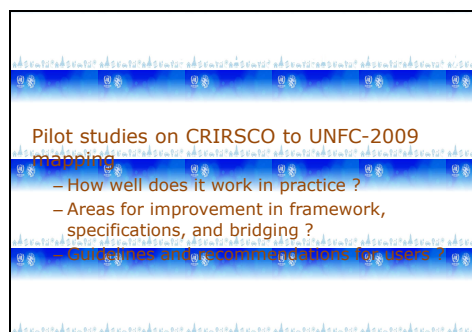


Slide 1



Slide 2



The 3 main purposes of the study are:

- * how well does the bridging work in practice?
- * what areas of improvement or modification in framework, specifications, and bridging?
- * guidelines for users

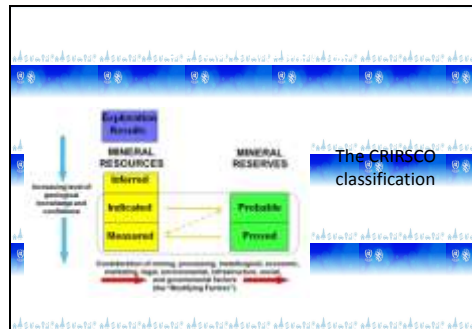
Slide 3



Let's start by looking at the standard defined mappings between CRIRSCO and UNFC-2009 classifications

This is the UNFC-2009 cube ...

Slide 4



... and the CRIRSCO classes.

Although this is the classification, it is part of a more general set of reporting standards.

Currently there are seven CRIRSCO-aligned standards recognised in different jurisdictions, for public reporting by minerals companies.

All use the same classification and an identical set of standard definitions

The scope of CRIRSCO is **all solid minerals**

This classification shows increasing geological knowledge downwards, and increasing knowledge of socio-economic and technical modifying factors towards the right

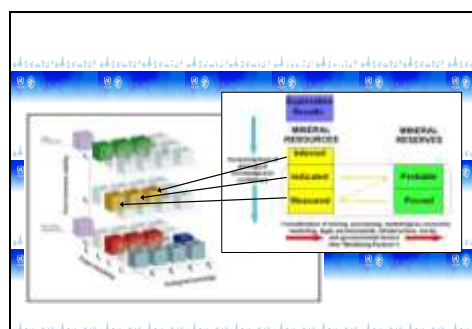
Slide 5



This is the DEFINED MAPPING between them

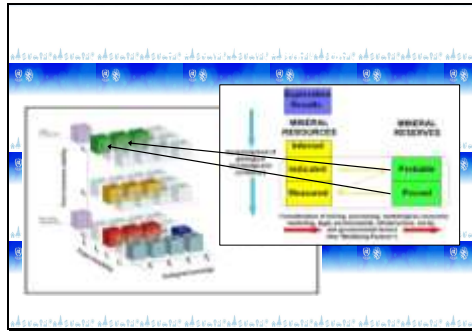
– first for Exploration Results (and Exploration Targets)

Slide 6



Then for the CRIRSCO classes of MINERAL RESOURCES

Slide 7



Finally for the CRIRSCO classes of MINERAL RESERVES

Slide 8

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

In November 2013 a revised version of the CRIRSCO Template was published.

Significant changes relevant to this report are:

New agreed standard definitions to be used in all CRIRSCO standards.

These include

- **Effective Date** and **Reference Point** definitions added, to harmonise with UNFC-2009
- **Exploration Target** definition to harmonise with CRIRSCO standards
- **Feasibility Study, Pre-feasibility Study, and Scoping Study** definitions added

Slide 9

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

A number of case studies were selected to cover a range of different types of mineral,

to include data from exploration and mining companies,

and both public listed companies and private companies.

Slide 10

Reserves											
	Type of mine(s)	Coal type (f)	Reserves		Marketable reserves		Marketable coal quality		Avg % yield to give marketable 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 %			
CRISCO											
Reserves at reporting date											
Blue Ash (f)	OC	SC	161	10	121	7.5	27.86	0.48	75	32	31
Clement	OC	SC	168	4.6	160	4.2	27.9	0.33	96	50.1	82
Hall Creek	OC	MC	94	44	43	23	32.2	0.35	52	82	54
Hunter Valley Operations	OC	SC/MC	270	47	184	33	28.99	0.58	68	80	177
Kestrel Coal Operations	UG	MC	45	95	37	79	31.6	0.59	83	80	93
Mount Thorley Operations	OC	SC/MC	36	7.4	20	8.7	29.8	0.45	66	64	16
Other undeveloped reserves (A)											
Mount Pleasant	OC	SC	27	999	144	1.1	26.92	0.48	82	80	24.9
Total											
			1,007	1,135	549	1,135					

To start with An international public company – RIO TINTO – data from their 2012 published annual report.

We'll start by looking at some of the published data on COAL RESERVES (and then go on to look at the RESOURCES).

Slide 11

Which use ?

Different Reference Points

In CRISCO 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

Which to use ?
 Different Reference Points
 In CRISCO 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

Different reference points –

- **Reserves** are at delivery to the processing plant;
- **Marketable Reserves** are after processing, at **point of sale**, these are commonly estimated based on averaged processing yields rather than actual measured numbers.

Of the two, it is NOT mandatory to report **Marketable Reserves**; conventionally only **Reserves** are required.

If data are to be aggregated, ALWAYS use the **Reserves** estimates.

Slide 12

Reserves										
	Type of mine(s)	Coal type (f)	Reserves		Marketable reserves		Marketable coal quality		Avg % yield to give marketable reserves	Rio Tinto share Marketable reserves
			Proved at end 2012 (subtotal)	Probable at end 2012 (subtotal)	Proved at end 2012 (subtotal)	Probable at end 2012 (subtotal)	Calorific value MJ/kg	Sulphur content %		
CRISCO										
Reserves at reporting date										
Blue Ash (f)	OC	SC	161	10	121	7.5	27.86	0.48	75	32
Clement	OC	SC	168	4.6	160	4.2	27.9	0.33	96	50.1
Hall Creek	OC	MC	94	44	43	23	32.2	0.35	52	82
Hunter Valley Operations	OC	SC/MC	270	47	184	33	28.99	0.58	68	80
Kestrel Coal Operations	UG	MC	45	95	37	79	31.6	0.59	83	80
Mount Thorley Operations	OC	SC/MC	36	7.4	20	8.7	29.8	0.45	66	64
Other undeveloped reserves (A)										
Mount Pleasant	OC	SC	27	999	144	1.1	26.92	0.48	82	80
Total										
			1,007	1,135	549	1,135				

So here is the mapping –

Proved Reserves are mapped to 111 and Probable Reserves are mapped to 112

Slide 13

Type of mineral	Coal type	Reserves	Marketable reserves	Marketable coal quality	Avg % yield to give	Interest	Risk
		Proved at end 2012	Probable at end 2012	Proved at end 2012	Probable at end 2012	Marketable reserves	Share
		tonnes	tonnes	tonnes	tonnes	tonnes	Marketable reserves
Other undeveloped reserves (k)		199	326	26.92	0.48	82	80
Yusuf Placemat	43C	46					24

(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.

Most of the data are about Reserves at operating Mines.

But one line refers to "other undeveloped reserves".
Footnote (k) in the report explains what these are.

Slide 14

Type of mineral	Coal type	Reserves	Marketable reserves	Marketable coal quality	Avg % yield to give	Interest	Risk
		Proved at end 2012	Probable at end 2012	Proved at end 2012	Probable at end 2012	Marketable reserves	Share
		tonnes	tonnes	tonnes	tonnes	tonnes	Marketable reserves
Other undeveloped reserves (k)		199	326	26.92	0.48	82	80
Yusuf Placemat	43C	46					24

(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.

E1.1-F1.3-G2

Permits are not yet in place and may not be obtained.

