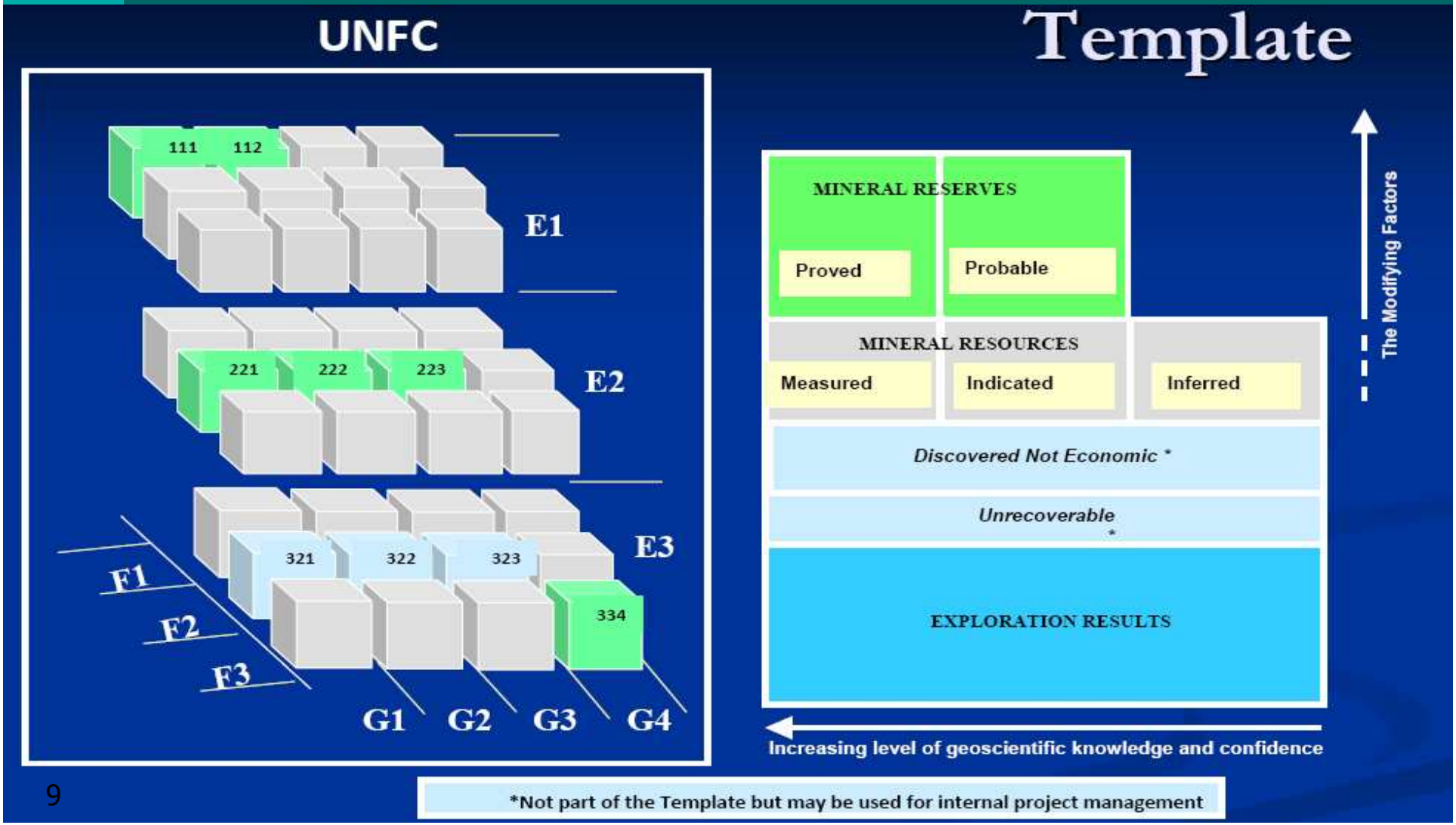


McKelvey system (minus undiscovered resources)

Public mineral resource reporting by companies 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 provide a commercial (relatively short term) view of what is to be mined
    - JORC Resources have "reasonable prospects for economic extraction"
- JORC Code is compatible with national system

