CRIRSCO-UNFC 2009 mapping Solid Minerals Case Studies

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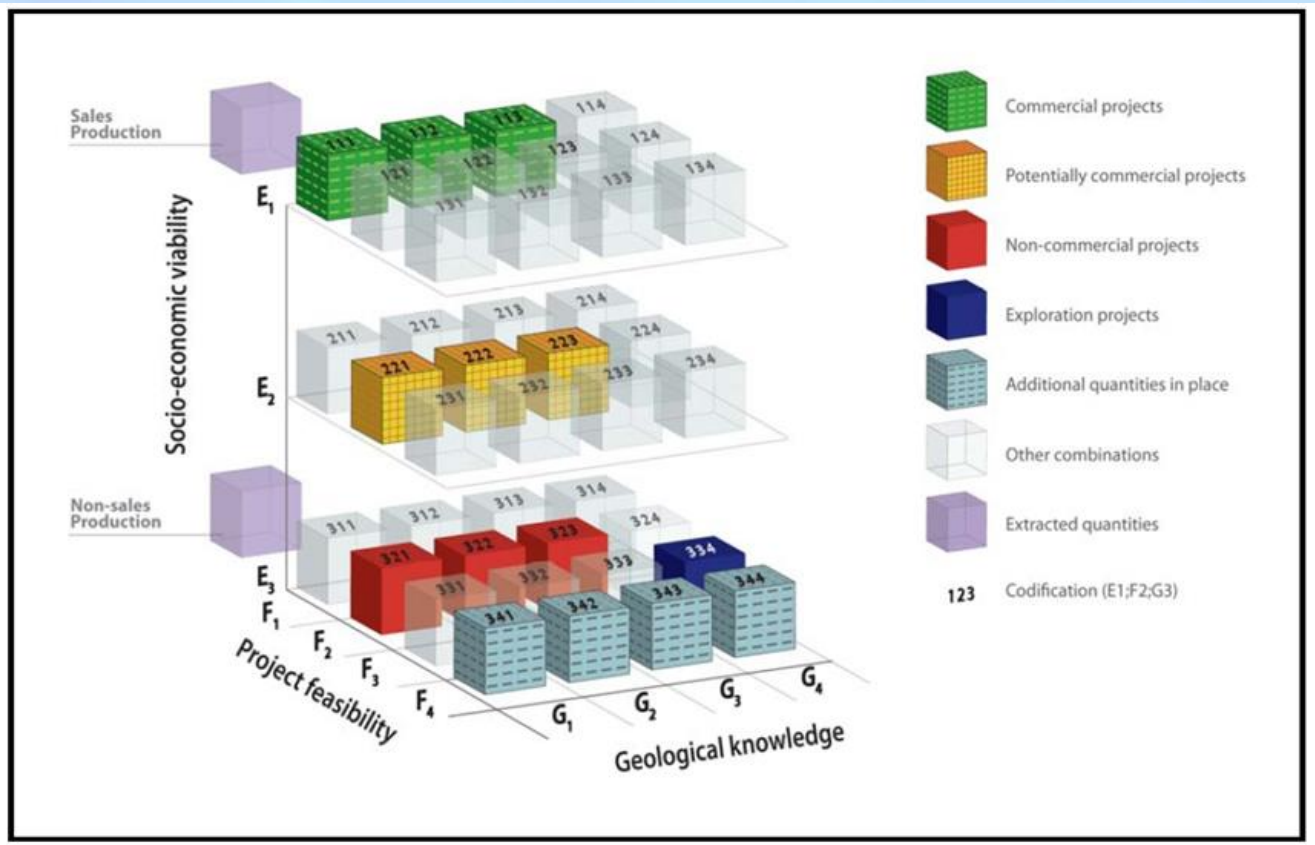
Terms of Reference: summary

Pilot studies on CRIRSCO to UNFC-2009 mapping

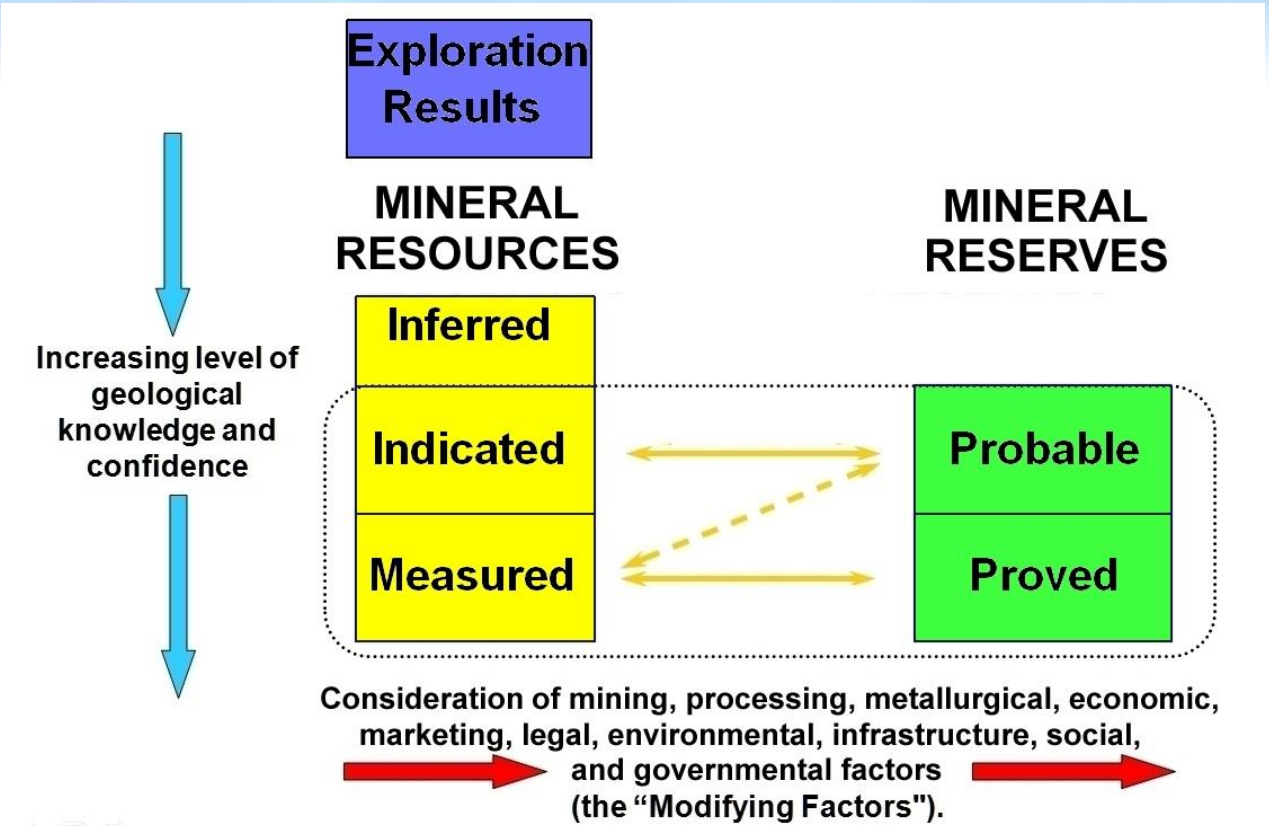
- How well does it work in practice ?
- Areas for improvement in framework, specifications, and bridging ?
- Guidelines and recommendations for users ?