They clearly fall into the sub-class E1.1 – F1.3 – G2.
E1.1 = economic (otherwise they wouldn't be Reserves)
F1.3 = development not yet underway – awaiting permits

Slide 15

Type of mineral	Coal type	Reserves	Marketable reserves	Marketable coal quality	Avg % yield to give	Interest	Risk
		Proved at end 2012	Probable at end 2012	Proved at end 2012	Probable at end 2012	Marketable reserves	Share
		tonnes	tonnes	tonnes	tonnes	tonnes	Marketable reserves
Other undeveloped reserves (k)		199	326	26.92	0.48	82	80
Yusuf Placemat	43C	46					24

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.

A trap for the unwary.

Always CHECK whether figures quoted are for the WHOLE deposit or for the PROPORTION owned by the reporting company
Data may be recorded in different ways by different companies.

Different joint venture participants may even have different estimates for the total reserves and resources on the same deposit.

Slide 16

Resources

Coal type (a)

Coal resources at end 2012

Measured Indicated Inferred

millions of tonnes (millions of tonnes) (millions of tonnes)

Rio Tinto Interest %

COAL (i)	Measured	Indicated	Inferred	Rio Tinto Interest %
Blair Athol (i)	11	0.2	3.7	50.1
Chisnall	11	0.2	3.7	50.1
Hill Creek	60	79	36	82
Hunter Valley Operations	201	428	368	80
Kestrel West	106	106	33	80
Lake Elphinstone	120	120	42	82
Mount Pleasant	245	245	205	80
Mount Thorley Operations (i)	162	162	19	64
Oaklands	196	196	90	80
Winchcombe	17	17	175	75

Now for RESOURCES.

This is for material in the ground, for which detailed mine planning studies have not yet been done.

There are reasonable prospects for eventual economic extraction

Slide 17

Resources

Coal type (a)

Measured Indicated Inferred

millions of tonnes (millions of tonnes) (millions of tonnes)

Rio Tinto Interest %

COAL (i)	Measured	Indicated	Inferred	Rio Tinto Interest %
Blair Athol (i)	11	0.2	3.7	50.1
Chisnall	11	0.2	3.7	50.1
Hill Creek	60	79	36	82
Hunter Valley Operations	201	428	368	80
Kestrel West	106	106	33	80
Lake Elphinstone	120	120	42	82
Mount Pleasant	245	245	205	80
Mount Thorley Operations (i)	162	162	19	64
Oaklands	196	196	90	80
Winchcombe	17	17	175	75

The standard mappings are straightforward

Measured resource to 221

Indicated resource to 222

Inferred resource to 223

Slide 18

Resources

Coal type (a)

Measured Indicated Inferred

millions of tonnes (millions of tonnes) (millions of tonnes)

Rio Tinto Interest %

COAL (i)	Measured	Indicated	Inferred	Rio Tinto Interest %
Blair Athol (i)	11	0.2	3.7	50.1
Chisnall	11	0.2	3.7	50.1
Hill Creek	60	79	36	82
Hunter Valley Operations	201	428	368	80
Kestrel West	106	106	33	80
Lake Elphinstone	120	120	42	82
Mount Pleasant	245	245	205	80
Mount Thorley Operations (i)	162	162	19	64
Oaklands	196	196	90	80
Winchcombe	17	17	175	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.

Footnote (i) in the report states that mining at Blair Athol has ceased.

Resources quoted here have been downgraded from material previously reported as **reserves**

We may be able to allocate these resources to sub-classes if there is further information in the text of the report to explain the circumstances.

Slide 19

	Type of mine (a)	Proved ore reserves at end 2012		Probable reserves at end 2012		Average mill recovery %	Rio Tinto share		Recoverable metal millions of tonnes
		Tonnage	Grade	Tonnage	Grade		Interest %		
GOLD									
Reserves at operating mines									
Bingham Canyon (USA)	OP/UG	800	1.03	1624	0.74	68	80	12,227	
Northparkes (Australia)	UG	8.2	0.24	66	0.28	67	80	0.015	
– open pit and stockpiles	UG			66		68	80	0.026	
Oya Tolgoi (Mongolia)	OP	426	0.42	614	0.24	74	33.5	2,581	
– South Oya open pit (i) (i)	OP	9	0.33			74	33.5	0.024	
Reserves at development projects									
Eagle (USA)	UG			5.2	0.25	55	100	0.023	
Oya Tolgoi (Mongolia)	UG			400	0.71	83	33.5	1,544	
– Hugo Damman N. East (i)	UG			31	0.42	83	30.5	0.159	

Rio Tinto again – **gold** reserves and resources.

We'll start with the Reserves table.

Slide 20

Type of mine (a)	Proved ore reserves at end 2012		Probable reserves at end 2012		Average mill recovery %	Rio Tinto share		Recoverable metal millions of ounces
	Tonnage	Grade	Tonnage	Grade		Interest %		
GOLD								
Reserves at operating mines								
Bingham Canyon (USA)	OP+UG	800	1.03	1624	0.74	68	80	12,227
Northparkes (Australia)	UG	8.2	0.24	66	0.28	67	80	0.015
Oya Tolgoi (Mongolia)	OP	426	0.42	614	0.24	74	33.5	2,581
South Oya open pit (i) (i)	OP	9	0.33			74	33.5	0.024
Reserves at development projects								
Eagle (USA)	UG		4.5	0.25	55	100	0.023	
Oya Tolgoi (Mongolia)	UG		400	0.71	83	33.5	1,544	
Hugo Damman N. East (i)	UG		31	0.42	83	30.5	0.159	

Here we have not just tonnages but **tonnages and grades**, as the proportion of contained gold will vary from one deposit to another, and from place to place within one deposit.

The standard mapping is still simple – but each Reserve estimate is now a pair of numbers TONNAGE and GRADE from which you can estimate an amount of contained metal in ore that will be delivered to the processing plant.

Slide 21

Type of mine (a)	Proved ore reserves at end 2012		Probable reserves at end 2012		Average mill recovery %	Rio Tinto share		Recoverable metal millions of tonnes
	Tonnage	Grade	Tonnage	Grade		Interest %		
GOLD								
Reserves at operating mines								
Bingham Canyon (USA)	OP/UG	800	1.03	1624	0.74	68	80	12,227
Northparkes (Australia)	UG	8.2	0.24	66	0.28	67	80	0.015
Oya Tolgoi (Mongolia)	OP	426	0.42	614	0.24	74	33.5	2,581
South Oya open pit (i) (i)	OP	9	0.33			74	33.5	0.024
Reserves at development projects								
Eagle (USA)	UG		4.5	0.25	55	100	0.023	
Oya Tolgoi (Mongolia)	UG		400	0.71	83	33.5	1,544	
Hugo Damman N. East (i)	UG		31	0.42	83	30.5	0.159	

For the "Reserves at Operating Mines", according to the guidelines in Annex V,

these are "On Production" and the reserves may be allocated to sub-classes E1.1-F1.1-G1 and E1.1-F1.1-G2 respectively.

Slide 22

	Type of mine (a)	F1-F1-G1		F1-F1-G2		Average mill recovery %	Rio Tinto share Interest %	Recoverable metal millions of tonnes			
		Proved ore reserves at end 2012 Tonnage	Grade	Probable reserves at end 2012 Tonnage	Grade						
GOLD											
Reserves at operating mines		millions of tonnes	grammes per tonne	millions of tonnes	grammes per tonne	<div>Reserves at development projects</div> <div>“Is justified for Development”</div> <div>Sub-classes F1.1-F1.6-G1 and F1.1-F1.2-G2</div>					
Bingham Canyon (USA)											
Northparkes (Australia)	OGP										
- open pit and stockpiles	USG										
South Oyu Tolgoi (Mongolia)	USG										
- South Oyu open pit (1) (1)	OGP	426	0.42	614	0.24				74	33.5	2.581
- South Oyu stockpiles (1) (2)	USG	9	0.33						74	33.5	0.024
Reserves at development projects											
Esmeralda (USA)	USG			8.2	0.28				83	30.0	0.023
Oyu Tolgoi (Mongolia)	USG	400	0.40	571	0.17				83	33.5	1.544
- Hugo Bossman N. (Russia)	USG			31	0.62	83	30.5	0.109			

For the "Reserves at Development Projects", these are **justified for development**.