High level mapping of JORC code to UNFC

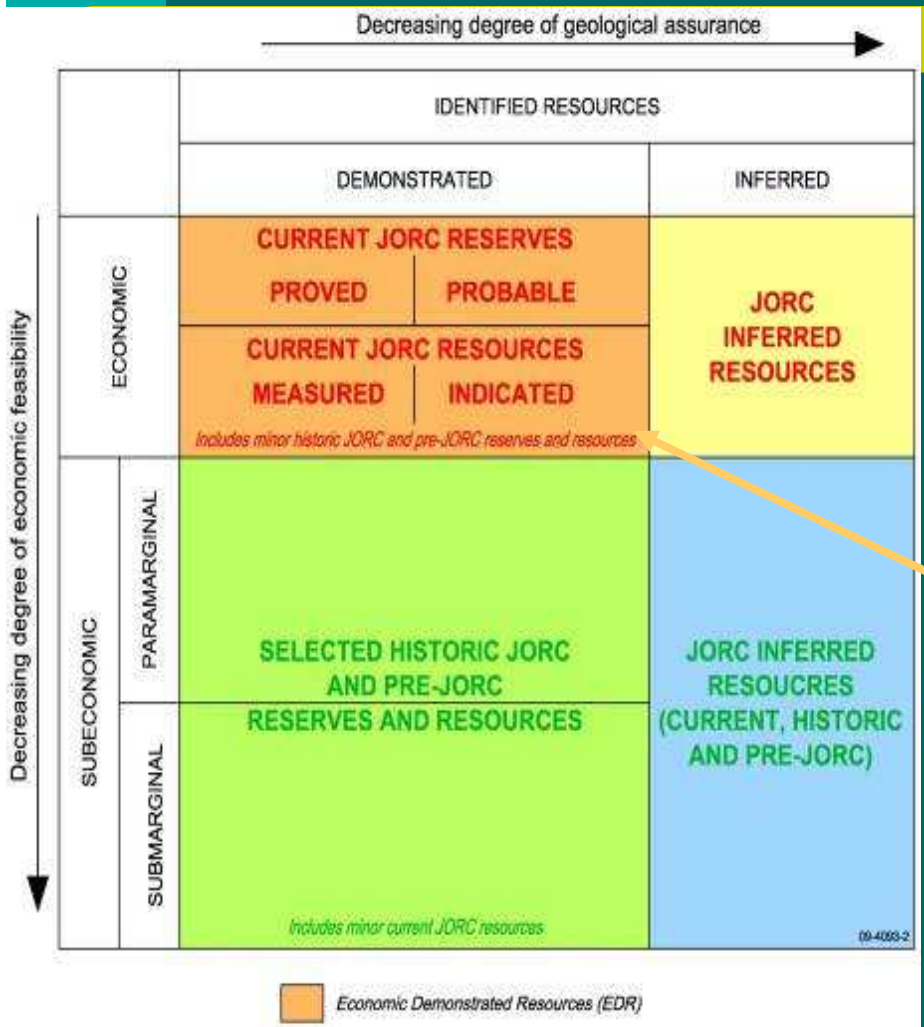


*Not part of the Template but may be used for internal project management

From company reports to national inventory

- Ore Reserve and Mineral Resource data reported for individual deposits by mining companies are compiled in Geoscience Australia's national mineral resources database
- These data provide the basis for the national assessment of Australia's mineral resources
  - JORC categories are aggregated into a smaller number of categories in the national system
  - To provide a longer term (~25 year) perspective of what is likely to be available for mining

Mapping Australia's National Resource Classification system to JORC Code



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

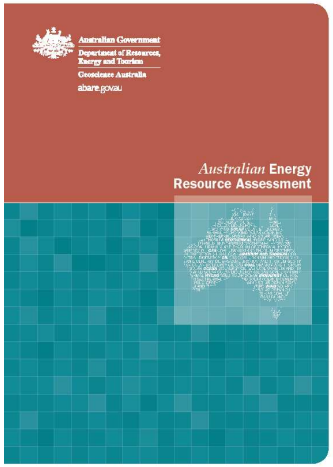
- 'Reserve' not used because of specific meaning under JORC
- EDR = 'Proved Reserves' + 'Probable Reserves' + 'Measured Resources' + 'Indicated Resources'
  - 'Subeconomic' Resources mainly from old reports

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

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 it provides a conservative estimate
    - Does not consider undiscovered resources



Australia's national system for energy commodities: petroleum + minerals

DECREASING GEOLOGICAL ASSURANCE →

DECREASING ECONOMIC FEASIBILITY ↓

	Identified resources		*Undiscovered resources*
	Demonstrated	Inferred	
Economic Demonstrated Resources	JORC mineral reserves Proved petroleum reserves Proved and probable petroleum reserves JORC measured and indicated mineral resources	JORC inferred mineral resources Possible petroleum resources	Quantitative mineral potential assessments Undiscovered petroleum resource assessments
Subeconomic Resources	Subeconomic mineral resources Contingent proved and probable petroleum resources	Contingent possible petroleum resources	

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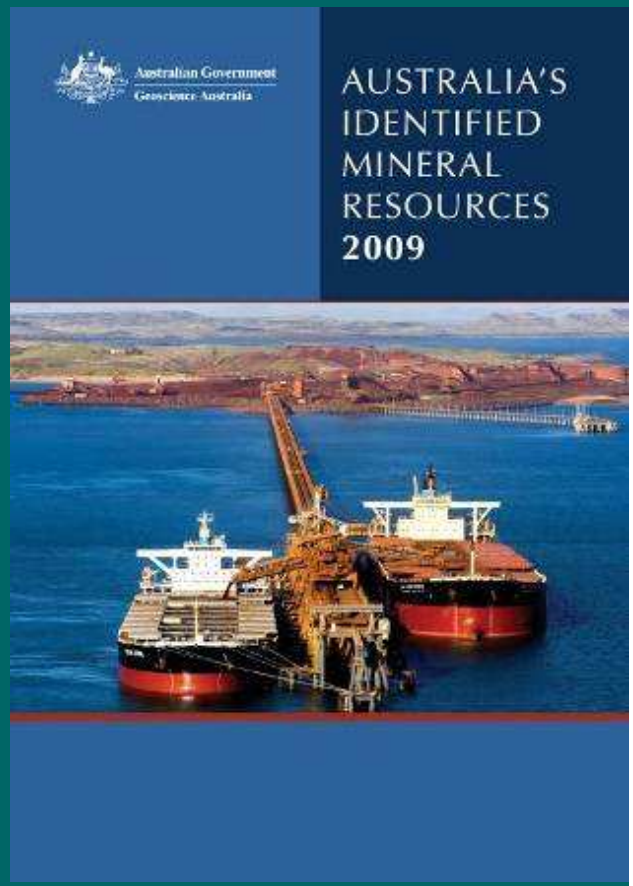
Online publication: *Australia's Identified Mineral Resources*