Default mappings



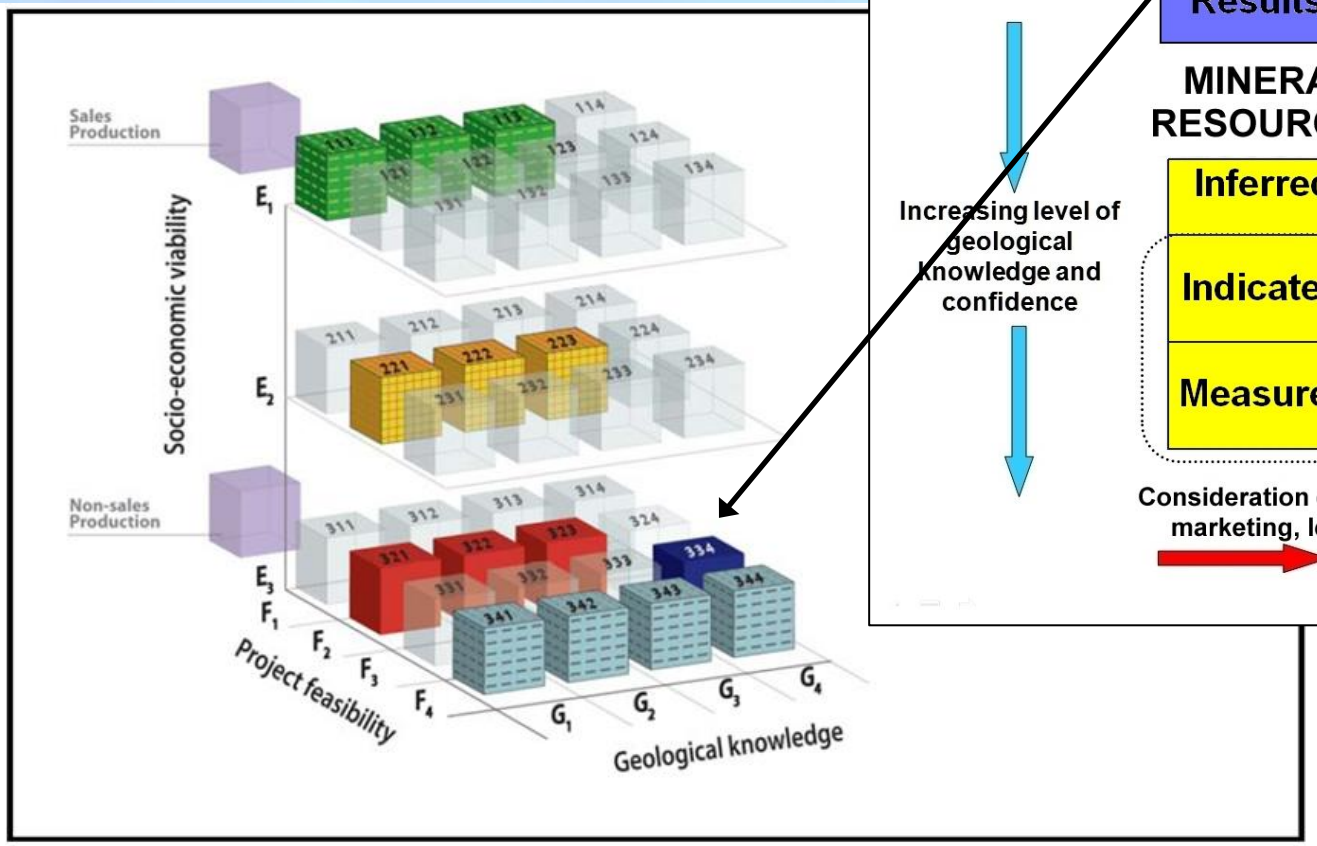
The UNFC-2009 classification

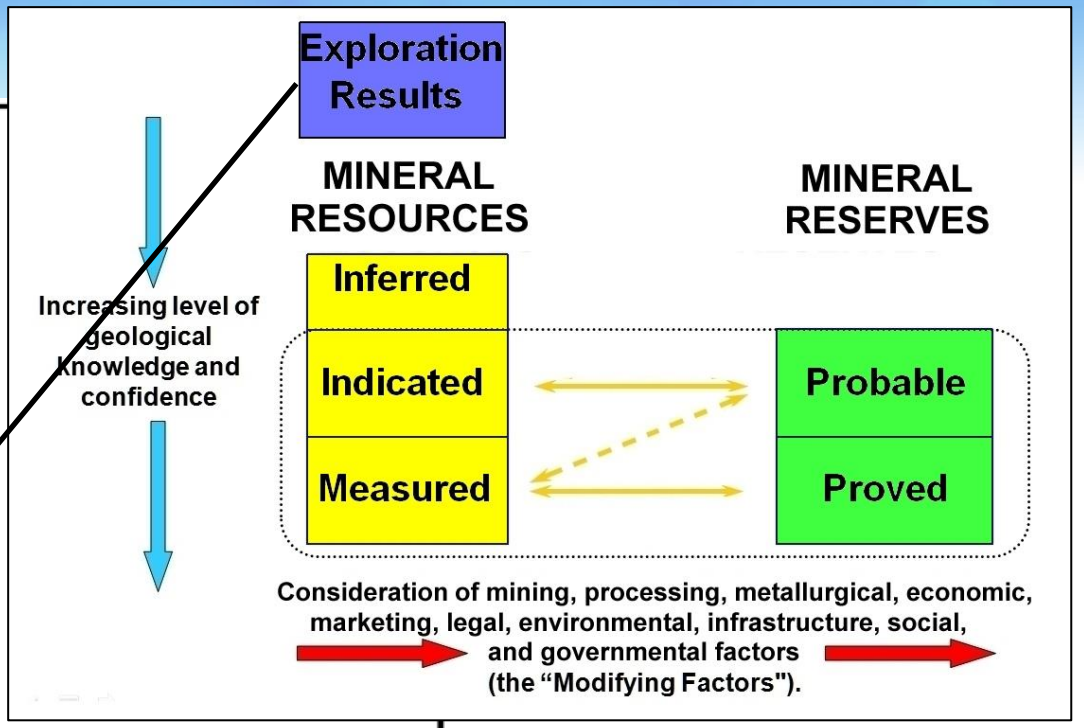
Default mappings



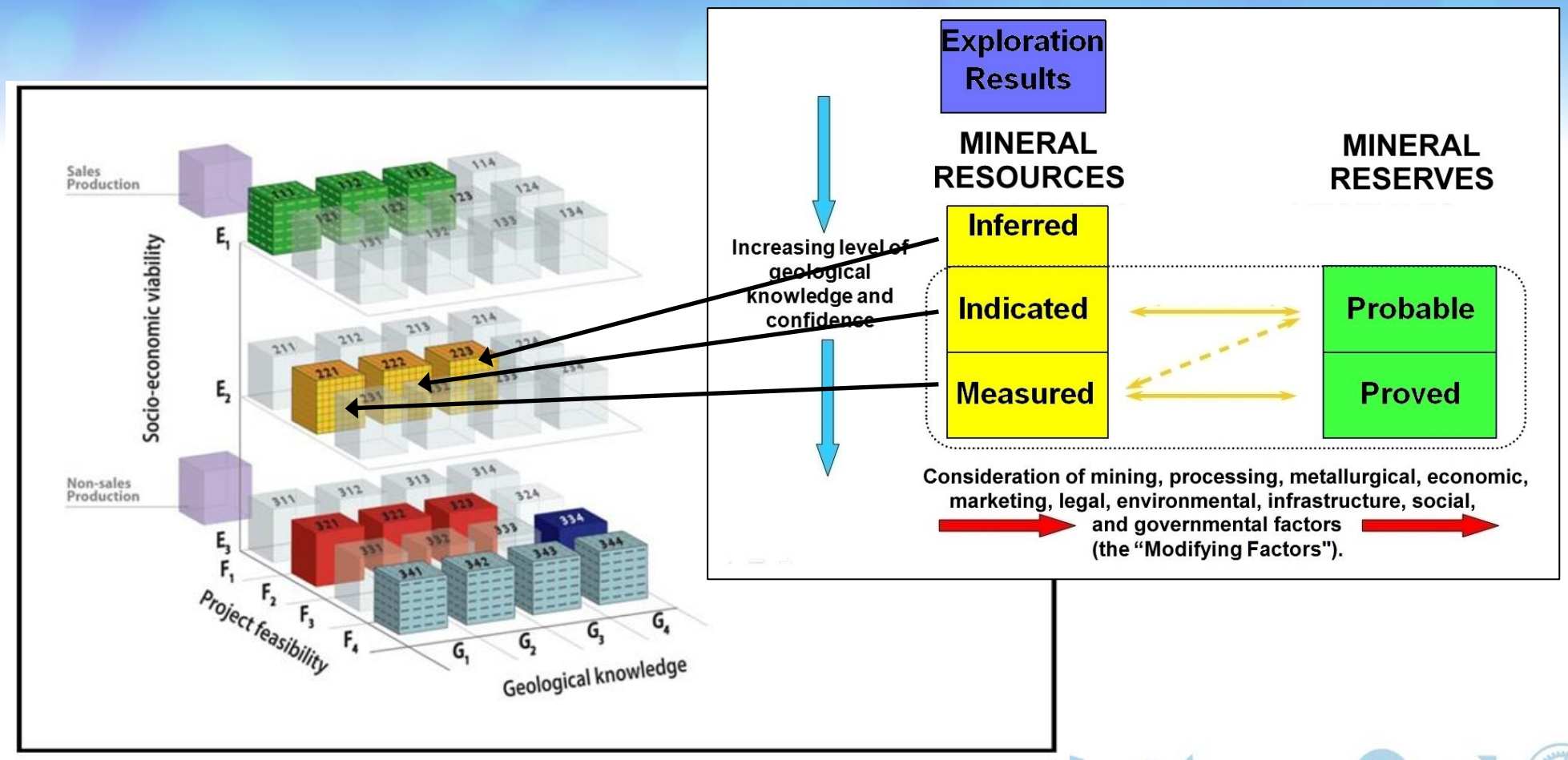
The CRIRSCO classification

Default mappings

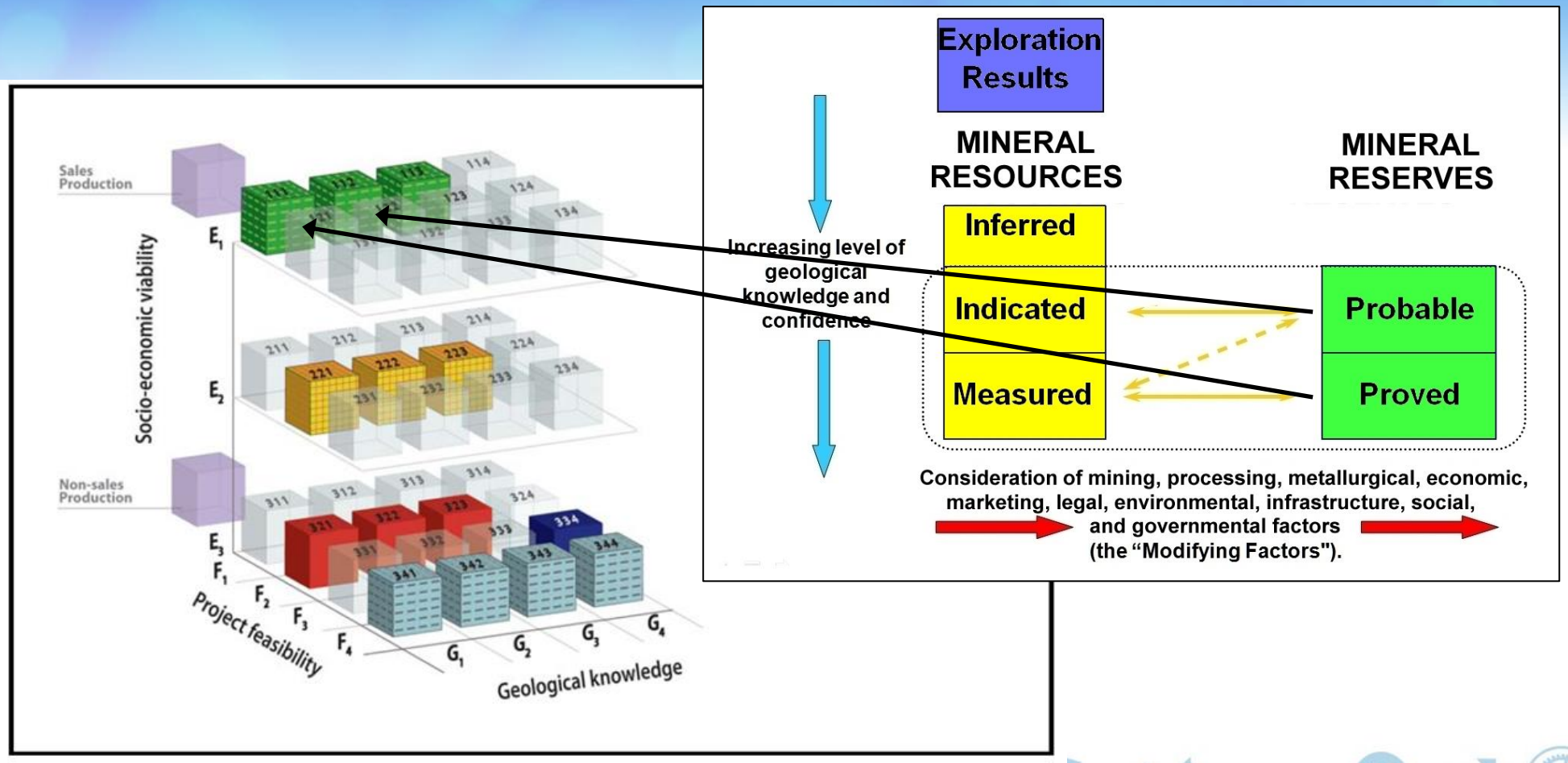




Default mappings



Default mappings



CRIRSCO Template

Note – this report includes some material based on the updated CRIRSCO Template (Nov.2013).

Significant changes include

- Standardised definitions
- Effective Date, Reference Point added
- Exploration Target defined
- Feasibility Study etc. defined

Scope of Case Studies

1) Coal Reserves & Resources
2) Gold and Uranium Reserves & Resources
3) Polymetallic Reserves & Resources
4) Industrial/Construction Minerals Data
5) Exploration Project Data

Rio Tinto 2012: coal reserves

			Reserves		Marketable reserves		Marketable coal quality				
	Type of mine(a)	Coal type (f)	Proved at end 2012	Probable at end 2012	Proved at end 2012	Probable at end 2012	Calorific value MJ/kg	Sulphur content %	Avg % yield to give mktable reserves	Interest %	Rio Tinto share Marketable reserves
COAL (h)			millions of tonnes	millions of tonnes	millions of tonnes	millions of tonnes	(g)	(g)			millions of tonnes
Reserves at operating mines											
Bengalla	O/C	SC	161	10	121	7.2	27.86	0.48	75	32	41
Blair Athol (i)	O/C	SC				71.2					
Clermont	O/C	SC	168	4.6	160	4.2	27.9	0.33	96	50.1	82
Hail Creek	O/C	MC	84	44	43	23	32.2	0.35	52	82	54
Hunter Valley Operations	O/C	SC+MC	270	47	184	33	28.99	0.58	68	80	173
Kestrel Coal	U/G	MC	45	95	37	79	31.6	0.59	83	80	93
Mount Thorley Operations	O/C	SC+MC	30	7.4	20	4.7	29.8	0.45	66	64	16
Warkworth	O/C	SC+MC	217	155	141	101	29.8	0.45	65	44.5	108
Other undeveloped reserves (k)											
Mount Pleasant	O/C	SC		399		326	26.92	0.48	82	80	261

Rio Tinto 2012: coal reserves

			Reserves	Marketable reserves	Marketable coal quality	Avg % yield to	Interest %	Rio Tinto share Marketable reserves
COAL (h								millions of tonnes
Reserves								
Bengalla							32	41
Blair Ath								
Clermont							50.1	82
Hail Cree							82	54
Hunter V							80	173
Operation								
Kestrel C							80	93
Mount Th							64	16
Operation								
Warkwor							44.5	108
Other undeveloped reserves (k)								
Mount Pleasant	O/C	SC		399	326	26.92	0.48	82	80	261

Which to use ?