F1.2 if capital is already committed

Slide 23

	Type of mine (a)	F1-F1-G1		F1-F1-G2		Average mill recovery %	Rio Tinto share Interest %	Recoverable metal millions of tonnes
		Proved ore reserves at end 2012 Tonnage	Grade	Probable reserves at end 2012 Tonnage	Grade			
GOLD								
Reserves at operating mines								
Bingham Canyon (USA)								
Northparkes (Australia)								
Oyu Tolgoi (Mongolia)								
South Oyu Tolgoi (Mongolia)								
Reserves at development projects								
Esmeralda (USA)								
Oyu Tolgoi (Mongolia)								
Hugo Bossman N. (Russia)								

If there is evidence in the Notes that all approvals have **not** been received and capital is not already committed, then they should be **F1.3**.

This could probably be answered from the context, in the body of the company's report.

Slide 24

	Type of mine (a)	F1-F1-G1		F1-F1-G2		Average mill recovery %	Rio Tinto share Interest %	Recoverable metal millions of tonnes
		Proved ore reserves at end 2012 Tonnage	Grade	Probable reserves at end 2012 Tonnage	Grade			
GOLD								
Reserves at operating mines		millions of tonnes	grammes per tonne	millions of tonnes	grammes per tonne			
Bingham Canyon (USA)								
Northparkes (Australia)								
Oyu Tolgoi (Mongolia)								
South Oyu Tolgoi (Mongolia)								
Reserves at development projects								
Esmeralda (USA)								
Oyu Tolgoi (Mongolia)								
Hugo Bossman N. (Russia)								

Here is an example where – even though Rio Tinto generally reports reserves and resources for the TOTAL deposit,

in this case **ONLY** the attributable proportion is reported.

ALWAYS necessary to check the footnotes !!

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!

	2006	2005	2004	2003	2002	2001	2000	1999	1998	1997	1996	1995	1994	1993	1992	1991	1990	1989	1988	1987	1986	1985	1984	1983	1982	1981	1980	1979	1978	1977	1976	1975	1974	1973	1972	1971	1970	1969	1968	1967	1966	1965	1964	1963	1962	1961	1960	1959	1958	1957	1956	1955	1954	1953	1952	1951	1950	1949	1948	1947	1946	1945	1944	1943	1942	1941	1940	1939	1938	1937	1936	1935	1934	1933	1932	1931	1930	1929	1928	1927	1926	1925	1924	1923	1922	1921	1920	1919	1918	1917	1916	1915	1914	1913	1912	1911	1910	1909	1908	1907	1906	1905	1904	1903	1902	1901	1900	1899	1898	1897	1896	1895	1894	1893	1892	1891	1890	1889	1888	1887	1886	1885	1884	1883	1882	1881	1880	1879	1878	1877	1876	1875	1874	1873	1872	1871	1870	1869	1868	1867	1866	1865	1864	1863	1862	1861	1860	1859	1858	1857	1856	1855	1854	1853	1852	1851	1850	1849	1848	1847	1846	1845	1844	1843	1842	1841	1840	1839	1838	1837	1836	1835	1834	1833	1832	1831	1830	1829	1828	1827	1826	1825	1824	1823	1822	1821	1820	1819	1818	1817	1816	1815	1814	1813	1812	1811	1810	1809	1808	1807	1806	1805	1804	1803	1802	1801	1800	1799	1798	1797	1796	1795	1794	1793	1792	1791	1790	1789	1788	1787	1786	1785	1784	1783	1782	1781	1780	1779	1778	1777	1776	1775	1774	1773	1772	1771	1770	1769	1768	1767	1766	1765	1764	1763	1762	1761	1760	1759	1758	1757	1756	1755	1754	1753	1752	1751	1750	1749	1748	1747	1746	1745	1744	1743	1742	1741	1740	1739	1738	1737	1736	1735	1734	1733	1732	1731	1730	1729	1728	1727	1726	1725	1724	1723	1722	1721	1720	1719	1718	1717	1716	1715	1714	1713	1712	1711	1710	1709	1708	1707	1706	1705	1704	1703	1702	1701	1700	1699	1698	1697	1696	1695	1694	1693	1692	1691	1690	1689	1688	1687	1686	1685	1684	1683	1682	1681	1680	1679	1678	1677	1676	1675	1674	1673	1672	1671	1670	1669	1668	1667	1666	1665	1664	1663	1662	1661	1660	1659	1658	1657	1656	1655	1654	1653	1652	1651	1650	1649	1648	1647	1646	1645	1644	1643	1642	1641	1640	1639	1638	1637	1636	1635	1634	1633	1632	1631	1630	1629	1628	1627	1626	1625	1624	1623	1622	1621	1620	1619	1618	1617	1616	1615	1614	1613	1612	1611	1610	1609	1608	1607																																																																																						
Gold	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,

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Uranium	Likely mining method	E1-F1-G1		E1-F1-G2		Rto Tinto Interest
		Proved ore reserves at end 2012	Probable ore reserves at end 2012	Proved ore reserves at end 2012	Probable ore reserves at end 2012	
		Millions of tonnes	U ₃ O ₈ %	Millions of tonnes	U ₃ O ₈ %	
Energy Resources of Australia (Australia)						
- Ranger #3 stockpiles (oo)				7.3	0.132	68.4
Rosang (Namibia) (pp)	OP	20	0.031	402	0.038	68.6

URANIUM **reserves** now.

Simple allocation to main classes

111 and 112

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Uranium	Likely mining method	E1-F1-G1		E1-F1-G2		Rto Tinto Interest
		Proved ore reserves at end 2012	Probable ore reserves at end 2012	Proved ore reserves at end 2012	Probable ore reserves at end 2012	
		Millions of tonnes	U ₃ O ₈ %	Millions of tonnes	U ₃ O ₈ %	
Energy Resources of Australia (Australia)						
- Ranger #3 stockpiles (oo)				7.3	0.132	68.4
Rosang (Namibia) (pp)	OP	20	0.031	402	0.038	68.6

Be careful !

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Uranium	Likely mining method	E1-F1-G1		E1-F1-G2		Rto Tinto Interest
		Proved ore reserves at end 2012	Probable ore reserves at end 2012	Proved ore reserves at end 2012	Probable ore reserves at end 2012	
		Millions of tonnes	U ₃ O ₈ %	Millions of tonnes	U ₃ O ₈ %	
Energy Resources of Australia (Australia)						
- Ranger #3 stockpiles (oo)				7.3	0.132	68.4
Rosang (Namibia) (pp)	OP	20	0.031	402	0.038	68.6

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

This line refers to STOCKPILED MATERIAL – already mined, but not yet processed.

Usually material in stockpiles would be considered as Proved Mineral Reserves, because all geological factors are known (the material has been mined) and all Modifying Factors are taken fully into account.

However, the Ranger#3 stockpiles are listed as partly Probable Mineral Reserves and partly Indicated Mineral Resources.

There may be some doubt over the economics of processing this material. Or it is possible that there may also be questions over some of the other Modifying Factors (such as environmental or social).

It is likely that the material should be allocated to lower sub-classes, such as E1.2-F2.2-G1 (for the Probable Reserves)

- F2.2 'project on hold'

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Resources

Vitamin	Likely survey method	Measured resources at end 2012		Imputed resources at end 2012		Imputed resources at end 2012		Rate (times current %)
		Domest.	Grande.	Domest.	Grande.	Domest.	Grande.	
Energy Reconstruction of Americas (Chemical)								
– Ethanol	L/G	0.2	0.887	14	0.52	03	0.545	68.4
– Rangeland mine (oz)	L/G			75.5	0.325	05	0.393	68.4
– Rangeland oil (vaccines) (oz)				0.00				68.4
– Rangeland (Domest.) (oz)	L/G	14	0.026	14	0.024	14	0.020	68.4

Standard mappings of main classes of RESOURCES

221 222 223

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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.