- 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*
- Petroleum resources are published separately by Geoscience Australia in *Oil and Gas Resources of Australia*
  - Petroleum is not our field of expertise, so we do not consider it further in this presentation



COMMODITY	UNITS	AUSTRALIA							WORLD	
		Demonstrated Resources			Inferred Resources (a)	Accessible EDR (AEDR)(b)	JORC Reserves(c) (% of AEDR)	Mine Pro-duction(d) 2007	Economic Demon-strated Resources(e)	Mine Pro-duction(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 Gt	 56.4 38.9	 4.1 2.2	 9.8 6.7	 97.7 61.6	 38.8	 12.5(g) (30%)	 0.421(h)	 687(i)	 5.5(i)(j)
Brown coal in situ recoverable	 Gt Gt	 41.4 37.3	 43.4 39	 18.1 16.3	 112 100.8	 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 (30%)	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 Mc	 97.3 101.3	 98.2 102.3	 0.2 0.3	 13.1 13.7	 97.3 101.3	 95.7 (98%) 99.6 (98%)	 9.4 9.8	 – 590	 106 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
Iron ore	Gt	20.3	0.3	1.7	24.4	20.2	8.1 (40%)	0.299	154	1.9
Lead	Mt Pb	23.3	8.5	1.6	19.3	23.3	10.6 (45%)	0.641	78	3.6

Available through Australian mines atlas

www.australianminesatlas.gov.au

Australian Government

australian atlas of
minerals resources, mines
& processing centres

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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**
- **Advanced Search**

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.

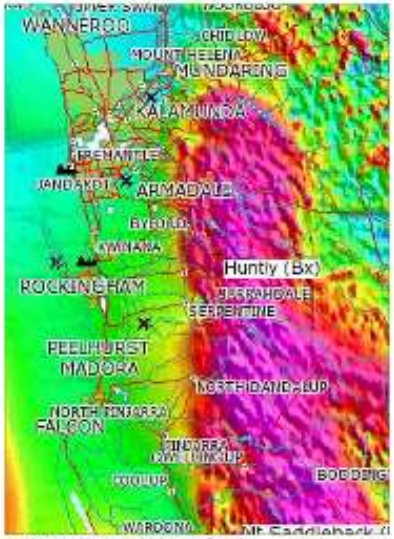
- **Australia's Identified Mineral Resources**
- **Mineral Fact Sheets**
- **Mineral Rock Files**
- **Minerals Downunder**
- **Geoprovince-Scale Assessment of Mineral Potential**

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

Applications of national minerals inventory

- We now very briefly digress to consider some ways in which the data from the national minerals inventory has been used
  - Comparison of long term and short term (commercial) estimates of minerals inventory
  - Trends for identified mineral resource stocks
  - Importance of quality of resources