Different Reference Points

In CRIRSCO reports, **Marketable Reserves estimates** are optional,

But **Reserves estimates** must always be quoted

Therefore whenever data are likely to be aggregated, use the **Reserves** figures

Rio Tinto 2012: coal reserves

E1-F1-G1 E1-F1-G2

	Type of mine(a)	Coal type (f)	Reserves		Marketable reserves		Marketable coal quality		Avg % yield to give mktable reserves	Interest %	Rio Tinto share Marketable reserves
			Proved at end 2012	Probable at end 2012	Proved at end 2012	Probable at end 2012	Calorific value MJ/kg	Sulphur content %			
COAL (h)			millions of tonnes	millions of tonnes	millions of tonnes	millions of tonnes	(g)	(g)			millions of tonnes
Reserves at operating mines											
Bengalla	O/C	SC	161	10	121	7.2	27.86	0.48	75	32	41
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Rio Tinto 2012: coal reserves

COAL (h)	Type of mine(a)	Coal type (f)	Reserves		Marketable reserves		Marketable coal quality		Avg % yield to give mktable reserves	Interest %	Rio Tinto share Marketable reserves
			Proved at end 2012	Probable at end 2012	Proved at end 2012	Probable at end 2012	Calorific value MJ/kg	Sulphur content %			
			millions of tonnes	millions of tonnes	millions of tonnes	millions of tonnes	(g)	(g)			millions of tonnes
Other undeveloped reserves (k)											
Mount Pleasant	O/C	SC		399		326	26.92	0.48	82	80	261

(k) The term “other undeveloped reserves” is used here to describe material that is economically viable on the basis of technical and economic studies but for which mining and processing permits may have yet to be requested or obtained. There is a reasonable, but not absolute, certainty that the necessary permits will be issued and that mining can proceed when required.

Rio Tinto 2012: coal reserves

			Reserves		Marketable reserves		Marketable coal quality		Avg % yield to give mktable reserves	Interest %	Rio Tinto share Marketable reserves
	Type of mine(a)	Coal type (f)	Proved at end 2012	Probable at end 2012	Proved at end 2012	Probable at end 2012	Calorific value MJ/kg	Sulphur content %			
COAL (h)			millions of tonnes	millions of tonnes	millions of tonnes	millions of tonnes	(g)	(g)			millions of tonnes
Other undeveloped reserves (k)											
Mount Pleasant	O/C	SC		399		326	26.92	0.48	82	80	261

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E1.1-F1.3-G2

Rio Tinto 2012: coal reserves

	Type of	Coal	Reserves		Marketable reserves		Marketable coal quality		Avg % yield to give mktable reserves	Interest %	Rio Tinto share Marketable reserves
			Proved at	Probable at	Proved at	Probable at	Calorific	Sulphur %			
COAL											millions of tonnes
Reserv											
Bengal								0.48	75	32	41
Blair A											
Clermo								0.33	96	50.1	82
Hail C								0.35	52	82	54
Hunter								0.58	68	80	173
Operat											
Kestrel								0.59	83	80	93
Mount								0.45	66	64	16
Operat											
Warkw								0.45	65	44.5	108
Other											
Mount								0.48	82	80	261

TAKE CARE! Avoid double-counting.

If assets are not wholly owned by the reporting company

Check whether reported resources and reserves are for the total deposit or just for the attributable proportion. Another company may also report the same deposit.

Rio Tinto 2012: coal resources

		Coal type (e)	Coal resources at end 2012			Rio Tinto Interest %
COAL (f)			Measured millions of tonnes	Indicated millions of tonnes	Inferred millions of tonnes	
Rio Tinto Coal Australia						
Bengalla (h)	O/C + U/G	SC + MC	68	112	66	32
Blair Athol (i)	O/C	SC	10	0.2		71.2
Clermont	O/C	SC	11		3.7	50.1
Hail Creek	O/C	MC	60	79	36	82
Hunter Valley Operations	O/C + U/G	SC + MC	201	428	368	80
Kestrel West	O/C	SC		106	33	80
Lake Elphinstone	O/C	MC		120	42	82
Mount Pleasant	O/C + U/G	SC + MC	162	245	205	80
Mount Thorley Operations (j)	O/C + U/G	SC + MC		19	94	64
Oaklands	O/C	SC	596	584	90	80
Valeria	O/C	SC		698	64	71.2
Warkworth	O/C + U/G	SC + MC	6.2	125	343	44.5
Winchester South	O/C	MC		17	175	75

Rio Tinto 2012: coal resources

COAL (f)		Coal type (e)	E2-F2-G1 Measured millions of tonnes	oal E2-F2-G2 Indicated millions of tonnes	20 E2-F2-G3 Inferred millions of tonnes	Rio Tinto Interest %
Rio Tinto Coal Australia						
Bengalla (h)	O/C + U/G	SC + MC	68	112	66	32
Blair Athol (i)	O/C	SC	10	0.2		71.2
Clermont	O/C	SC	11		3.7	50.1
Hail Creek	O/C	MC	60	79	36	82
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Winchester South	O/C	MC		17	175	75

Rio Tinto 2012: coal resources

		Coal type (e)	E2-F2-G1	oal	E2-F2-G2	20	E2-F2-G3	Rio Tinto Interest %
COAL (f)			Measured millions of tonnes		Indicated millions of tonnes		Inferred millions of tonnes	
Rio Tinto Coal Australia								
~~Bengalla (h)~~	~~O/C + U/G~~	~~SC + MC~~	~~68~~		~~112~~		~~66~~	~~32~~
Blair Athol (i)	O/C	SC	10		0.2			71.2
Clermont	O/C	SC	11				3.7	50.1
Ha								82
Hu								80
Ke								80
La								82
Mc								80
Mc								64
Oa								80
Va								71.2
Wa								44.5
Wi								75

Note (i): All remaining reserves at Blair Athol have been converted to resources following the cessation of mining in November 2012.

- suggests that it might be appropriate to allocate these resources to sub-classes. But we can only do this if we know the reason for cessation of mining - whether technical (F axis) or socio-economic (E axis). This should be found in the full text of the report.

Rio Tinto 2012: gold reserves

GOLD	Type of mine (a)	Proved ore reserves at end 2012 Tonnage millions of tonnes	Proved ore reserves at end 2012 Grade grammes per tonne	Probable orereserves at end 2012 Tonnage millions of tonnes	Probable orereserves at end 2012 Grade grammes per tonne	Average mill recovery %	Rio Tinto share Interest %		Recoverable metal millions of ounces
Reserves at operating mines									
Bingham Canyon (US)									
– open pit (l)	O/P	417	0.21	287	0.18		64	100	2.875
– stockpiles		40	0.14	41	0.14		64	100	0.232
Grasberg (Indonesia)	OP+UG	800	1.03	1624	0.74		68	(q)	12.227
Northparkes (Australia)									
– open pit and stockpiles		8.2	0.24				67	80	0.035
– underground	U/G			66	0.28		68	80	0.328
Oyu Tolgoi (Mongolia)									
– South Oyu open pit (r) (y)	O/P	426	0.42	614	0.24		74	33.5	2.581
– South Oyu stockpiles (s) (r)		9	0.33				74	33.5	0.024
Reserves at development projects									
Eagle (US) (u)	U/G			5.2	0.25		55	100	0.023
Oyu Tolgoi (Mongolia)									
– Hugo Dummett N (v)	U/G			460	0.37		83	33.5	1.544
– Hugo Dummett N Ext(w)	U/G			31	0.62		83	30.5	0.159

Rio Tinto 2012: gold reserves

GOLD	Type of mine (a)	E1-F1-G1 Proved ore reserves at end 2012 Tonnage millions of tonnes	E1-F1-G1 Proved ore reserves at end 2012 Grade grammes per tonne	E1-F1-G2 Probable orereserves at end 2012 Tonnage millions of tonnes	E1-F1-G2 Probable orereserves at end 2012 Grade grammes per tonne	Average mill recovery %	Rio Tinto share Interest %		Recoverable metal millions of ounces
Reserves at operating mines									
Bingham Canyon (US)									
– open pit (l)	O/P	417	0.21	287	0.18		64	100	2.875
– stockpiles		40	0.14	41	0.14		64	100	0.232
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Northparkes (Australia)									
– open pit and stockpiles		8.2	0.24				67	80	0.035
– underground	U/G			66	0.28		68	80	0.328
Oyu Tolgoi (Mongolia)									
– South Oyu open pit (r) (y)	O/P	426	0.42	614	0.24		74	33.5	2.581
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Rio Tinto 2012: gold reserves

GOLD	Type of mine (a)	Proved ore reserves at end 2012 Tonnage millions of tonnes	Proved ore reserves at end 2012 Grade grammes per tonne	Probable orereserves at end 2012 Tonnage millions of tonnes	Probable orereserves at end 2012 Grade grammes per tonne	Average mill recovery %	Rio Tinto share Interest %		Recoverable metal millions of ounces
Reserves at operating mines									
Bingham Canyon (US)									
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Grasberg (Indonesia)	OP+UG	800	1.03	1624	0.74		68	(q)	12.227
Northparkes (Australia)									
– open pit and stockpiles		8.2	0.24				67	80	0.035
– underground	U/G								
Oyu Tolgoi (Mongolia)									
– South Oyu open pit (r) (y)	O/P								
– South Oyu stockpiles (s) (r)									
Reserves at development projects									
Eagle (US) (u)	U/G								
Oyu Tolgoi (Mongolia)									
– Hugo Dummett N (v)	U/G			460	0.37		83	33.5	1.544
– Hugo Dummett N Ext(w)	U/G			31	0.62		83	30.5	0.159

E1-F1-G1 **E1-F1-G2**

Reserves at Operating Mines
= “On Production”
higher sub-classes **E1.1-F1.1-G1** and **E1.1-F1.1-G2**

Rio Tinto 2012: gold reserves

E1-F1-G1 **E1-F1-G2**

GOLD	Type of mine (a)	Proved ore reserves at end 2012 Tonnage millions of tonnes	Proved ore reserves at end 2012 Grade grammes per tonne	Probable orereserves at end 2012 Tonnage millions of tonnes	Probable orereserves at end 2012 Grade grammes per tonne	Average mill recovery %	Rio Tinto share Interest %	Recoverable metal millions of ounces
Reserves at operating mines								
Bingham Canyon (US)								
– open pit (l)	O/P							
– stockpiles								
Grasberg (Indonesia)	OP+U							
Northparkes (Australia)								
– open pit and stockpiles								
– underground	U/G			66	0.28	68	80	0.328
Oyu Tolgoi (Mongolia)								
– South Oyu open pit (r) (y)	O/P	426	0.42	614	0.24	74	33.5	2.581
– South Oyu stockpiles (s) (r)		9	0.33			74	33.5	0.024
Reserves at development projects								
Eagle (US) (u)	U/G			5.2	0.25	55	100	0.023
Oyu Tolgoi (Mongolia)								
– Hugo Dummett N (v)	U/G			460	0.37	83	33.5	1.544
– Hugo Dummett N Ext(w)	U/G			31	0.62	83	30.5	0.159

Reserves at development projects
= “Justified for Development”
Sub-classes **E1.1-F1.2-G1** and **E1.1-F1.2-G2**

Rio Tinto 2012: gold reserves

GOLD	Type of mine (a)	Proved ore reserves at end 2012 E1-F1-G1 Tonnage millions of tonnes	Proved ore reserves at end 2012 E1-F1-G1 Grade grammes per tonne	Probable orereserves at end 2012 E1-F1-G2 Tonnage millions of tonnes	Probable orereserves at end 2012 E1-F1-G2 Grade grammes per tonne	Average mill recovery %	Rio Tinto share Interest %	Recoverable metal millions of ounces
Reserves at operating mines								
Bingham Canyon (US)								
– open pit (l)	O/P							
– stockpiles								
Grasberg (Indonesia)	OP+U							
Northparkes (Australia)								
– open pit and stockpiles								
– underground	U/G							
Oyu Tolgoi (Mongolia)								
– South Oyu open pit (r) (y)	O/P							
– South Oyu stockpiles (s) (r)								
Reserves at development projects								
Eagle (US) (u)	U/G			5.2	0.25	55	100	0.023
Oyu Tolgoi (Mongolia)								
– Hugo Dummett N (v)	U/G			460	0.37	83	33.5	1.544
– Hugo Dummett N Ext(w)	U/G			31	0.62	83	30.5	0.159

Reserves at development projects
= “Justified for Development”
Lower sub-classes **E1.1-F1.2-G1** and **E1.1-F1.2-G2**
Possibly E1.1-F1.3-G1 and E1.1-F1.3-G2 if capital NOT already committed (or mining permits not obtained)

Rio Tinto 2012: gold reserves

		E1-F1-G1		E1-F1-G2				
	Type of mine (a)	Proved ore reserves at end 2012		Probable orereserves at end 2012		Average mill recovery %	Rio Tinto share	
		Tonnage	Grade	Tonnage	Grade		Interest %	Recoverable metal
GOLD		millions of tonnes	grammes per tonne	millions of tonnes	grammes per tonne			millions of ounces
Reserves at operating mines								
Bingham Canyon (US)								
– open pit (l)	O/P	417	0.21	287	0.18	64	100	2.875
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Northpar…								
– open								
– unde								
Oyu Tolg								
– South								
– South								
Reserve								
Eagle (U								
Oyu Tolg								
– Hugo I								
– Hugo I								

Note (q): Under the terms of a joint venture agreement between Rio Tinto and FCX, Rio Tinto is entitled to a direct 40 per cent share in reserves discovered after 31 December 1994 and it is this entitlement that is shown.