Resource #	Resource Name	Resource Type	Resource Grade	Resource Tonnage	Resource Value	Resource Status
1	Ranger#1 mine (nn)	Underground	0.5	0.522	0.5	0.5
2	Ranger#2 stockpile (nn)	Open Cut	0.5	0.522	0.5	0.5
3	Ranger#3 stockpile (oo)	Open Cut	0.5	0.522	0.5	0.5
4	Ranger#4 stockpile (oo)	Open Cut	0.5	0.522	0.5	0.5
5	Ranger#5 stockpile (oo)	Open Cut	0.5	0.522	0.5	0.5
6	Ranger#6 stockpile (oo)	Open Cut	0.5	0.522	0.5	0.5
7	Ranger#7 stockpile (oo)	Open Cut	0.5	0.522	0.5	0.5
8	Ranger#8 stockpile (oo)	Open Cut	0.5	0.522	0.5	0.5
9	Ranger#9 stockpile (oo)	Open Cut	0.5	0.522	0.5	0.5
10	Ranger#10 stockpile (oo)	Open Cut	0.5	0.522	0.5	0.5
11	Ranger#11 stockpile (oo)	Open Cut	0.5	0.522	0.5	0.5
12	Ranger#12 stockpile (oo)	Open Cut	0.5	0.522	0.5	0.5
13	Ranger#13 stockpile (oo)	Open Cut	0.5	0.522	0.5	0.5
14	Ranger#14 stockpile (oo)	Open Cut	0.5	0.522	0.5	0.5
15	Ranger#15 stockpile (oo)	Open Cut	0.5	0.522	0.5	0.5
16	Ranger#16 stockpile (oo)	Open Cut	0.5	0.522	0.5	0.5
17	Ranger#17 stockpile (oo)	Open Cut	0.5	0.522	0.5	0.5
18	Ranger#18 stockpile (oo)	Open Cut	0.5	0.522	0.5	0.5
19	Ranger#19 stockpile (oo)	Open Cut	0.5	0.522	0.5	0.5
20	Ranger#20 stockpile (oo)	Open Cut	0.5	0.522	0.5	0.5
21	Ranger#21 stockpile (oo)	Open Cut	0.5	0.522	0.5	0.5
22	Ranger#22 stockpile (oo)	Open Cut	0.5	0.522	0.5	0.5
23	Ranger#23 stockpile (oo)	Open Cut	0.5	0.522	0.5	0.5
24	Ranger#24 stockpile (oo)	Open Cut	0.5	0.522	0.5	0.5
25	Ranger#25 stockpile (oo)	Open Cut	0.5	0.522	0.5	0.5
26	Ranger#26 stockpile (oo)	Open Cut	0.5	0.522	0.5	0.5
27	Ranger#27 stockpile (oo)	Open Cut	0.5	0.522	0.5	0.5
28	Ranger#28 stockpile (oo)	Open Cut	0.5	0.522	0.5	0.5
29	Ranger#29 stockpile (oo)	Open Cut	0.5	0.522	0.5	0.5
30	Ranger#30 stockpile (oo)	Open Cut	0.5	0.522	0.5	0.5
31	Ranger#31 stockpile (oo)	Open Cut	0.5	0.522	0.5	0.5
32	Ranger#32 stockpile (oo)	Open Cut	0.5	0.522	0.5	0.5
33	Ranger#33 stockpile (oo)	Open Cut	0.5	0.522	0.5	0.5
34	Ranger#34 stockpile (oo)	Open Cut	0.5	0.522	0.5	0.5
35	Ranger#35 stockpile (oo)	Open Cut	0.5	0.522	0.5	0.5
36	Ranger#36 stockpile (oo)	Open Cut	0.5	0.522	0.5	0.5
37	Ranger#37 stockpile (oo)	Open Cut	0.5	0.522	0.5	0.5
38	Ranger#38 stockpile (oo)	Open Cut	0.5	0.522	0.5	0.5
39	Ranger#39 stockpile (oo)	Open Cut	0.5	0.522	0.5	0.5
40	Ranger#40 stockpile (oo)	Open Cut	0.5	0.522	0.5	0.5
41	Ranger#41 stockpile (oo)	Open Cut	0.5	0.522	0.5	0.5
42	Ranger#42 stockpile (oo)	Open Cut	0.5	0.522	0.5	0.5
43	Ranger#43 stockpile (oo)	Open Cut	0.5	0.522	0.5	0.5
44	Ranger#44 stockpile (oo)	Open Cut	0.5	0.522	0.5	0.5
45	Ranger#45 stockpile (oo)	Open Cut	0.5	0.522	0.5	0.5
46	Ranger#46 stockpile (oo)	Open Cut	0.5	0.522	0.5	0.5
47	Ranger#47 stockpile (oo)	Open Cut	0.5	0.522	0.5	0.5
48	Ranger#48 stockpile (oo)	Open Cut	0.5	0.522	0.5	0.5
49	Ranger#49 stockpile (oo)	Open Cut	0.5	0.522	0.5	0.5
50	Ranger#50 stockpile (oo)	Open Cut	0.5	0.522	0.5	0.5
51	Ranger#51 stockpile (oo)	Open Cut	0.5	0.522	0.5	0.5
52	Ranger#52 stockpile (oo)	Open Cut	0.5	0.522	0.5	0.5
53	Ranger#53 stockpile (oo)	Open Cut	0.5	0.522	0.5	0.5

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

F2.2 – The Ranger #3 stockpiles again

'project activities are on hold ...'

If this really is stockpiled material that has already been mined, then it should be **G1**.

The downgrading to a CRIRSCO Indicated Resource is probably a result of doubt over Modifying Factors, as with the Reserves for the same stockpiles.

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Example: The Teller province

	Monetary Reserves			Indicated Reserves			Inferred Reserves		
	Day Tremors (millions)	Gold Grade Ag-Au (g/t Au)	Copper Grade Cu-Cu (% Cu)	Day Tremors (millions)	Gold Grade Ag-Au (g/t Au)	Copper Grade Cu-Cu (% Cu)	Day Tremors (millions)	Gold Grade Ag-Au (g/t Au)	Copper Grade Cu-Cu (% Cu)
Mean Domain Open Pk	25	0.16	0.01	1.8	0.16	0.01	27	0.16	0.01
Teller Underground	-	-	-	-	-	-	27	0.16	0.01
Teller	-	-	-	0.15	0.2	0.015	10	0.26	0.01
TC Cellhouse	-	-	-	-	-	0.25	9	-	0.25
Dec-12 Ore Reserves									
	Proven Reserves			Probable Reserves					
	Day Tremors (millions)	Gold Grade Ag-Au (g/t Au)	Copper Grade Cu-Cu (% Cu)	Day Tremors (millions)	Gold Grade Ag-Au (g/t Au)	Copper Grade Cu-Cu (% Cu)			
Mean Domain Open Pk	25	0.16	0.01	1.8	0.16	0.01			
West Domain Open Pk	-	-	-	10	0.21	0.02			
Teller Underground	-	-	-	45	1.1	0.1			
TC Cellhouse	-	-	-	9	-	0.25			

Different company now - NEWCREST

Now on to the situation of multiple mineral products from the same deposit. Here, for simplicity, just gold and copper.

But there is also one further complication in this report from Newcrest.

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Example: The Teller province

Dec-12 Mineral Resources	Measured Resources				Dry Tonnage (millions)
	Dry Tonnage (millions)	Gold Grade (g/t Au)	Copper Grade (% Cu)	Proved Reserve	
Gold and Copper Resources (if = includes stockpiles)					
West Dumas Open Pit #	1,000	0.12	0.08	240	0.76
Teller Underground	-	-	-	-	-
Other	-	-	-	-	-
OCullaghan	-	-	-	-	-
Dec-12 Ore Reserves					
Gold and Copper Resources (if = includes stockpiles)					
West Dumas Open Pit #	1,000	0.12	0.08	240	0.76
Teller Underground	-	-	-	-	-
OCullaghan	-	-	-	-	-

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.