Comparing long term (EDR) and short term (JORC Code Reserves) estimates

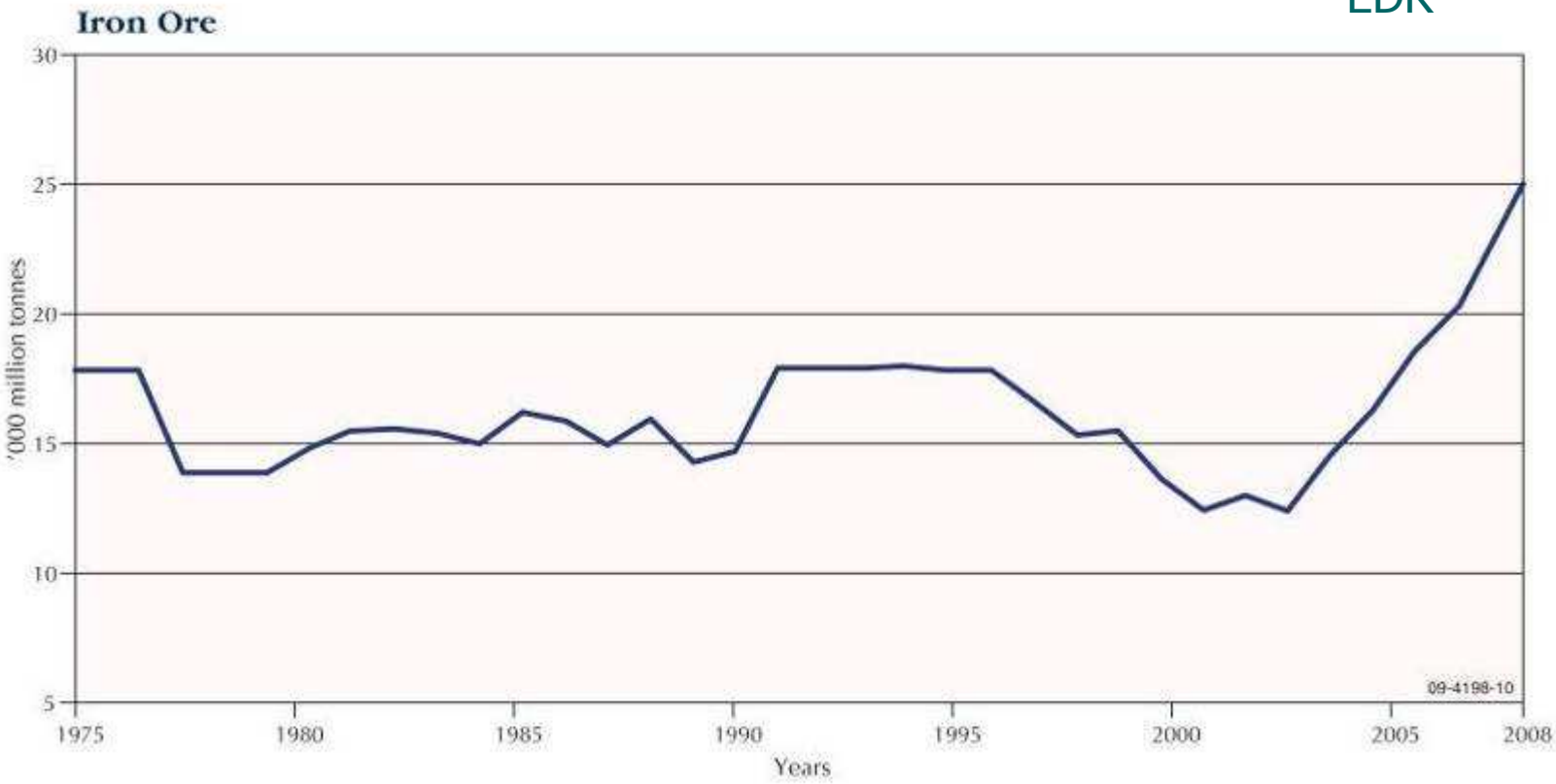
- Ore Reserves provide a short to medium term view of what is planned to be mined
  - Reflecting the time frame for commercial decisions
- National minerals inventory provides an indication of what is likely to be available for mining in the longer term

Comparing long term (EDR) and short term (JORC Code Reserves) estimates

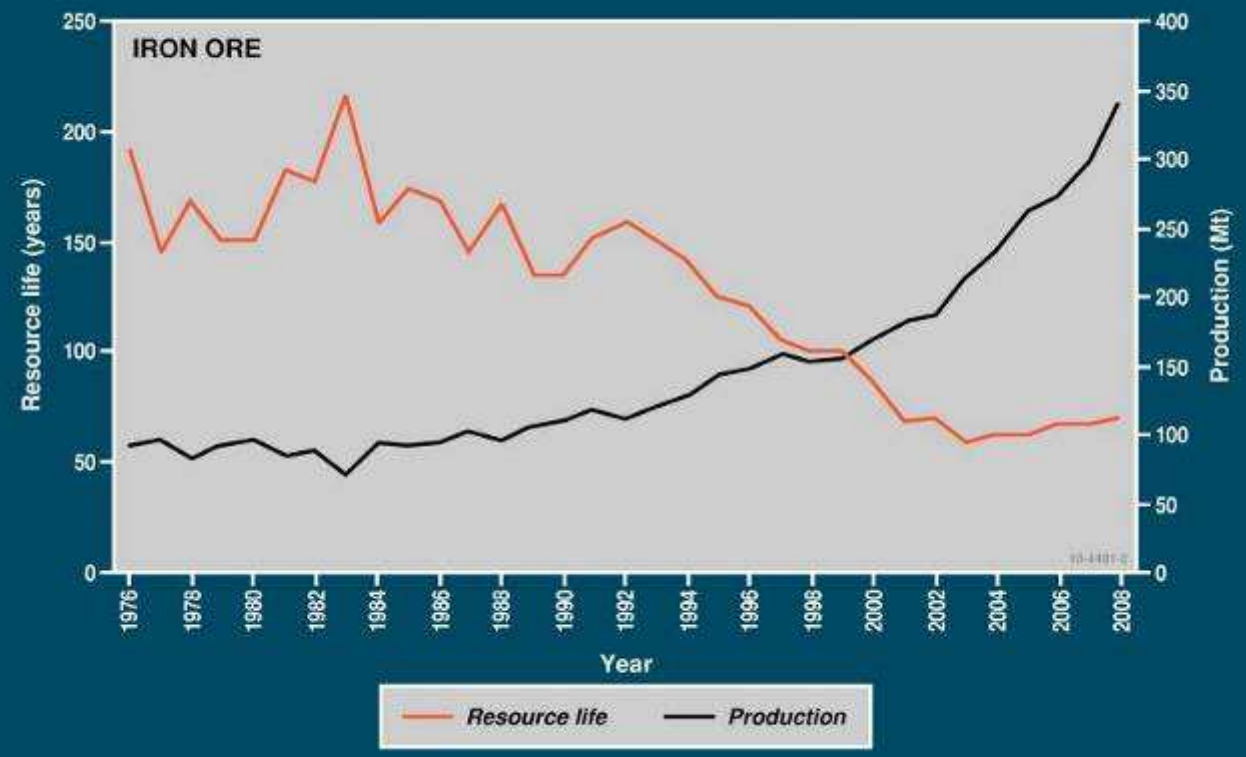
- EDR is commonly considerably larger than JORC Ore Reserves as reported by companies:
  - For bauxite, Reserves amount to only 35% of EDR
    - But 81% of EDR is in active mining areas
  - For gold, Reserves amount to 56% of EDR
    - But 80% of EDR associated with existing or committed mines
  - For some other commodities (eg. mineral sands) very high proportions of deposits included in EDR are well removed from existing mines
    - But have economic grades and tonnages