This is a case where only the attributable proportion of the reserves has been reported, not the total deposit

Rio Tinto 2012: gold resources

GOLD	Likely mining method (a)	E2-F2-G1 Measured resources at end 2012 Tonnage millions of tonnes	E2-F2-G1 Measured resources at end 2012 Grade grammes per tonne	E2-F2-G2 Indicated resources at end 2012 Tonnage millions of tonnes	E2-F2-G2 Indicated resources at end 2012 Grade grammes per tonne	E2-F2-G3 Inferred resources at end 2012 Tonnage millions of tonnes	E2-F2-G3 Inferred resources at end 2012 Grade grammes per tonne	Rio Tinto Interest %
Bingham Canyon (US)								
– Open Pit (l)	O/P					2.7	0.13	100
– North Rim Skarn	U/G	1	2.1	9	1.7	10	1.5	100
Eagle (US) (m)	U/G			0.4	0.18	0.1	0.12	100
Grasberg (Indonesia)	OP+UG	490	0.63	1851	0.53	94	0.46	(r)
Northparkes (Australia)	U/G	14	0.3	3.7	0.13	271	0.26	80
Oyu Tolgoi (Mongolia)								
– Heruga ETG (s)	U/G					910	0.49	30.5
– Heruga IVN (t)	U/G					60	0.37	33.5
– Hugo Dummett North (u)	U/G			292	0.31	574	0.31	33.5
– Hugo Dummett North Extension (v)	U/G			90	0.57	100	0.3	30.5
– Hugo Dummett South (w)	U/G					490	0.09	33.5
– South Oyu (x)	O/P	22	0.65	150	0.5	453	0.23	33.5
Wabu (Indonesia)	O/P					44	2.47	(r)

Rio Tinto 2012: gold resources

GOLD	Likely mining method (a)	E2-F2-G1 Measured resources at end 2012 Tonnage millions of tonnes	E2-F2-G1 Measured resources at end 2012 Grade grammes per tonne	E2-F2-G2 Indicated resources at end 2012 Tonnage millions of tonnes	E2-F2-G2 Indicated resources at end 2012 Grade grammes per tonne	E2-F2-G3 Inferred resources at end 2012 Tonnage millions of tonnes	E2-F2-G3 Inferred resources at end 2012 Grade grammes per tonne	Rio Tinto Interest %
Bingham Canyon (US)								
– Open Pit (l)	O/P					2.7	0.13	100
– North Rim Skarn	U/G	1	2.1	9	1.7	10	1.5	100
Eagle (US) (m)	U/G					.1	0.12	100
Grasberg (Indonesia)	OP+UG					94	0.46	(r)
Northparkes (Australia)	U/G					71	0.26	80
Oyu Tolgoi (Mongolia)								
– Heruga ETG (s)	U/G					10	0.49	30.5
– Heruga IVN (t)	U/G					60	0.37	33.5
– Hugo Dummett North (u)	U/G					74	0.31	33.5
– Hugo Dummett North Extension (v)	U/G			90	0.57	100	0.3	30.5
– Hugo Dummett South (w)	U/G					490	0.09	33.5
– South Oyu (x)	O/P	22	0.65	150	0.5	453	0.23	33.5
Wabu (Indonesia)	O/P					44	2.47	(r)

As before – take care when attributable share is less than 100%

Rio Tinto 2012: gold resources

F2-F2-G1 F2-F2-G2 F2-F2-G3

Note (r): Under the terms of a joint venture agreement between Rio Tinto and FCX, Rio Tinto is entitled to a direct 40 per cent share in resources discovered after 31 December 1994.

As with the reserves – interpretation of the numbers will often depend on the footnotes!

GO							rces 2 Grade	Rio Tinto Interest %
							mmes tonne	
Bing								
– Op							0.13	100
– No							1.5	100
Eagl							0.12	100
Gras							0.46	(r)
Nort							0.26	80
Oyu								
– He							0.49	30.5
– He							0.37	33.5
– Hugo Dummett North (u)	U/G			292	0.31	574	0.31	33.5
– Hugo Dummett North Extension (v)	U/G			90	0.57	100	0.3	30.5
– Hugo Dummett South (w)	U/G					490	0.09	33.5
– South Oyu (x)	O/P	22	0.65	150	0.5	453	0.23	33.5
Wabu (Indonesia)	O/P					44	2.47	(r)

Rio Tinto 2012: uranium reserves

		E1-F1-G1		E1-F1-G2		
Uranium	Likely mining method	Proved ore reserves at end 2012		Probable ore reserves at end 2012		Rio Tinto Interest
		Tonnage	Grade	Tonnage	Grade	%
		Millions of tonnes	U_3O_8 %	Millions of tonnes	U_3O_8 %	
Energy Resources of Australia (Australia)						
– Ranger #3 stockpiles (oo)				7.3	0.132	68.4
Rössing (Namibia) (pp)	O/P	29	0.031	102	0.035	68.6

Rio Tinto 2012: uranium reserves

E1-F1-G1

E1-F1-G2

Uranium	Likely mining method	Proved ore reserves at end 2012		Probable ore reserves at end 2012		Rio Tinto Interest
		Tonnage	Grade	Tonnage	Grade	%
		Millions of	U3O8 %	Millions of	U3O8	
Energy Resources of Australia (Australia)						
– Ranger #3 stockpiles (oo)				7.3	0.132	68.4
Rössing (Namibia) (pp)	O/P	29	0.031	102	0.035	68.6

Watch the attributable percentage again!

Rio Tinto 2012: uranium reserves

Note (oo): Following completion of open cut mining, Ranger #3 reserves are reported as stockpiles only, with reduced tonnes and grade.
Probably should be **E1.1-F2.2-G1** but detailed explanation needed from report text

E1-F1-G2

		Probable ore reserves at end 2012			Rio Tinto Interest
		Tonnage		Grade	%
		Millions of tonnes		U_3O_8 %	
Energy Resources of Australia (Australia)					
– Ranger #3 stockpiles (oo)		7.3		0.132	68.4
Rössing (Namibia) (pp)	O/P	29		0.031	68.6

Rio Tinto 2012: uranium resources

		E2-F2-G1		E2-F2-G2		E2-F2-G3		
Uranium	Likely mining method	Measured resources at end 2012		Indicated resources at end 2012		Inferred resources at end 2012		Rio Tinto interest
		Tonnage	Grade	Tonnage	Grade	Tonnage	Grade	%
		millions of tonnes	U_3O_8 %	millions of tonnes	U_3O_8 %	millions of tonnes	U_3O_8 %	
Energy Resources of Australia (Australia)								
– Jabiluka	U/G	1.2	0.887	14	0.52	10	0.545	68.4
– Ranger#3 mine (nn)	U/G			9.5	0.325	0.6	0.383	68.4
– Ranger #3 stockpiles (oo)				69	0.043			68.4
Rössing (Namibia) (pp)	O/P	15	0.026	148	0.024	173	0.026	68.6

Rio Tinto 2012: uranium resources

Notes: (nn) Ranger open cut resource tonnes have decreased following the completion of open cut mining. Underground resources at a significantly higher grade are now reported. (oo) Following completion of open cut mining, Ranger stockpile resources are reported as a separate entity for the first time.

F2-G3

							esources at	Rio Tinto interest
							Grade	%
							f s U_3O_8 %	
Jabiluka	U/G	1.2		14		10	0.545	68.4
– Ranger#3 mine (nn)	U/G			9.5	0.325	0.6	0.383	68.4
– Ranger #3 stockpiles (oo)				69	0.043			68.4
Rössing (Namibia)								

Ranger#3 Stockpile Resources should probably be **E2-F2.2-G1**

Newcrest: gold and copper

Example: The Telfer province

Dec-12 Mineral Resources	Measured Resource			Indicated Resource			Inferred Resource		
Gold and Copper Resources (# = includes stockpiles)	Dry Tonnes (million)	Gold Grade (g/t Au)	Copper Grade (% Cu)	Dry Tonnes (million)	Gold Grade (g/t Au)	Copper Grade (% Cu)	Dry Tonnes (million)	Gold Grade (g/t Au)	Copper Grade (% Cu)
Main Dome Open Pit #	28	0.43	0.07	380	0.65	0.08	50	0.57	0.07
West Dome Open Pit	-	-	-	390	0.53	0.06	27	0.54	0.07
Telfer Underground	-	-	-	78	1.3	0.32	21	0.76	0.25
Other	-	-	-	0.57	4.2	0.03	16	0.28	0.34
O'Callaghans	-	-	-	69	-	0.29	9	-	0.24

Dec-12 Ore Reserves	Proved Reserve			Probable Reserve		
Gold and Copper Reserves (# = includes stockpiles)	Dry Tonnes (million)	Gold Grade (g/t Au)	Copper Grade (% Cu)	Dry Tonnes (million)	Gold Grade (g/t Au)	Copper Grade (% Cu)
Main Dome Open Pit #	28	0.43	0.07	240	0.76	0.09
West Dome Open Pit	-	-	-	180	0.61	0.06
Telfer Underground	-	-	-	45	1.1	0.3
O'Callaghans	-	-	-	59	-	0.29

Newcrest: gold and copper

Example: The Telfer province

Dec-12 Mineral Resources	**Measured Resource**			**In**		
Gold and Copper Resources (# = includes stockpiles)	Dry Tonnes (million)	Gold Grade (g/t Au)	Copper Grade (% Cu)	Dry Tonnes (million		
Main Dome Open Pit #	28	0.43	0.07	38		
West Dome Open Pit	-	-	-	9		
Telfer Underground	-	-	-	7		
Other	-	-	-			
O'Callaghans	-	-	-	6		
Dec-12 Ore Reserves	**Proved Reserve**			**Proba**		
Gold and Copper Reserves (# = includes stockpiles)	Dry Tonnes (million)	Gold Grade (g/t Au)	Copper Grade (% Cu)	Dry Tonnes (million)	Grade (g/t Au)	Copper Grade (% Cu)
Main Dome Open Pit #	28	0.43	0.07	240	0.76	0.09
West Dome Open Pit	-	-	-	180	0.61	0.06
Telfer Underground	-	-	-	45	1.1	0.3
O'Callaghans	-	-	-	59	-	0.29

From the Newcrest report: "***Mineral Resources are quoted inclusive of Ore Reserves***" though here it is quite simple – Proved Reserve numbers are identical to Measured Resource numbers.