From their annual report, introduction to the reserves and resources tables: ***"Mineral Resources are quoted inclusive of Ore Reserves"***

We can see this clearly in that the Proved Reserve uses up all of the Measured Resource.

In UNFC-2009, data in all classes is exclusive of all others, **so we must take care not to double count.**

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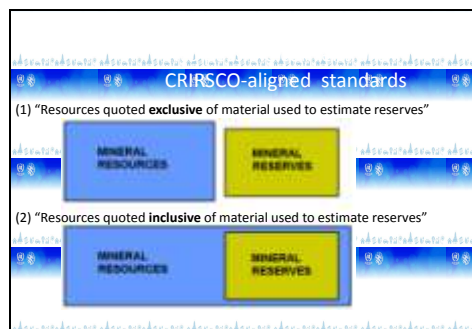
Example: The Teller province

Dec-12 Mineral Resources	Measured Resources				Dry Tonnage (millions)
	Dry Tonnage (millions)	Gold Grade (g/t Au)	Copper Grade (% Cu)	Proved Reserve	
Gold and Copper Resources (if = includes stockpiles)					
West Dumas Open Pit #	1,000	0.12	0.08	240	0.76
Teller Underground	-	-	-	-	-
Other	-	-	-	-	-
OCullaghan	-	-	-	-	-
Dec-12 Ore Reserves					
Gold and Copper Resources (if = includes stockpiles)					
West Dumas Open Pit #	1,000	0.12	0.08	240	0.76
Teller Underground	-	-	-	-	-
OCullaghan	-	-	-	-	-

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.

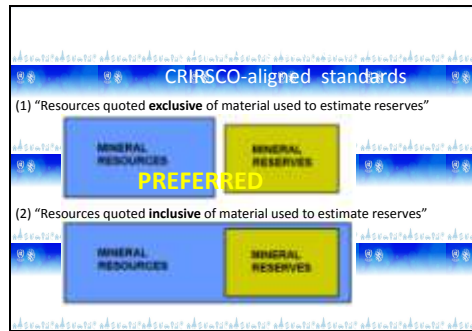
Unless explicitly quoted, it **cannot be assumed that you can back-calculate Resources** from the Reserves estimates.

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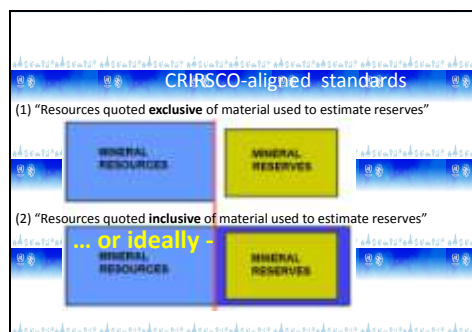
In CRIRSCO, it is allowed to report resources and reserves in two ways – BUT it must always be specified which convention is being used.

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Although it is preferred that resources be quoted **EXCLUSIVE** of reserves, some companies use the other convention.
Newcrest is one of these companies.

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Ideally, all of the quantities should be quoted to make it quite explicit what has been done.
So the dark blue area represents mineral resources which have been used to estimate the mineral reserves.

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Example: The Teferi province

Dec-12 Mineral Resources (# includes stockpiles)	Measured Resource			Indicated Resource			Inferred Resource		
	Dry Tonnage (million)	Gold Grade (g/t Au)	Copper Grade (%) Cu)	Dry Tonnage (million)	Gold Grade (g/t Au)	Copper Grade (%) Cu)	Dry Tonnage (million)	Gold Grade (g/t Au)	Copper Grade (%) Cu)
Measu Mine Open Pit	10	0.43	0.07	240	0.36	0.08	27	0.24	0.07
Teferi Underground	78	1.3	0.32	23	0.36	0.23	-	-	-
Other	-	-	-	827	4.2	0.20	10	0.20	0.24
OCallaghan	-	-	-	89	0.30	-	9	-	-
Dec-12 Ore Reserves	Proved Reserve			Probable Reserve					
Gold and Copper Reserves (# includes stockpiles)	Dry Tonnage (million)	Gold Grade (g/t Au)	Copper Grade (%) Cu)	Dry Tonnage (million)	Gold Grade (g/t Au)	Copper Grade (%) Cu)			
Measu Mine Open Pit	20	0.43	0.07	240	0.36	0.08			
Teferi Underground	-	-	-	180	0.81	0.06			
OCallaghan	-	-	-	89	1.1	0.3			

The Measured Resource is fully used up in defining the Proved Reserve and so it must not be counted separately.

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Example: The Teller province

Dec-12 Mineral Resources	Measured Resource			Indicated Resource			Inferred Resource		
	Dry Tonnage (Mt)	Gold Grade (g/t Au)	Copper Grade (% Cu)	Dry Tonnage (Mt)	Gold Grade (g/t Au)	Copper Grade (% Cu)	Dry Tonnage (Mt)	Gold Grade (g/t Au)	Copper Grade (% Cu)
Gold and Copper Resources (if = includes stockpiles)	-	-	-	-	-	-	-	-	-
Mineral Reserves (if = includes stockpiles)	-	-	-	-	-	-	-	-	-
Other	-	-	-	-	-	-	-	-	-
Dec-12 Dry Reserves	-	-	-	-	-	-	-	-	-
Gold and Copper Resources (if = includes stockpiles)	-	-	-	-	-	-	-	-	-
Mineral Reserves (if = includes stockpiles)	-	-	-	-	-	-	-	-	-
Other	-	-	-	-	-	-	-	-	-
Dec-12 Dry Reserves	-	-	-	-	-	-	-	-	-
Gold and Copper Resources (if = includes stockpiles)	-	-	-	-	-	-	-	-	-
Mineral Reserves (if = includes stockpiles)	-	-	-	-	-	-	-	-	-
Other	-	-	-	-	-	-	-	-	-
Dec-12 Dry Reserves	-	-	-	-	-	-	-	-	-

The Indicated Resource is PARTIALLY used in defining the Probable Reserve

so must be recalculated (if this can be done using the reported estimates)

to give a separate figure for the Resource, to avoid double counting of the amount used for Reserves..

Slide 41

Example: The Teller province

Dec-12 Mineral Resources	Measured Resource			Indicated Resource			Not so easy here: some of the Indicated Resource has not been converted to Probable Reserve – but we don't know how much
	Dry Tonnage (Mt)	Gold Grade (g/t Au)	Copper Grade (% Cu)	Dry Tonnage (Mt)	Gold Grade (g/t Au)	Copper Grade (% Cu)	
Gold and Copper Resources (if = includes stockpiles)	-	-	-	-	-	-	
Mineral Reserves (if = includes stockpiles)	-	-	-	-	-	-	
Other	-	-	-	-	-	-	
Dec-12 Dry Reserves	-	-	-	-	-	-	
Gold and Copper Resources (if = includes stockpiles)	-	-	-	-	-	-	
Mineral Reserves (if = includes stockpiles)	-	-	-	-	-	-	
Other	-	-	-	-	-	-	
Dec-12 Dry Reserves	-	-	-	-	-	-	
Gold and Copper Resources (if = includes stockpiles)	-	-	-	-	-	-	
Mineral Reserves (if = includes stockpiles)	-	-	-	-	-	-	
Other	-	-	-	-	-	-	
Dec-12 Dry Reserves	-	-	-	-	-	-	

If there is not sufficient data in the Tables or in the body of the report to allow such re-calculation, the data must be sought from the company.

NOTE THAT it is not in general sufficient simply to back-calculate using dilution and loss factors, because some resources might have been excluded from the mine design.

The assignment of UNFC classes is simple once we have these numbers.