Australian iron ore: EDR

EDR



Iron ore: Production and resource life*



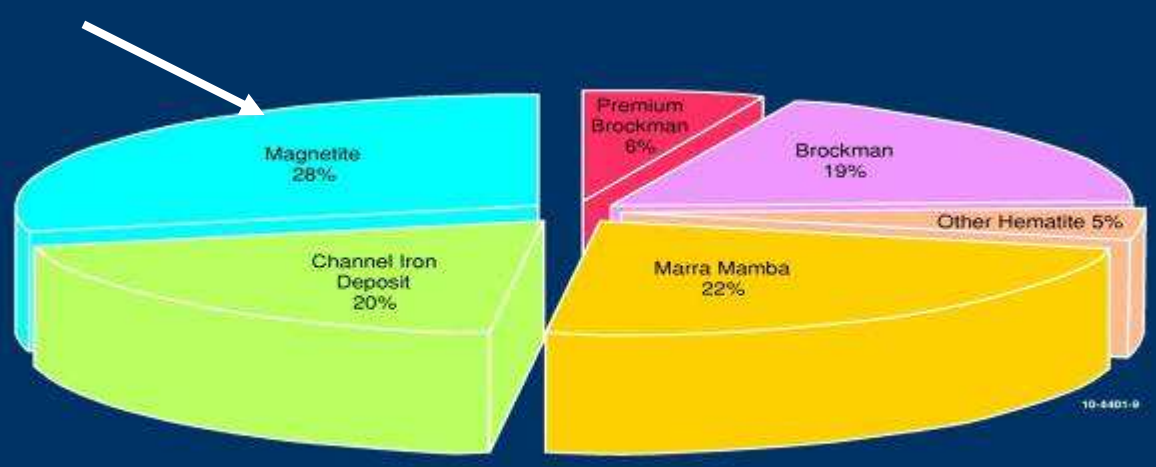
* EDR/production

Quality of resources

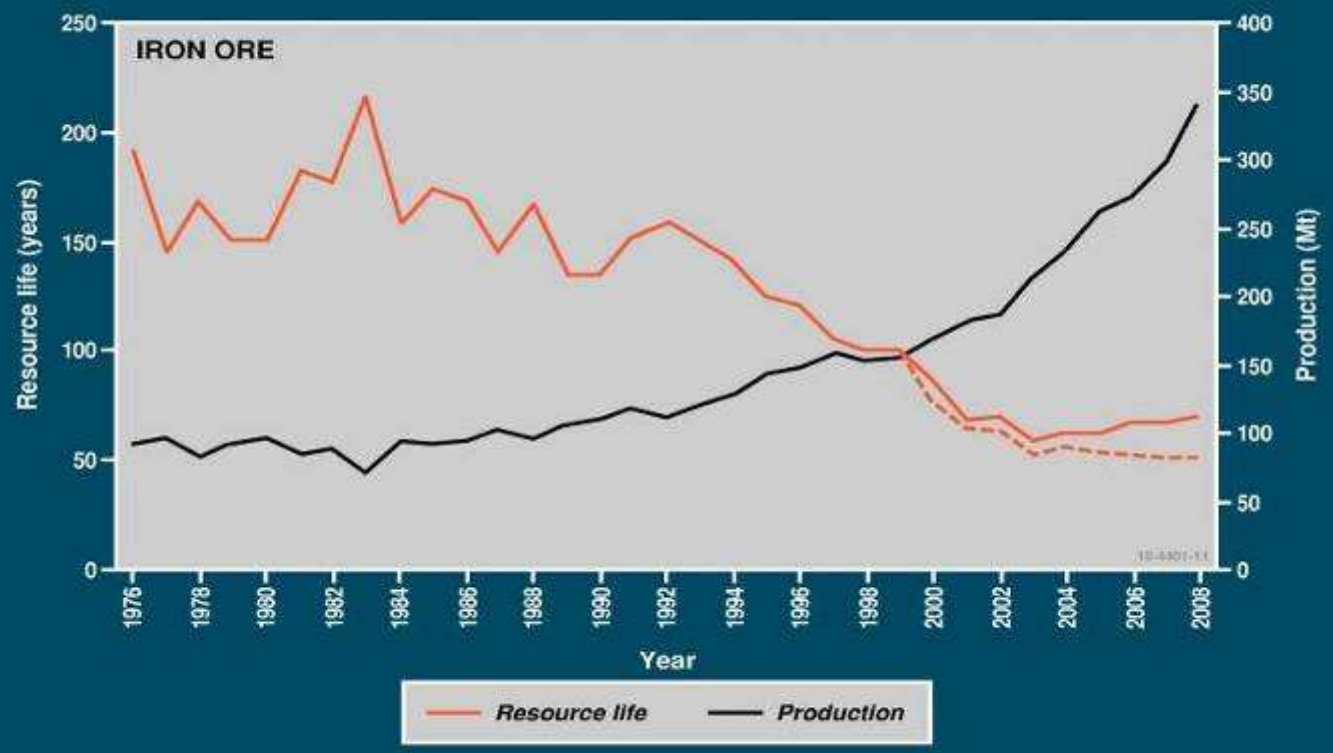
- Not all deposits included in Australia's EDR will be systematically mined
  - Deposits in Australia are increasingly competing with deposits elsewhere in the world
    - Lower quality deposits (ie. lower returns) are unlikely to be mined in short to medium term