Newcrest: gold and copper

Example: The Telfer province

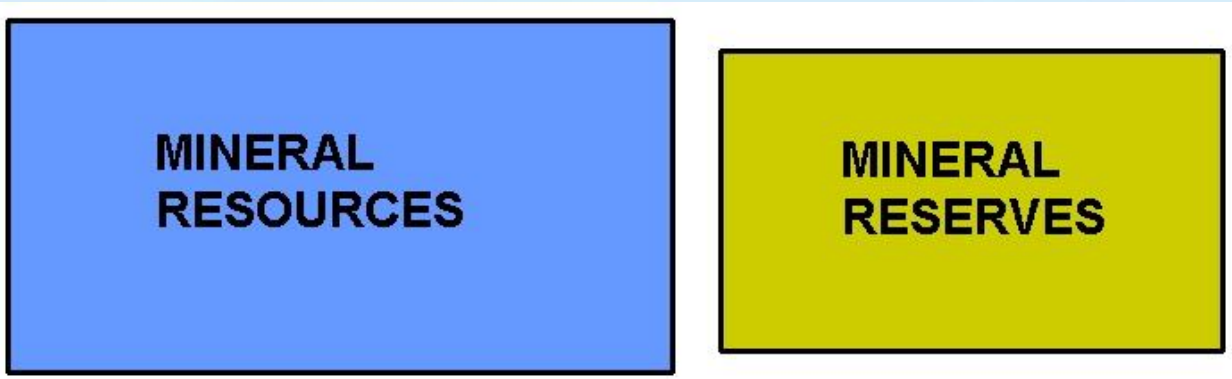
Dec-12 Mineral Resources	**Measured Resource**			**In**
Gold and Copper Resources (# = includes stockpiles)	Dry Tonnes (million)	Gold Grade (g/t Au)	Copper Grade (% Cu)	Dry Tonnes (million
Main Dome Open Pit #	28	0.43	0.07	38
West Dome Open Pit	-	-	-	9
Telfer Underground	-	-	-	7
Other	-	-	-	3
O'Callaghans	-	-	-	6
Dec-12 Ore Reserves	**Proved Reserve**			**Proba**
Gold and Copper Reserves (# = includes stockpiles)	Dry Tonnes (million)	Gold Grade (g/t Au)	Copper Grade (% Cu)	Dry Tonnes (million
Main Dome Open Pit #	28	0.43	0.07	24
West Dome Open Pit	-	-	-	18
Telfer Underground	-	-	-	4
O'Callaghans	-	-	-	5

From the Newcrest report: "***Mineral Resources are quoted inclusive of Ore Reserves***" though here it is quite simple – Proved Reserve numbers are identical to Measured Resource numbers.

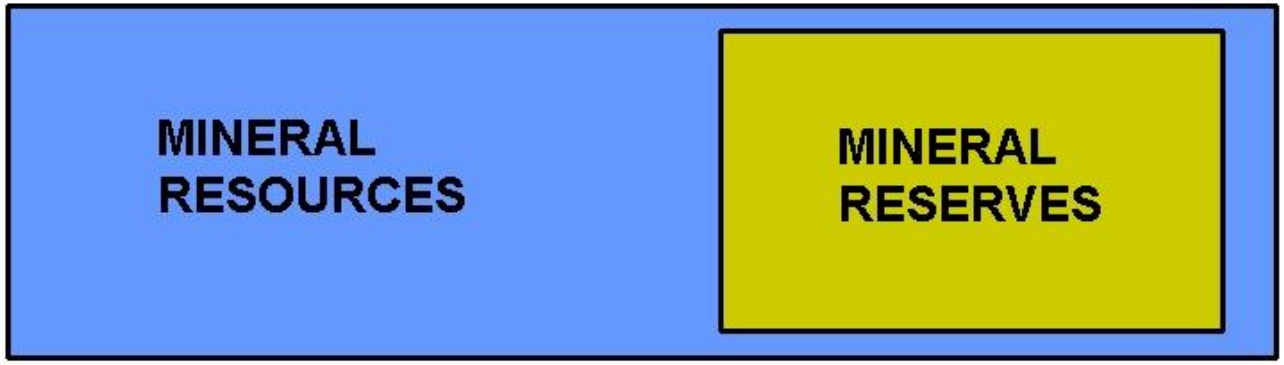
But in general it cannot be assumed that you can back-calculate the Resources excluding Reserves. It may be necessary to ask the company.

Resources & Reserves: two possible conventions in CRIRSCO-aligned standards

(1) “Resources quoted **exclusive** of material used to estimate reserves”



(2) “Resources quoted **inclusive** of material used to estimate reserves”



Resources & Reserves: two possible conventions in CRIRSCO-aligned standards

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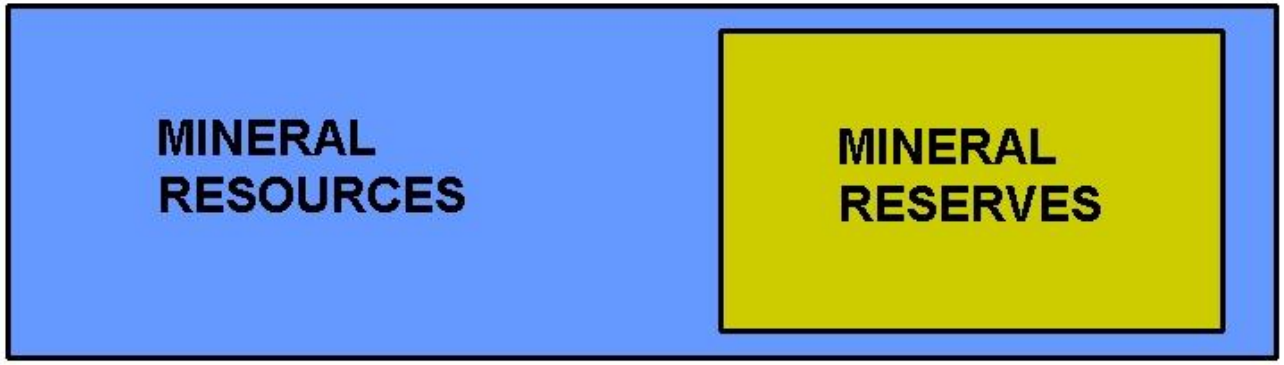

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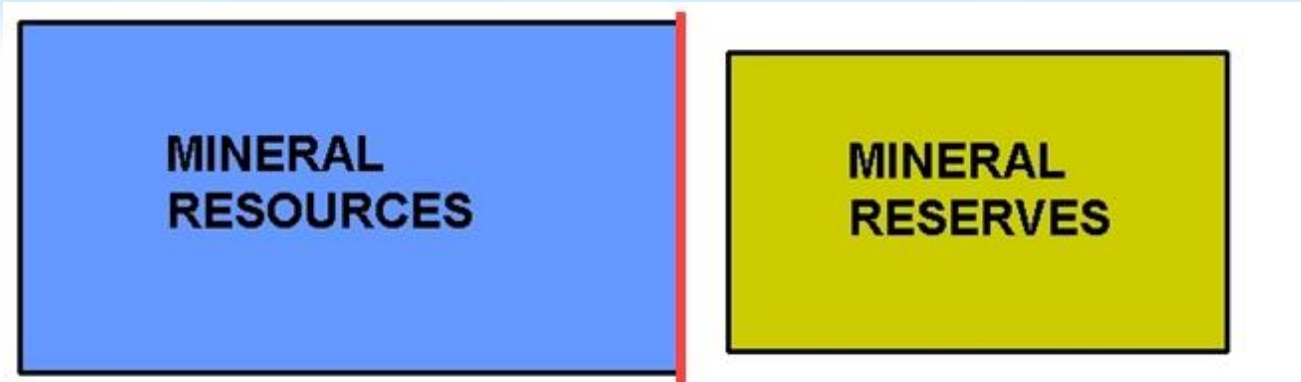

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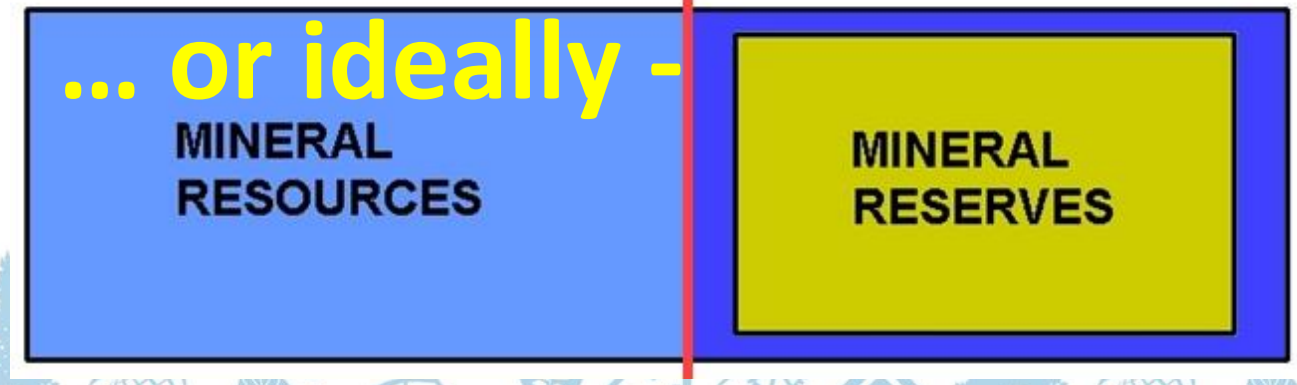

Newcrest: gold and copper

Example: The Telfer province

Dec-12 Mineral Resources	Measured Resource			Indicated Resource			Inferred Resource		
Gold and Copper Resources (# = includes stockpiles)	Dry Tonnes (million)	Gold Grade (g/t Au)	Copper Grade (% Cu)	Dry Tonnes (million)	Gold Grade (g/t Au)	Copper Grade (% Cu)	Dry Tonnes (million)	Gold Grade (g/t Au)	Copper Grade (% Cu)
Main Dome Open Pit #	28	0.43	0.07	380	0.65	0.08	50	0.57	0.07
West Dome Open Pit	-	-	-	390	0.53	0.06	27	0.54	0.07
Telfer Underground	-	-	-	78	1.3	0.32	21	0.76	0.25
Other	-	-	-	0.57	4.2	0.03	16	0.28	0.34
O'Callaghans	-	-	-	69	-	0.29	9	-	0.24

Dec-12 Ore Reserves	Proved Reserve			Probable Reserve		
Gold and Copper Reserves (# = includes stockpiles)	Dry Tonnes (million)	Gold Grade (g/t Au)	Copper Grade (% Cu)	Dry Tonnes (million)	Gold Grade (g/t Au)	Copper Grade (% Cu)
Main Dome Open Pit #	28	0.43	0.07	240	0.76	0.09
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Telfer Underground	-	-	-	45	1.1	0.3
O'Callaghans	-	-	-	59	-	0.29

Newcrest: gold and copper

Example: The Telfer province

Dec-12 Mineral Resources	Measured Resource			Indicated Resource			Inferred Resource		
Gold and Copper Resources (# = includes stockpiles)	Dry Tonnes (million)	Gold Grade (g/t Au)	Copper Grade (% Cu)	Dry Tonnes (million)	Gold Grade (g/t Au)	Copper Grade (% Cu)	Dry Tonnes (million)	Gold Grade (g/t Au)	Copper Grade (% Cu)
Main Dome Open Pit #	28	0.43	0.07	380	0.65	0.08	50	0.57	0.07
West Dome Open Pit	-	-	-	390	0.53	0.06	27	0.54	0.07
Telfer Underground	-	-	-	78	1.3	0.32	21	0.76	0.25
Other	-	-	-	0.57	4.2	0.03	16	0.28	0.34
O'Callaghans	-	-	-	69	-	0.29	9	-	0.24
Dec-12 Ore Reserves	**Proved Reserve**			**Probable Reserve**					
Gold and Copper Reserves (# = includes stockpiles)	Dry Tonnes (million)	Gold Grade (g/t Au)	Copper Grade (% Cu)	Dry Tonnes (million)	Gold Grade (g/t Au)	Copper Grade (% Cu)			
Main Dome Open Pit #	28	0.43	0.07	240	0.76	0.09			
West Dome Open Pit	-	-	-	180	0.61	0.06			
Telfer Underground	-	-	-	45	1.1	0.3			
O'Callaghans	-	-	-	59	-	0.29			

Newcrest: gold and copper

Example: The Telfer province

Dec-12 Mineral Resources	Measured Resource			Indicated Resource		
Gold and Copper Resources (# = includes stockpiles)	Dry Tonnes (million)	Gold Grade (g/t Au)	Copper Grade (% Cu)	Dry Tonnes (million)	Gold Grade (g/t Au)	Copper Grade (% Cu)
Main Dome Open Pit #	28	0.43	0.07	380	0.65	0.08
West Dome Open Pit	-	-	-	390	0.53	0.06
Telfer Underground	-	-	-	78	1.3	0.32
Other	-	-	-	0.57	4.2	0.03
O'Callaghans	-	-	-	69	-	0.29
Dec-12 Ore Reserves	**Proved Reserve**			**Probable Reserve**		
Gold and Copper Reserves (# = includes stockpiles)	Dry Tonnes (million)	Gold Grade (g/t Au)	Copper Grade (% Cu)	Dry Tonnes (million)	Gold Grade (g/t Au)	Copper Grade (% Cu)
Main Dome Open Pit #	28	0.43	0.07	240	0.76	0.09
West Dome Open Pit	-	-	-	180	0.61	0.06
Telfer Underground	-	-	-	45	1.1	0.3
O'Callaghans	-	-	-	59	-	0.29