Slide 42

	E1-F1-G1 Reserves (Mt)		E1-F1-G2 Reserves (Mt)		E2-F2-G1 Resources (Mt)		E2-F2-G2 Resources (Mt)		E2-F2-G3 Resources (Mt)	
	Proved	Probable	Measured	Indicated	Measured	Indicated	Measured	Indicated	Measured	Indicated
Cement Quarry A (note 1)										
Clay 1	1.43	2.04	0.00	5.46	0.00	0.00	0.00	0.00	0.00	0.00
Clay 2	0.89	1.14	0.00	2.51	0.00	0.00	0.00	0.00	0.00	0.00
Limestone 1	1.61	18.25	0.00	27.25	0.00	0.00	0.00	0.00	0.00	0.00
Limestone 2	0.00	0.00	1.75	2.61	0.00	0.00	0.00	0.00	0.00	0.00
Limestone 3	1.18	4.26	0.00	8.23	0.00	0.00	0.00	0.00	0.00	0.00
Cement Quarry B (note 2)										
Limestone 1	2.37	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Limestone 2	13.18	0.00	2.37	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Cement Quarry C (note 3)										
Limestone 1	0.57	4.50	0.00	5.23	0.00	0.00	0.00	0.00	0.00	0.00
Limestone 2	24.00	0.00	0.00	1.07	0.00	0.00	0.00	0.00	0.00	0.00
Aggregate Quarry A (note 3)										
Unit 1	3.35	0.00	16.05	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Unit 2	46.96	0.00	4.19	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Aggregate Quarry B (note 4)										
Unit 1	141.05	0.00	8.92	38.96	0.00	0.00	0.00	0.00	0.00	0.00

Now to look at **Construction Minerals**

– cement raw materials and aggregates

This table is real sample data from an internationally operating cement and aggregates producer.

Simple assignment of UNFC classes to these reserves and resources is shown at the top of the columns.

Slide 43

	E1-F1-G1	E1-F1-G2	E2-F2-G1	E2-F2-G2	E2-F2-G3
	Reserves (Mt)			Resources (Mt)	
	Proved	Probable	Measured	Indicated	Inferred
Cement Quarry A (note 1)					
Clay 1	1.43	2.94	0.00	5.46	0.00
Clay 2	0.89	1.14	0.00	1.51	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
					0.00
					0.00
					0.00
					0.00
					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.

CEMENT QUARRY "A"

Not all of the Resources can be used with the processing method currently in use.

However, they could be used later, with modified processing methods. There ARE reasonable prospects for eventual economic extraction.

Because the relative proportions are not specified, we cannot subdivide the classes.

Slide 44

	E1-F1-G1	E1-F1-G2	E2-F2-G1	E2-F2-G2	E2-F2-G3
	Reserves (Mt)			Resources (Mt)	
	Proved	Probable	Measured	Indicated	Inferred
Cement Quarry B (note 2)					
Limestone 1	2.37	0.00	0.00	0.00	0.00
Limestone 2	12.18	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				0.00	0.00
					38.96
					0.00

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.

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

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

CEMENT QUARRY "B"

"Other materials are available at the site"

Material that is not reported does not have "reasonable prospects for eventual economic extraction" and therefore cannot be assigned to any CRIRSCO class.

In theory it could be reported in UNFC as recoverable uneconomic.

However, it is of no current interest to the company and therefore there may not be any usable estimates

Slide 45

	E1-F1-G1	E1-F1-G2	E2-F2-G1	E2-F2-G2	E2-F2-G3
	Reserves (Mt)			Resources (Mt)	
	Proved	Probable	Measured	Indicated	Inferred
Cement Quarry A (note 1)					
Clay 1	1.43	2.94	0.00	5.46	0.00
Clay 2	0.89	1.14	0.00	1.51	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
					0.00
					0.00
					0.00
					0.00
					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

Aggregate Quarry A (note 3)

Unit 1

Unit 2

Aggregate Quarry B (note 4)

Unit 1

Unit 2

In Aggregate Quarry "A",

the reported reserves cannot be extracted yet because not all required permits are in place.

These therefore qualify for the sub-class 'Justified for Development', **F1.3**

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	E1-F1-G1	E1-F1-G2	E2-F2-G1	E2-F2-G2	E2-F2-G3
	Reserves (Mt)		Resources (Mt)		
	Proven	Probable	Measured	Indicated	Inferred
Cement Quarry A (note 1)					
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	2.41	0.00
Limestone 3	1.18	4.26	0.00	8.22	0.00
Aggregate Quarry B (note 4)					
Unit 1	5.35	0.00	16.00	0.00	0.00
Unit 2	66.96	0.00	4.09	0.00	0.00
Aggregate Quarry B (note 4)	121.05	0.00	5.92	28.90	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

The Resources identified for **Aggregate Quarry B** are not currently accessible.

These would be identified as 'development on hold', with a corresponding F sub-class of **F2.2**

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When data on construction minerals are aggregated over a number of sites and definition of sub-classes may not be possible.

Data are often aggregated over many sites - and definition of sub-classes may not be possible or appropriate

Slide 48

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	4887	1695	6582
	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	1950	87302
	Total	85343	1950	87302

This is a classic example, from the **IMERYS annual report for 2012**.

These data are aggregated across supra-national regions.

Such aggregation of data is allowed in the CRIRSCO-aligned PERC Standard 2013, for consistency with the ESMA regulations, provided that the company retains full Competent Person reports for each site or each geographical group of sites.

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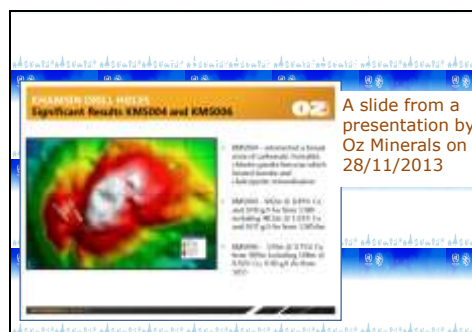
Product	Region	Proven	Probable	Total
Ball clays		E1-F1-G1	E1-F1-G2	2012 (kt)
	Asia Pacific	899		899
	Europe incl. Africa	8304	4415	12719
				852
				900
				115
				102
				188
				10
				995
				302
				302

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.

The CRIRSCO to UNFC mapping for such data is simple – but for government reporting the company may be asked to supply the underlying data on separate sites.

Slide 50



Now to look at **EXPLORATION DATA**

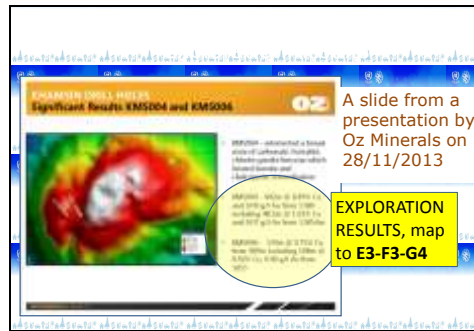
First – **Exploration Results**. These are raw data from drilling, geochemical, geophysical, or any other mineral exploration methods

The CRIRSCO definition is:
Exploration Results include data and information generated by mineral exploration programmes that might be of use to investors but which do not form part of a declaration of Mineral Resources or Mineral Reserves.

These are mapped to UNFC-2009 class 334

Oz Minerals is a small Australian exploration company listed on the Australian Stock Exchange.

Slide 51

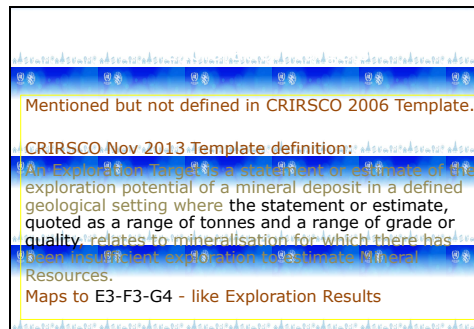


Of the three items on this page, the first is purely descriptive and probably would not normally be considered as 'Exploration Results' – though it does fall within the CRIRSCO definition as it is “information”.