Quality of iron ore resources

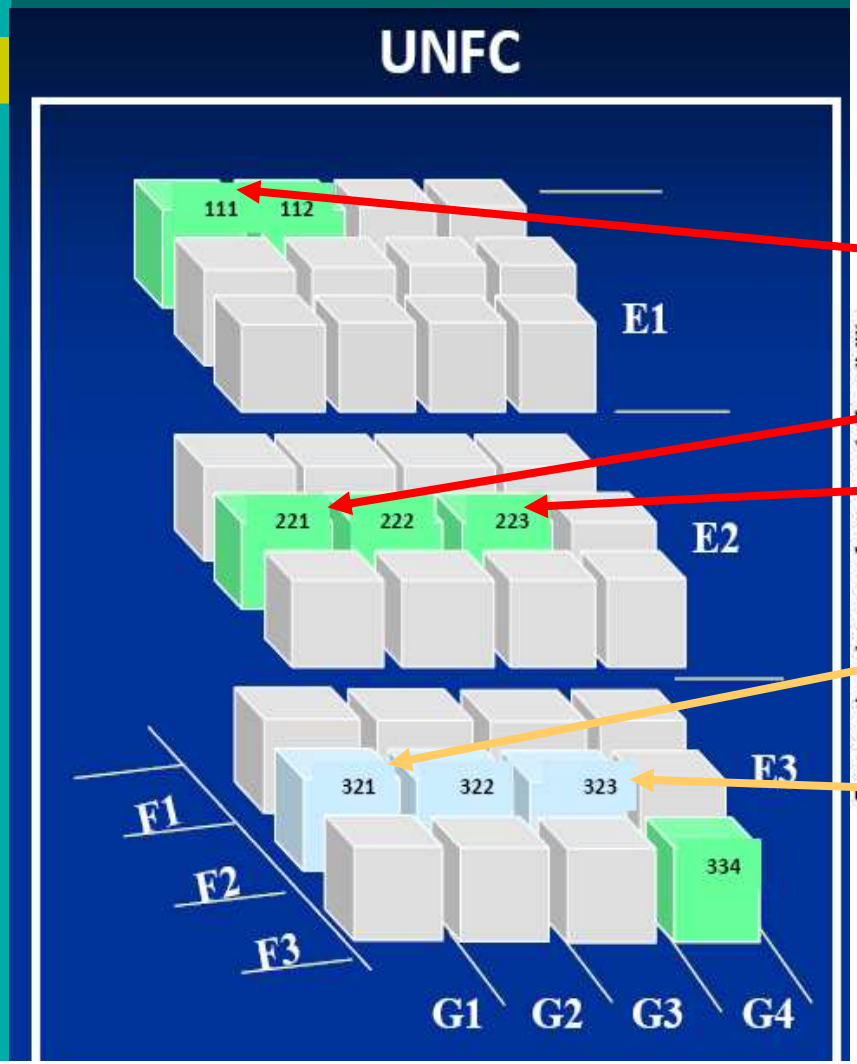
Magnetite is not direct shipping ore - requires beneficiation