Not so easy here: some of the Indicated Resource has **not** been converted to Probable Reserve – but we don't know how much

Construction Minerals

	E1-F1-G1	E1-F1-G2	E2-F2-G1	E2-F2-G2	E2-F2-G3
	Reserves (Mt)		Resources (Mt)		
Cement Quarry A (note 1)	**Proved**	**Probable**	**Measured**	**Indicated**	**Inferred**
Clay 1	1.43	2.94	0.00	5.46	0.00
Clay 2	0.89	1.14	0.00	3.51	0.00
Limestone 1	1.61	18.25	0.00	27.25	0.00
Limestone 2	0.00	0.00	1.75	2.61	0.00
Limestone 3	1.18	4.26	0.00	8.23	0.00
Cement Quarry B (note 2)					
Limestone 1	2.37	0.00	0.00	0.00	0.00
Limestone 2	32.18	0.00	2.37	0.00	0.00
Cement Quarry C (note 2)					
Limestone 1	0.57	4.50	0.00	5.23	0.00
Limestone 2	24.00	0.00	0.00	1.07	0.00
Aggregate Quarry A (note 3)					
Unit 1	3.35	0.00	16.05	0.00	0.00
Unit 2	46.96	0.00	4.19	0.00	0.00
Aggregate Quarry B (note 4)					
Unit 1	141.05	0.00	8.92	38.96	0.00

Construction Minerals

	E1-F1-G1	E1-F1-G2	E2-F2-G1	E2-F2-G2	E2-F2-G3
	Reserves (Mt)		Resources (Mt)		
Cement Quarry A (note 1)	Proved	Probable	Measured	Indicated	Inferred
Clay 1	1.43	2.94	0.00	5.46	0.00
Clay 2	0.89	1.14	0.00	3.51	0.00
Limestone 1	1.61	18.25	0.00	27.25	0.00
Limestone 2	0.00	0.00	1.75	2.61	0.00
Limestone 3	1.18	4.26	0.00	8.23	0.00

Note 1. Reserves and resources comprise the materials to be used in the kiln feed. Materials in the Resources classes include, amongst other things, that tonnage beyond the ratio necessary for the current recipe but which are expected to be worked in the future by additional blending or use of imported additives.

-- relative proportion of such material not specified, so not possible to identify tonnages to different sub-classes.

Construction Minerals

Note 2. Reserves and resources are stated for those tonnages only that will be recovered based on the current kiln recipe. Other materials are available at the site, but for which there is currently no proposal for recovery hence are not reported.

					F2-G3
					erred
Limestone 3	1.18	4.26	0.00	8.23	0.00
Cement Quarry B (note 2)					
Limestone 1	2.37	0.00	0.00	0.00	0.00
Limestone 2	32.18	0.00	2.37	0.00	0.00
Cement Quarry C (note 2)					
Limestone 1	0.57	4.50	0.00	5.23	0.00
Limestone 2	24.00	0.00	0.00	1.07	0.00
Aggregate Quarry A (note 3)					
Unit 1	3.35	0.00	16.05	0.00	0.00
				0.00	0.00
				38.96	0.00

All resources and reserves quoted can be processed with current methods. There may be additional material not reported – but this cannot be listed as we have no numbers for it

Construction Minerals

	E1-F1-G1	E1-F1-G2	E2-F2-G1	E2-F2-G2	E2-F2-G3
	Reserves (Mt)		Resources (Mt)		
Cement Quarry A (note 1)	**Proved**	**Probable**	**Measured**	**Indicated**	**Inferred**
Clay 1	1.43	2.94	0.00	5.46	0.00
					0.00
					0.00
					0.00
					0.00
					0.00
					0.00
Limestone 1	0.57	4.50	0.00	5.23	0.00
Limestone 2	24.00	0.00	0.00	1.07	0.00
Aggregate Quarry A (note 3)					
Unit 1	3.35	0.00	16.05	0.00	0.00
Unit 2	46.96	0.00	4.19	0.00	0.00
Aggregate Quarry B (note 4)					
Unit 1	141.05	0.00	8.92	38.96	0.00

Note 3. Two different materials are present in the quarry suitable for the production of aggregates. Additional permits are necessary to recover the resources stated.

Proved Reserves, "Justified for development" = **E1.1-F1.3-G1**

Construction Minerals

	E1-F1-G1	E1-F1-G2	E2-F2-G1	E2-F2-G2	E2-F2-G3
	Reserves (Mt)		Resources (Mt)		
Cement Quarry A (note 1)	**Proved**	**Probable**	**Measured**	**Indicated**	**Inferred**
Clay 1	1.43	2.94	0.00	5.46	0.00
Clay 2	0.89	1.14	0.00	3.51	0.00
Limestone 1	1.61	18.25	0.00	27.25	0.00
Limestone 2	0.00	0.00	1.75	2.61	0.00
Limestone 3	1.18	4.26	0.00	8.23	0.00
Cement Quarry B (note 2)					
Unit 1	3.35	0.00	16.05	0.00	0.00
Unit 2	46.96	0.00	4.19	0.00	0.00
Aggregate Quarry B (note 4)					
Unit 1	141.05	0.00	8.92	38.96	0.00

Note 4. Additional investment is necessary to recover the resources stated (currently beneath the plant and stock areas).

Resources are “Development on hold” = **E2-F2.2-G1** and **E2-F2.2-G2**

Construction Minerals

When data on construction minerals are reported to stock exchanges, they are often aggregated over a number of sites and definition of sub-classes may not be possible.

Imerys 2012: industrial minerals

Product	Region	Proven	Probable	Total
		2012 (kt)	2012 (kt)	2012 (kt)
Ball clays				
	Asia/Pacific	899		899
	Europe incl. Africa	8304	4415	12719
	North America	4687	1695	6382
	Total	13890	6110	20000
Carbonates (calcite, marble, chalk, limestone, dolomite & dimension stone)				
	Asia/Pacific	1589	37426	39015
	Europe incl. Africa	5824	24278	30102
	North America	116482	41686	158168
	South America	610	6800	7410
	Total	124505	110190	234695
Clays (brick & roof tile raw materials)				
	Europe	85343	1959	87302
	Total	85343	1959	87302

Imerys 2012: industrial minerals

Product	Region	Proven	Probable	Total
		E1-F1-G1	E1-F1-G2	2012 (kt)
Ball clays				
	Asia/Pacific	899		899
	Europe incl. Africa	8304	4415	12719
				382
				000
				015
				102
				168
				410
				695
				302
				302

Mapping these data into UNFC-2009 does not present a problem - all will follow the Bridging Document guidelines.

For government reporting it is likely that the company would have to be asked for detail relating to an individual country or regions within a country.

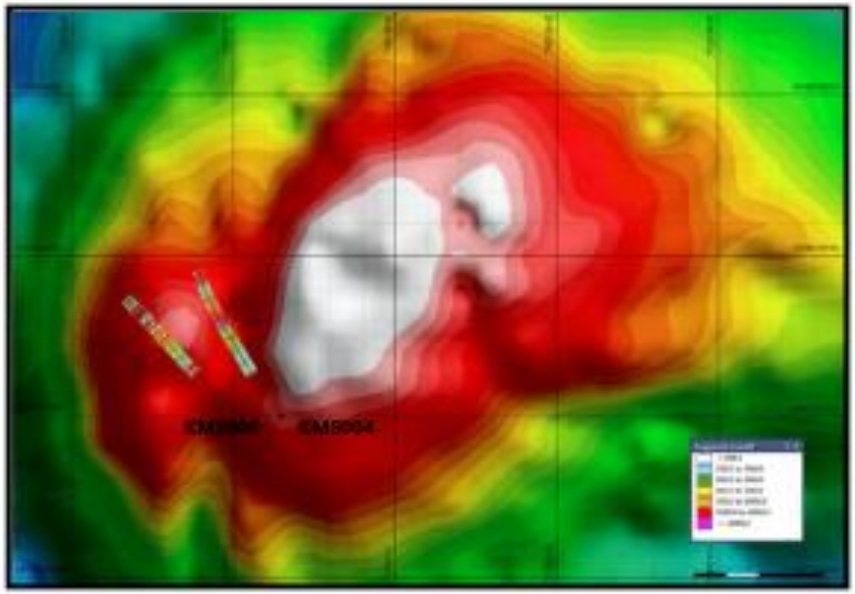
UNITED NATIONS
ECONOMIC COMMISSION
FOR EUROPE

FOR A STRONGER AND GREENER ECONOMY
UNECE

Exploration Results

KHAMSIN DRILL HOLES
Significant Results KMS004 and KMS006

OZ MINERALS

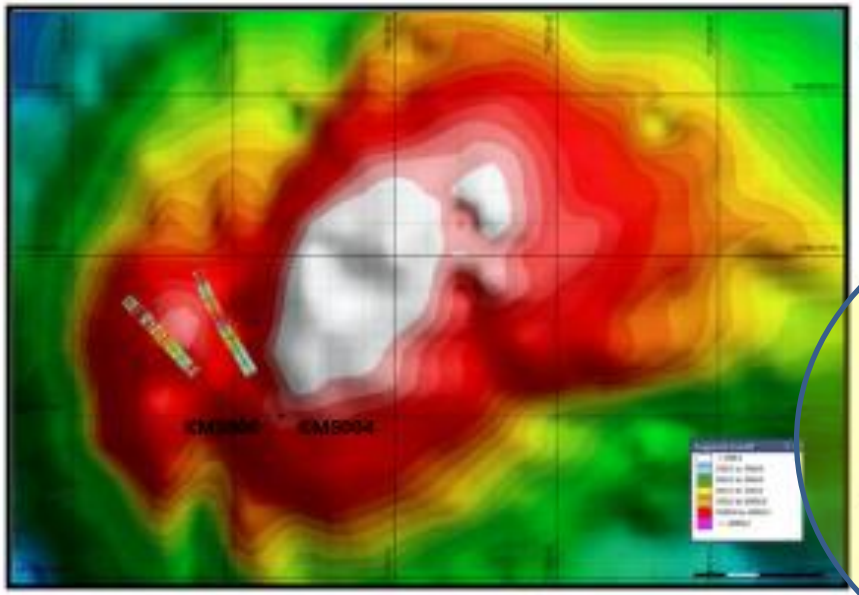


- KMS004 – intersected a broad zone of carbonate, hematite, chlorite granite breccias which hosted bornite and chalcopyrite mineralisation
- KMS004 - 442m @ 0.49% Cu and 0.09 g/t Au from 1380 including 48.5m @ 1.01% Cu and 0.07 g/t Au from 1385.6m
- KMS006 - 334m @ 0.75% Cu from 909m including 108m @ 0.92% Cu, 0.40 g/t Au from 1033

A slide from a presentation by Oz Minerals on 28/11/2013

Exploration Results

KHAMSIN DRILL HOLES
Significant Results KMS004 and KMS006



- KMS004 – intersected a broad zone of carbonate, hematite, chlorite granite breccias which hosted bornite and chalcopyrite mineralisation
- KMS004 - 442m @ 0.49% Cu and 0.09 g/t Au from 1380 including 48.5m @ 1.01% Cu and 0.07 g/t Au from 1385.6m
- KMS006 - 334m @ 0.75% Cu from 909m including 108m @ 0.92% Cu, 0.40 g/t Au from 1033

A slide from a presentation by Oz Minerals on 28/11/2013

EXPLORATION RESULTS, map to **E3-F3-G4**

Exploration Targets

Mentioned but not defined in CRIRSCO 2006 Template.

CRIRSCO Nov 2013 Template definition:

An Exploration Target is a statement or estimate of the exploration potential of a mineral deposit in a defined geological setting where the statement or estimate, **quoted as a range of tonnes and a range of grade or quality**, relates to mineralisation for which there has been insufficient exploration to estimate Mineral Resources.