The second and third items contain quantitative data which would constitute Exploration Results and would map to the UNFC-2009 class E3-F3-G4.

It must be noted that these are purely drill hole data, and cannot be related to any estimated tonnage or any estimate of average grade. They do not represent resources, but are merely publication of preliminary data which might (or might not) later be used to estimate a mineral resource.

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EXPLORATION TARGETS

These were originally defined in JORC 2004, and briefly mentioned in the CRIRSCO 2006 Template.

A full definition was provided in the CRIRSCO 2013 Template in order to control (and prevent the misuse) of this term.

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- 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

A CRIRSCO Exploration Target quite clearly maps to the UNFC class E3-F3-G4.

It ought to be possible to use G-axis sub-classes to differentiate it on the basis of relative amounts of supporting geological information.

Slide 54

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.
- ...

Data from a COAL EXPLORATION project in Mongolia

This is a simple range of coal tonnages.

Slide 55

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

E AXIS: Exploration phase – insufficient economic information, so would be E3.2

F AXIS: Because some site-specific geological information is available, this would map to F3.1 under current Specification R

– though it is illogical to use the F axis for subdivision on the basis of geological knowledge.

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Newera Resources pul
2013 concerning its S

Newera Resources Limited
work over the last month
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

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

G AXIS: Under the current Specification P

... it could be mapped to G4.1 for the lower limit and G4.3 for the upper limit (well actually the difference between upper and lower – G4.2 and G4.3 are defined as increments)

G4.2 best case would be undefined.

Cannot be zero because this implies that the lower limit is also the best case.

However, in my view this is an inappropriate way to subdivide the G axis, as all elements of a range have the same degree of geological uncertainty.

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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) of 1.2 to 2.7% 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 ...
... exploration will result in determination of a mineral resource.

A different company now - and
IRON ORE EXPLORATION DATA

As an Exploration Target, assignment to 3 3 4 is clear.

Can we assign to sub-classes?

The ranges here are in terms of both **tonnage** and **grade** expressed as a magnetite recovery factor.

The company goes further and identifies five separate exploration targets which are combined in these figures.....

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Exploration Target estimates (detail):

Target Area	Strike (km)	Thickness (m)	Down Dip (m)	Volume (Mm ³)	Density (t/m ³)	In situ Tonnes (Mt)	Concentrate (Mt)
South Dam	4.5-10.5	80-120	250	190-320	3.05	580-960	70-250
Braemar W	8.5-9.5	80-120	250	170-270	3.05	520-810	60-250
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!)

Three drill holes to estimate the potential in FIVE exploration areas.

Assignment to UNFC-2009 sub-classes is problematic.

As we have just seen, mapping to an F3 sub-class (in this case F3.2) is wrong because **the F axis is here being used for relative amounts of GEOLOGICAL knowledge** - should be a G4 sub-class.

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"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? (G4.1 'low case', G4.2 increment to 'best case', G4.3 further increment to 'high case')

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

Worse still, on the G axis -- the Exploration Target is expressed as TWO ranges, of **tonnage AND grade**. These don't map to the G4.1 / G4.2 / G4.3 sub-classes as defined in Specification P.

These G4 sub-classes are not usable even if we allow ourselves to leave the 'best case' value undefined – because there are TWO ranges of different parameters (tonnage and magnetite content) – and in general there could be any number of ranges for different mineral components.

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"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? (G4.1 'low case', G case', G4.3 further increment)

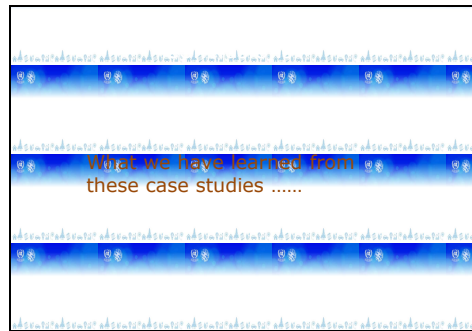
The same data item is expressed as TWO parameters, tonnage and grade.

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

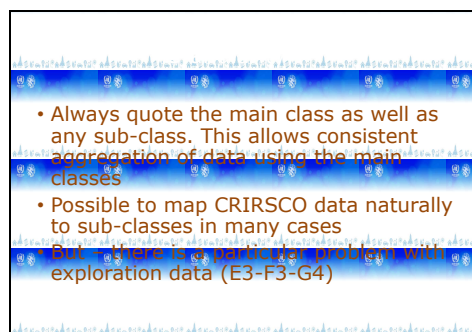
It would be wrong to put all of the lower limits into a G4.1 class and all of the upper limits into a G4.3 class because this could be taken as implying perfect positive correlation among the different parameters.

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What we have learned

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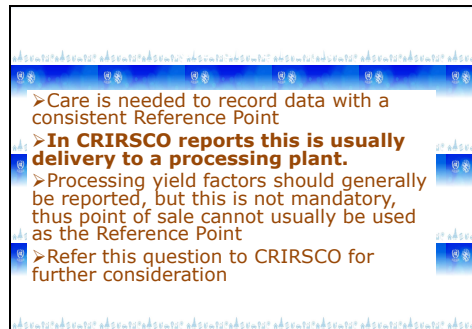


It is (almost) always possible to assign a main UNFC class, given a CRIRSCO class. In some cases it could be necessary to ask a company for extra information, for example where Resources have been quoted INCLUSIVE of material used to define Reserves, or where data have been aggregated over multiple sites in different regions or different countries.

It is sometimes possible also to define a natural mapping to sub-classes .

A particular problem has been identified in that the F and G axis subdivisions for Exploration Data require some re-definition. This will be discussed as a separate issue.

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Reference point requires care – a particular example in this report is Coal Reserves and Marketable Coal Reserves.

CRIRSCO standards require that Coal Reserves (delivered to processing plant) always be reported, estimates of marketable reserves are optional, and, although recommended, it is not mandatory to quote processing yield factors in a CRIRSCO report.

if time allows -

Possible standardisation on a point-of-sale reference point has been discussed before in CRIRSCO but the question should be given further consideration.

One problem is that it requires mandatory inclusion of processing yield factors, something which many companies do not currently quote, and which could be a particular problem for industrial minerals companies where the same source mineral can lead to several alternative end-products as a result of blending or different processing paths.

The yield factors in such circumstances may indeed be trade secrets which the companies will resist pressures to disclose.

Resources Estimates

- Combining **E1F1G1-2** with **E2F2G1-3** ?
- 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 the Specification (ECE 42, part II, section VI(K)) allows aggregation of different projects. **This cannot be interpreted as consistency – to prohibit aggregation in situations where the numbers in the different classes are not directly comparable**

GREAT CARE IS NEEDED WHEN AGGREGATING DATA

We may have Estimates of different things:-

CRIRSCO definitions include:

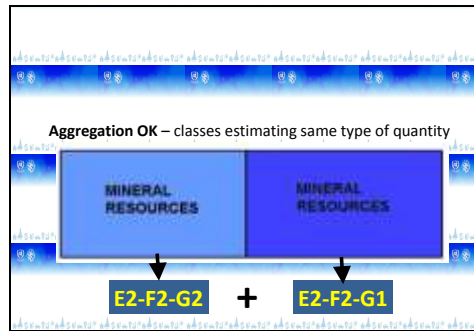
A Mineral Resource is a quantity of mineral which has "**reasonable prospects for eventual economic extraction.**"

A Mineral Reserve is "**the economically mineable part of a Measured and/or Indicated Mineral Resource**" on which assessments at feasibility or pre-feasibility level "demonstrate at the time of reporting that extraction could reasonably be justified".

A Reserve will in general include only part of a Resource – within a defined mine design, and after allowance for dilution and mining losses.