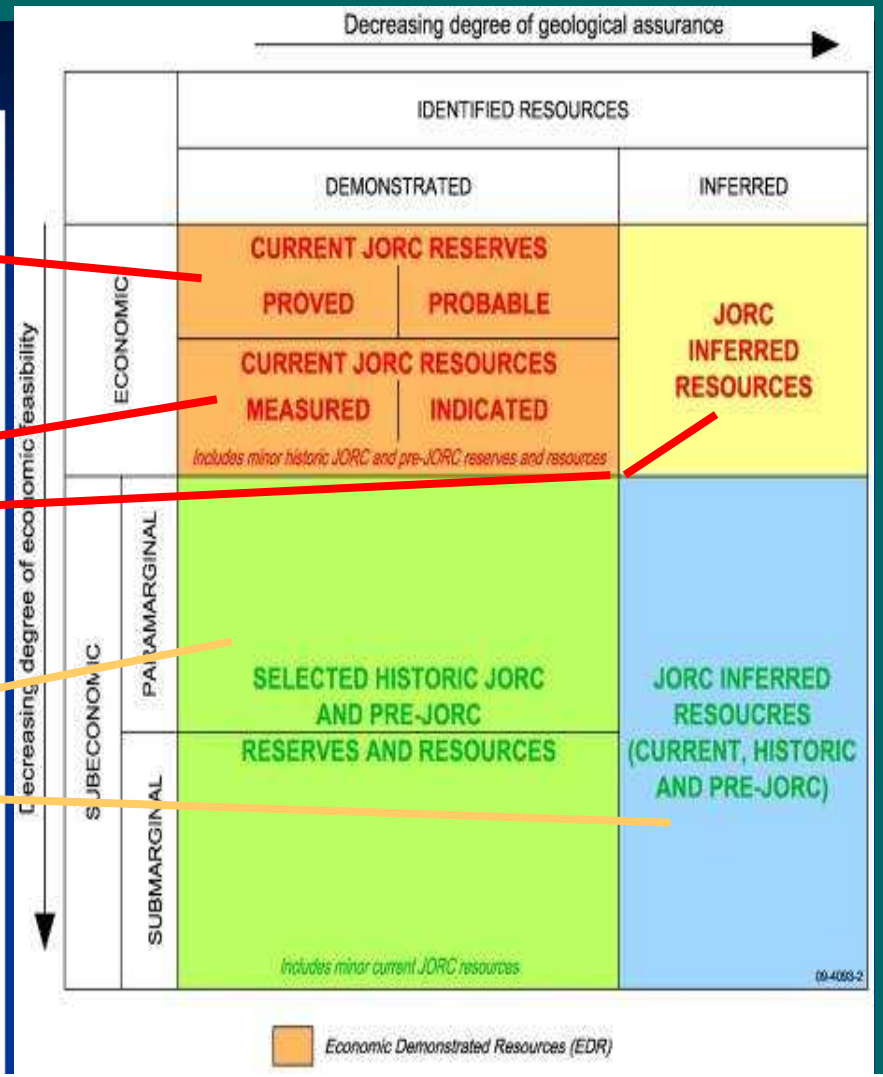


Iron ore production and resource life (without magnetite)



Correlation of Australia's national system with UNFC-2009





Correlation of Australia's national system with UNFC-2009

UNFC Classes defined by categories and sub-categories									
odity initially in place	Extracted	Sales Production							
		Non-sales Production							
	Class		Sub-class	Categories					
				E	F	G			
	Known Deposit	Commercial Projects	On Production	1	1.1	1	2	3	
			Approved for Development	1	1.2	1	2	3	
			Justified for Development	1	1.3	1	2	3	
		Potentially Commercial Projects	Development Pending	2	2.1	1	2	3	
			Development On Hold	2	2.2	1	2	3	
			Development	3.2	2.2	1	2	3	

Inferred

EDR

Correlation of Australia's national system with UNFC-2009

- It appears that UNFC needs an additional sub-category to accommodate our Subeconomic Resources
  - These are currently non-viable but can reasonably be expected to become economic in the foreseeable future
  - Suggested additional UNFC sub-class could be called "Development Viable in Foreseeable Future"
    - It would sit under UNFC's 'Non-Commercial Projects' as shown in the next slide

UNFC Classes defined by categories and sub-categories

Total commodity initially in place	Extracted	Sales Production						
		Non-sales Production						
	Class		Sub-class	Categories				
				E	F	G		
	Known Deposit	Commercial Projects	On Production	1	1.1	1	2	3
			Approved for Development	1	1.2	1	2	3
			Justified for Development	1	1.3	1	2	3
		Potentially Commercial Projects	Development Pending	2	2.1	1	2	3
			Development On Hold	2	2.2	1	2	3
		Non-Commercial Projects	Development Unclarified	3.2	2.2	1	2	3
			Development Viable in Foreseeable Future	3.3.1	2.2	1	2	3
			Development Not Viable in Foreseeable Future	3.3.2	2.3	1	2	3
		Additional quantities in place		3.3	2.3	1	2	3

LEGEND

- Australia's National Mineral Resource System Economic Demonstrated Resources (EDR)
- Paramarginal and Submarginal Resources
- Inferred Resources

Subeconomic

Proposed addition of resource terms to UNFC

- We consider it would be helpful from a minerals perspective to add resource terms to the projects column in Figure 3 of UNFC-2009
  - This would to some extent address the issue raised by some stakeholders that there is little indication of what sort of resources one is dealing with the various projects
  - It would provide an indication of the nature of resources that are associated with the various stages of projects under the UNFC

Proposed addition of resource terms to UNFC

UNFC Classes defined by categories and sub-categories

Total commodity initially in place	Extracted	Sales Production							
		Non-sales Production							
	Class		Sub-class	Categories					
				E	F	G			
	Known Deposit	Commercial Projects *CONFIRMED RESOURCES*	On Production	1	1.1	1	2	3	
			Approved for Development	1	1.2	1	2	3	
			Justified for Development	1	1.3	1	2	3	
		Potentially Commercial Projects *POTENTIAL RESOURCES*	Development Pending	2	2.1	1	2	3	
			Development On Hold	2	2.2	1	2	3	
		Non-Commercial Projects *SUB-ECONOMIC RESOURCES*	Development Unclarified	3.2	2.2	1	2	3	
			Development Viable in Foreseeable Future	3.3.1	2.2	1	2	3	
			Development Not Viable in Foreseeable Future	3.3.2	2.3	1	2	3	
		Additional quantities in place		3.3	2.3	1	2	3	
	ential posit	Exploration Projects *UNDISCOVERED RESOURCES*	[No sub-classes defined]	3.2	3				4