Maps to E3-F3-G4 - like Exploration Results

Exploration Targets

- An Exploration Target may or may not have supporting geological data (geophysical, geochemical, drilling, etc.)
- It should be possible to differentiate along the G axis by sub-division of G4 – representing different relative amounts of geological knowledge

Newera: coal in Mongolia

Newera Resources published a statement on 18th March 2013 concerning its Shanagan Coal Project in Mongolia:

Newera Resources Limited (ASX: NRU) is pleased to advise that work over the last month to calculate an Exploration Target – as defined under Section 17 of the updated JORC Code - has now been completed.

Highlights:

- *A determination that an **Exploration Target of 64 to 111 million tonnes of coal** can currently be attributed to Newera's Shanagan coal project, based on exploration to-date, including Newera's recently completed phase 1 and phase 2 drilling programs.*
- *...*

Newera: coal in Mongolia

Newera Resources published a statement on 18th March 2013 concerning its Shanagan Coal Project in Mongolia:

Newera Resources Limited (ASX: NRU) is pleased to advise that work over the last month to calculate an Exploration Target – as defined under Section 17 of the updated JORC Code - has now been completed.

Highlights:

- *A determination that an Exploration Target of 64 to 111 million tonnes of coal can currently be attributed to Newera's Shanagan coal project, based on exploration to-date, including Newera's recently completed phase 1 and phase 2 drilling programs.*
- *...*

E3.2-F3.1-G4

Newera: coal in Mongolia

Newera Resources pu
2013 concerning its S

Newera Resources Limite
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Highlights:

- *A determination that an Exploration Target of 64 to 111 million tonnes of coal can currently be attributed to Newera's Shanagan coal project, based on exploration to-date, including Newera's recently completed phase 1 and phase 2 drilling programs.*
- *…*

Sub-classes?

As **currently** defined in the Specifications:

"Low case" **G4.1 = 64 million tonnes**

"Best estimate" **G4.2 is undefined**

"High case" 111 million tonnes. G4.3 is the increment 111 - 64

G4.3 = 47 million tonnes

E3.2-F3.1-G4

Carpentaria 2013: iron ore

At the Braemar JV (CAP earning in) and contiguous South Dam project (100% CAP), independent geologists H&S Consultants Pty Ltd (H&SC) have estimated an ***Exploration Target of 1.7 to 3.1 billion tonnes, with an estimated magnetite mass recovery (Davis Tube Recovery, "DTR") of 12 to 27% for between 200 million tonnes and 850 million tonnes of iron concentrate at 63-67% iron (Table 1).***

The potential quantity and grade of the Exploration Target is conceptual in nature and there is insufficient exploration to define a mineral resource. It is uncertain if further exploration will result in determination of a mineral resource.

Carpentaria 2013: iron ore

Exploration Target estimates (detail):

Target Area	Strike (km)	Thickness (m)	Down Dip (m)	Volume (Mm3)	Density (t/m3)	In situ Tonnes (Mt)	Concentrate (Mt)
South Dam	9.5-10.5	80-120	250	190-320	3.05	580-960	70-260
Braemar W	8.5-9.5	80-120	250	170-290	3.05	520-870	60-230
Braemar C	8.0-9.0	80-120	250	160-270	3.05	490-820	60-220
Braemar E	2.0-4.5	100-150	250	50-170	3.05	150-515	20-140
Totals	28.0-33.5	80-150	250	570-1040		1740-3170	210-850

Supporting data: three reverse-circulation drill holes and some geophysical exploration (airborne and ground magnetic data):
Probably **E3-F3.2-G4** because data are not site-specific

(… but see recommendations!)

Carpentaria 2013: iron ore

"Exploration Target of 1.7 to 3.1 billion tonnes, with an estimated magnetite mass recovery … of 12 to 27%"

How do we map this to the G4.1 / G4.2 / G4.3 sub-classes?

The same data item is expressed as ranges of TWO parameters, tonnage and grade.

We cannot just say "(low case) 1.7 billion tonnes at 12% to (high case) 3.1 billion tonnes at 27%" because this makes unsupported assumptions about the correlation between tonnage and grade

Carpentaria 2013: iron ore

"Exploration Target of 1.7 to 3.1 billion tonnes, with an estimated magnetite mass recovery … of 12 to 27%"

How do we map this to the classes?

The same data item is ex… TWO parameters, tonnage and grade!

We cannot just say "(low case) 1.7 billion tonnes at 12% to (high case) 3.1 billion tonnes at 27%" because this makes unsupported assumptions about the correlation between tonnage and grade

So we cannot use the G4 sub-classes as they are currently defined

Conclusions

What we have learned from these case studies ……

Granularity

- Always quote the main class as well as any sub-class. This allows consistent aggregation of data using the main classes
- Possible to map CRIRSCO data naturally to sub-classes in many cases
- But – there is a particular problem with exploration data (E3-F3-G4)

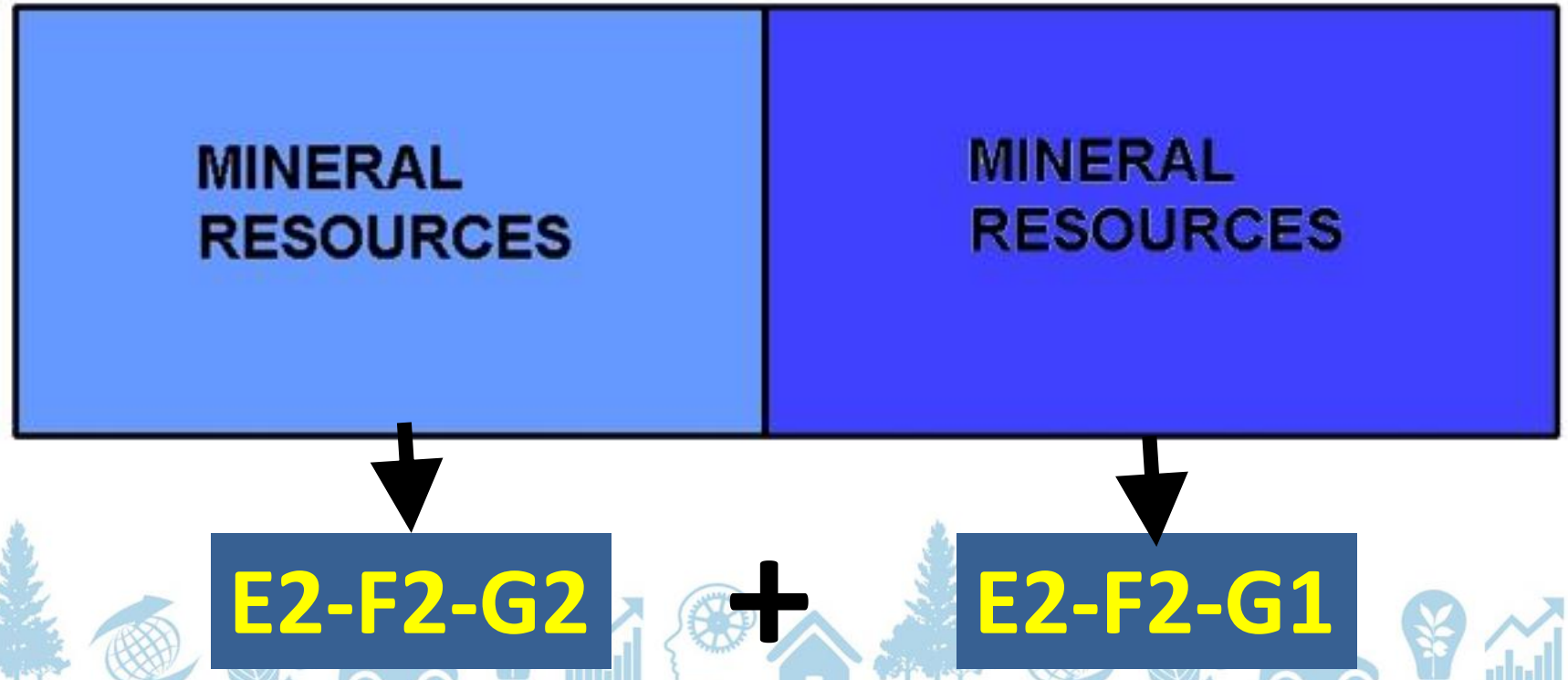
Reference Point

- Care is needed to record data with a consistent Reference Point
- **In CRIRSCO reports this is usually delivery to a processing plant.**
- Processing yield factors should generally be reported, but this is not mandatory, thus point of sale cannot usually be used as the Reference Point

Aggregation of Reserves and Resources estimates

- Combining **E1 F1 G1-2** with **E2 F2 G1-3** ?
- CRIRSCO prohibits this. **The numbers cannot be combined, as they are estimates of different things.**
- It would seem that the Bridging Document (ECE 42, part II Annex III, p.34, last paragraph) also prohibits this (resources and reserves are considered as separate projects)
- BUT Specification K (ECE 42, part II, section VI(K)) allows aggregation of different projects. **This should be amended for consistency – to prohibit aggregation in situations where the numbers in the different classes are not directly comparable**

Aggregation OK – classes estimating same type of quantity



Cannot aggregate – classes estimate DIFFERENT things

Exploration Targets

Mentioned but not defined in CRIRSCO 2006 Template.

CRIRSCO Nov 2013 Template definition:

An Exploration Target is a statement or estimate of the exploration potential of a mineral deposit in a defined geological setting where the statement or estimate, **quoted as a range of tonnes and a range of grade or quality**, relates to mineralisation for which there has been insufficient exploration to estimate Mineral Resources.

Maps to E3-F3-G4 - like Exploration Results

Exploration data

There are two problems with the currently defined sub-division of the E3-F3-G4 class:

1. **G4** sub-division in Specification P is data codification. But a range is really a single item of information: just ONE sub-class! Ranges of multiple quantity/quality parameters cannot be accommodated as defined

2. **F3** sub-division in specification R is defined in terms of relative extents of **geological** knowledge rather than technical feasibility

Exploration data

G-axis (G4 class) sub-division

Possible data types include

- **raw data - drill hole intercepts, geochemical survey data, geophysical data, …**
- **ranges with low case, best estimate, and high case (PRMS)**
- **ranges with low and high limits of one OR MORE parameters (CRIRSCO)**
- **… potentially many others?**

Wrong to sub-divide to provide codification for just one of these data types. CRIRSCO Exploration Targets with ranges of tonnages and grades cannot use these sub-classes

Exploration data

G-axis (G4 class) sub-division

Possible data types include

- ra… …ical
  su…
- ra… …high
  ca…
- ra… …R
  M…
- ..

Wron… …on
for ju… …O
Explo… …ges
and g… …s

A ‘range’ is just one set of data and belongs in just ONE sub-class: suggest deletion of specification P as unnecessary and unworkable.

In any case, at this exploration stage, it is unlikely there will be sufficient data to justify such granularity

Exploration data

This would then allow …….

- **F3 sub-division** - replace by **G4 sub-division**
- The current specification R sub-divides the F axis on different degrees of **geological** knowledge.
- **It is incorrect to use the F axis for this purpose.** These sub-divisions should lie along the G-axis – not **F3.1,F3.2,F3.3** but **G4.1,G4.2,G4.3**.
- This would leave the F-axis free for sub-division on **non-**geological aspects of 'project maturity' if required

Orthogonality?

The UNFC-2009 E, F, and G axes should be orthogonal (otherwise we don't have a cube!)

If the F axis represents progress of 'studies' ('project maturity'?), surely these cannot include studies which are socio-economic (E axis) or geological (G axis)?

That would imply that we really need only ONE axis M = project maturity

ECE ENERGY SERIES No. 42
Part II: proposed replacement paragraphs

The report includes proposed text to replace specifications P, Q, and R

The G axis as proposed

UNFC-2009 Definitions

G3: Quantities associated with a known deposit that can be estimated with a low level of confidence.

G2: Quantities associated with a known deposit that can be estimated with a moderate level of confidence.

G1: Quantities associated with a known deposit that can be estimated with a high level of confidence.

The G axis as proposed

UNFC Specifications - Part II, section VI(R) as proposed

… favourable conditions may be inferred from **regional geological studies**

… **local geological studies** and exploration activities indicate the potential

… **site-specific geological studies** and exploration activities have identified the potential

G4.3
G4.2
G4.1
G3
G2
G1

UNFC-2009 Definitions

G3: Quantities associated with a known deposit that can be estimated with a **low level** of confidence.