UNFC as Rosetta stone

- The ability of UNFC 2009 to act as a ‘Rosetta Stone’ is potentially its most important role
  - This requires all industry, financial, national and international resource reporting systems mapped to UNFC in publicly available form
  - This would enhance the familiarisation of the UNFC 2009 with custodians of other resource classification systems
- Many countries already have mandated commercial reporting systems
  - It would be counter-productive to encourage these to adopt the UNFC in place of their existing reporting arrangements

Government Resources Management: Reporting National Minerals Inventories

- There is support for recognition of additional (aggregated) classes to UNFC for national reporting:
  - *'…national classes could be defined under UNFC-2009 that, combined with appropriate specifications, could provide a common basis for reporting aggregated estimates. In this way, the specifications of the Template, for example, which preclude the aggregation of reserves and resources, would remain in place, but the option to aggregate for national reporting purposes would exist at the level of UNFC-2009'*

Reporting National Minerals Inventories

- A two stage process is suggested
- Stage 1: All major resource countries to map their mineral resource categories to UNFC template, as done by Australia above (and some others)
  - ➔This offers a non-threatening way of generating discussion in regard to differences and encourage incremental harmonization between different systems
    - It could possibly be presented as an additional Annexe of UNFC
  - This would also help to avoid confusion generated by uncoordinated use of the UNFC based on interpretation by individuals

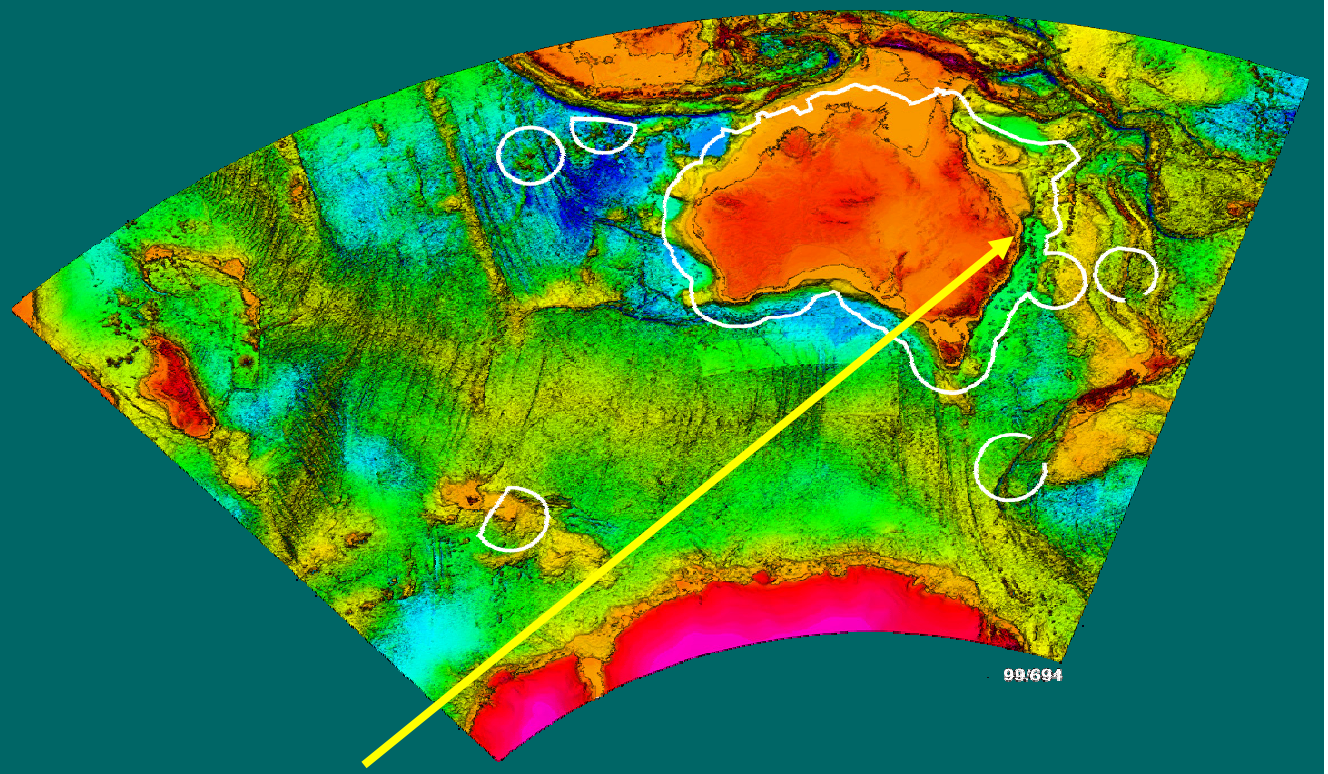
Reporting National Minerals Inventories

- Stage 2**:** After participating countries have submitted correlations of their national schemes with UNFC 2009:
  - *'…national classes could be defined under UNFC-2009 that, combined with appropriate specifications, could provide a common basis for reporting aggregated estimates'*
  - It would be up to each country as to whether this ultimately leads to changes in their national mineral resource reporting

Conclusions for national reporting by Governments

- With a view to meaningful comparisons between countries' inventories and better informed estimates of total remaining global stocks
  - Countries should be encouraged to map their mineral resource classification systems to the UNFC
  - As a precursor to developing UNFC specifications or guidelines for national reporting
    - To provide a common basis for reporting aggregated estimates

34th International Geological Congress



Brisbane, 2-10 August, 2012

www.34igc.org

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