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The G axis as proposed

G4.3
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G1

UNFC Specifications - Part II, section VI(R)

… favourable conditions may be inferred from **regional geological studies**

… **local geological studies** and exploration activities indicate the potential

… **site-specific geological studies** and exploration activities have identified the potential

CRIRSCO Template

(INFERRED) Geological evidence is **sufficient to imply but not verify** geological and grade or quality continuity

(INDICATED) Geological evidence is … **sufficient to assume** geological and grade or quality continuity

(MEASURED) Geological evidence is … **sufficient to confirm** geological and grade or quality continuity

The G axis as proposed

G4.3	} EXPLORATION TARGET
G4.2	
G4.1	
G3	Geological evidence is sufficient to imply but not verify geological and grade or quality continuity
G2	Geological evidence is … sufficient to assume geological and grade or quality continuity
G1	Geological evidence is … sufficient to confirm geological and grade or quality continuity

studies
otential
dentified

The G axis as proposed

G4.3
G4.2
G4.1

} EXPLORATION TARGET

G4.1 – Exploration Results (site-specific data)

studies
otential
dentified

G3

Geological evidence is sufficient to imply but not verify geological and grade or quality continuity

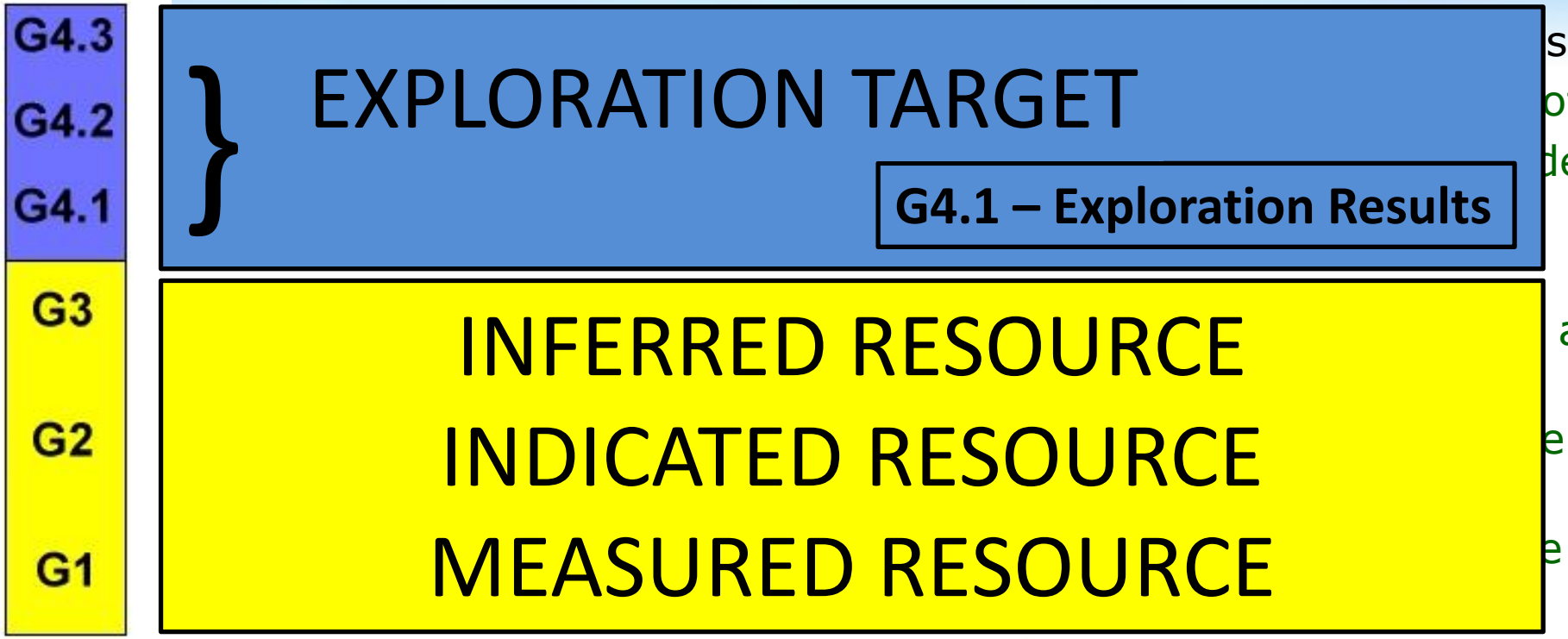
G2

Geological evidence is … sufficient to assume geological and grade or quality continuity

G1

Geological evidence is … sufficient to confirm geological and grade or quality continuity

The G axis as proposed



studies
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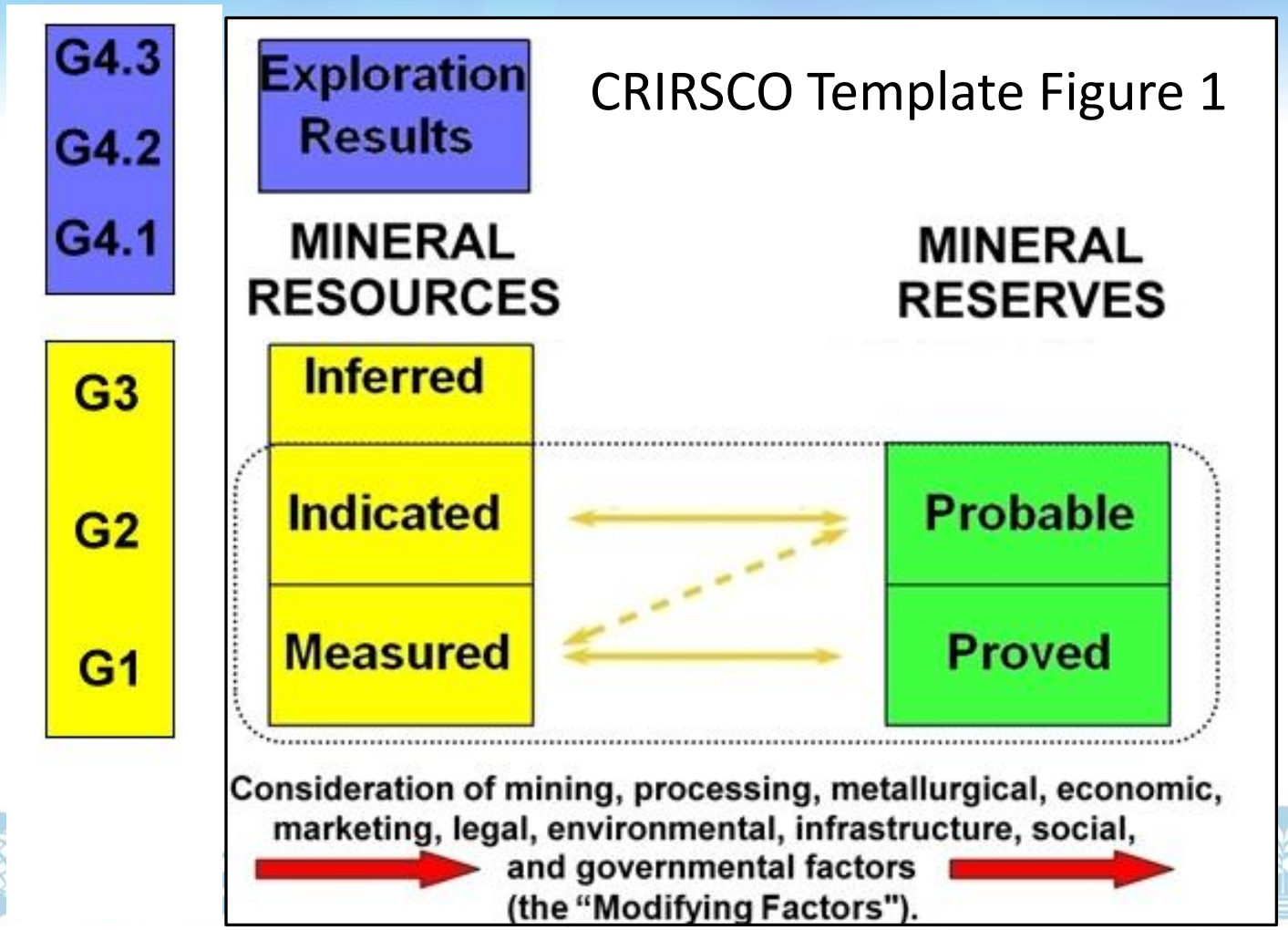
The G axis as proposed

EXPLORATION TARGET and EXPLORATION RESULTS

MINERAL RESOURCES



Recommendations for government reporting

- "Competent Person" validation

Recommendations for government reporting

- "Competent Person" validation

  - Competent Person requirement for most public listed companies
  - Not normally required for unlisted and private companies
  - EU Minventory project suggests a government Competent Person to provide consistent data validation: this is a useful general recommendation

Recommendations for government reporting

- "Competent Person" validation
- Data formats; tabulation (use two UNFC columns in database, for main classes, and for sub-classes – **or use ONLY the main classes**)
- Watch for CRIRSCO resource estimates reported *inclusive* of reserves (avoid double-counting)
- Watch for reporting from joint ventures (avoid double-counting, avoid under-counting)
- Take care if aggregating data reported using very different economic assumptions or cutoff grades

Recommendations for government reporting (continued)

- For 'undiscovered' resources, preferable to use non-company data (e.g. geological survey) – as also for uneconomic or unrecoverable
- DO NOT aggregate CRIRSCO-derived resources (E2F2G1-3) classes with reserves (E1F1G1-2) because the estimates are not comparable
- Use a consistent Reference Point (for solid minerals, this is usually delivery to processing plant)

Question raised by Geoscience Australia – how to distinguish Resources "economic now" from "uneconomic now but potentially in the future" ?

Classes E2F2G1 / E2F2G2 / E2F2G3

UNFC: Potentially Commercial Projects are expected to be developed in the foreseeable future, in that the quantities are assessed to have reasonable prospects for eventual economic extraction, but technical and/or commercial feasibility has not yet been confirmed. Consequently, not all Potentially Commercial Projects may be developed.

CRIRSCO: Mineral Resource definition also says: … there are reasonable prospects for eventual economic extraction …

The CRIRSCO-UNFC mapping is OK – but if a government agency wants to distinguish between "economic now" and "uneconomic now but reasonable prospects etc…." how do they do it? Sub-classes have not been defined.

My answer – NOT sub-division of Resources classes.

Simply requires more information on Modifying Factors (E and F axes) to re-classify as E1-F1-G1 and E1-F1-G2 (CRIRSCO Reserves = "economic now")

Feedback from an industrial minerals company

FIRST POINT

a) A (the) major consideration today is mining permits. This is a separate question from both socio-economic and technical feasibility, and should be a different axis.

b) Reserves can only be reported if permits are in place, otherwise will be 211 or 212 class. But Resources could also map to 211, 212, 213. This violates the 1:1 mapping and could lead to confusion

Feedback from an industrial minerals company

SECOND POINT

a) "… the Economical and Technical Feasibility considerations are in reality very much linked, and the E & F axes should be combined to one. Everything can technically be done...but at a cost !"

b) The third axis should then be "the combination of all considerations (legal, social, environmental, etc.) that influence on the Permitability. P1 (Permits in place), P2 (Future Permits more likely than not), P3 (Permits Possible, but not Probable)"

Feedback from an industrial minerals company

SECOND POINT - Example: in two deposits to which a E3-F1-G1 code is assigned, you cannot differentiate between an

unsaleable clay deposit, technically ready to go, that is fully permitted

and a

high quality clay deposit, technically ready to go, but located within a nature reserve.

Both might have the same E3-F1-G1 class.

(In this example neither of them would qualify as any kind of CRIRSCO Resource or Reserve)

Summary

- Defined mapping to main classes (almost) always works
- Extra information in company reports often allows use of sub-classes
- Some minor problems in assigning sub-classes for Resources and Reserves. A more general problem that data quality often does not support sub-classes: for statistical purposes best always to work with main classes
- Exploration sub-classes – recommended amendments to the Specifications, or avoid using E3-F3-G4 sub-classes
- Some detailed updates proposed for the Bridging Document

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Thank you