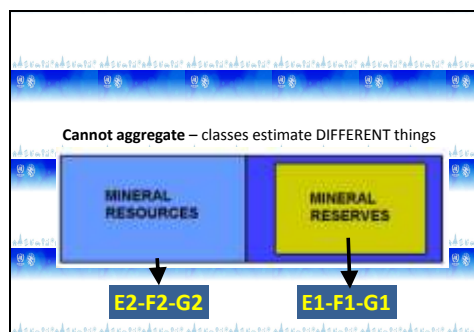
Resources cannot in general be back-calculated from Reserves.

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Two sets of mineral resources can be added together

Slide 66



But it is wrong to add mineral resources and reserves together.

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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

As already seen. This is a new definition in the CRIRSCO 2013 Template – but is a formalisation of something that was already defined in the 2004 JORC Code.

They map to 3 3 4 just like Exploration results.

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

Now to the problems with subdividing the 334 class.

G AXIS: A range of values (or multiple ranges of several parameters) represents data from just a **single level of geological uncertainty** and should all be included within a SINGLE sub-class along the G axis. Separate sub-classes G4.1, G4.2, and G4.3 as defined in Specification P might wrongly be seen as expressing different degrees of knowledge.

F AXIS: The F sub-division defined in the Specification R is purported to represent ‘project maturity’ but **ACTUALLY expresses different degrees of geological knowledge.**

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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

Let's look at the G axis (specification P) first.

There are many different ways to represent exploration information. It is not appropriate or even feasible to define sub-divisions to allow each of these data types to be codified in UNFC-2009,

and it is not appropriate to define a set of sub-divisions which are specific to the requirements of a single sector of the extractive industry.

Sub-division along the G-axis should represent just differing relative amounts of geological knowledge.

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G-axis (G4 class) sub-division

Possible data types include

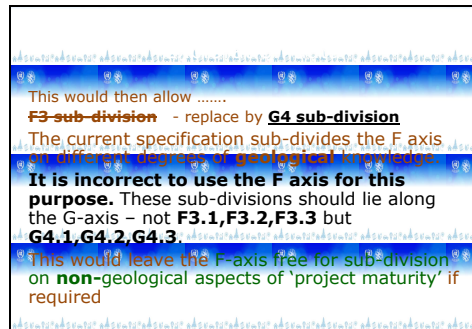
- A 'range' is just one set of data and belongs in just ONE sub-class: suggest deletion of specification P as unnecessary and unworkable.
- In any case, at this exploration stage, it is unlikely there will be sufficient data to justify such granularity

Wrong for UNFC-2009 Exploration Targets and grades cannot use these sub-classes

All the numbers associated with a range, or other kinds of data, will fall within just ONE sub-class.

We should not split out elements of a range into different sub-classes. All have the same degree of geological knowledge.

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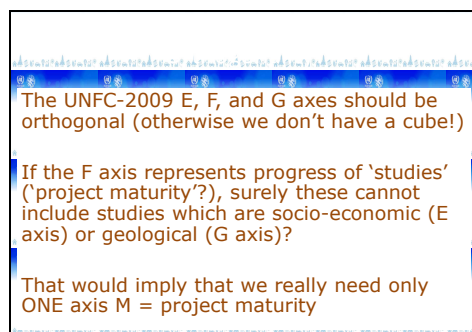
Now for the F axis (specification R)

Relative stages of “project maturity” will involve changes in the underlying factors on **all three axes** E, F, and G, and **any sub-divisions should be done along the appropriate axis.**

For changes in the relative amount of geological knowledge, surely that is the G axis ?

This would leave the F axis free for NON-geological aspects of project maturity

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This raises the issue of ORTHOGONALITY.

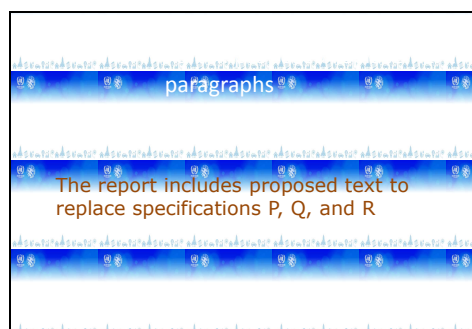
This is a question that is fundamental to the UNFC-2009 structure.

The E, F, and G axes must be orthogonal.

This means that we can't map geological knowledge sometimes along G and other times along F.

If the 'project maturity' concept were to be considered as fundamental then maybe we need only one axis M to replace all three ?

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I have suggested replacements for Specifications P, Q, and R -- -- but personally I think at an early exploration stage there is unlikely to be enough data to justify ANY subdivision.

Subdivision of 334 gives a false sense of precision.

The best option might be simply to delete specifications P, Q, and R

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G4.3	
G4.2	
G4.1	
G3	UNFC-2009 Definitions G3: Quantities associated with a known deposit that can be estimated with a low level of confidence .
G2	G2: Quantities associated with a known deposit that can be estimated with a moderate level of confidence .
G1	G1: Quantities associated with a known deposit that can be estimated with a high level of confidence .

However ---

Just to illustrate what I proposed in the report, here is a new G axis mapping from CRIRSCO to UNFC-2009.

First the G1, G2, G3 standard definitions in UNFC

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G4.3	
G4.2	
G4.1	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 ...
G3	UNFC-2009 Definitions G3: Quantities associated with a known deposit that can be estimated with a low level of confidence .
G2	G2: Quantities associated with a known deposit that can be estimated with a moderate level of confidence .
G1	G1: Quantities associated with a known deposit that can be estimated with a high level of confidence .

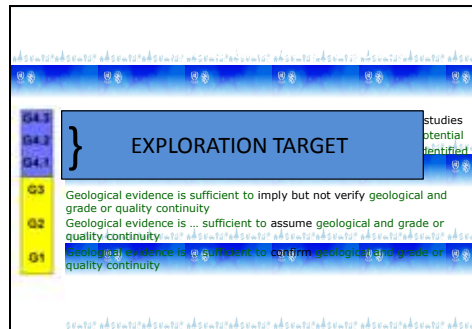
Now the proposed replacement definitions in specification R

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G4.3	
G4.2	
G4.1	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 ...
G3	CRIRSCO Template (INFERRED) Geological evidence is sufficient to imply but not verify geological and grade or quality continuity
G2	(INDICATED) Geological evidence is sufficient to assume geological and grade or quality continuity
G1	(MEASURED) Geological evidence is sufficient to confirm geological and grade or quality continuity

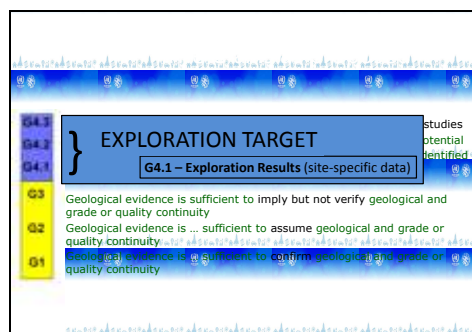
The CRIRSCO classes which map to the G1, G2, and G3 classes

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The CRIRSCO Exploration Target which maps to G4 and its sub-classes

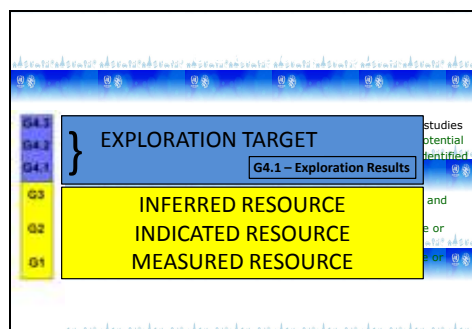
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Exploration results neatly fit into the proposed G4.1 sub-class

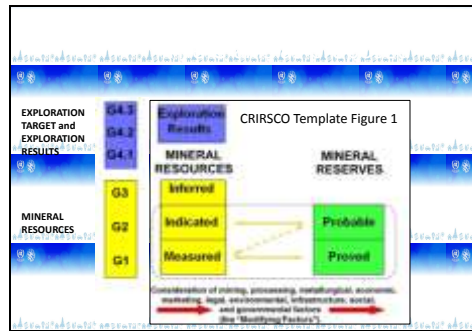
(this is F3.1 in the current specification R)

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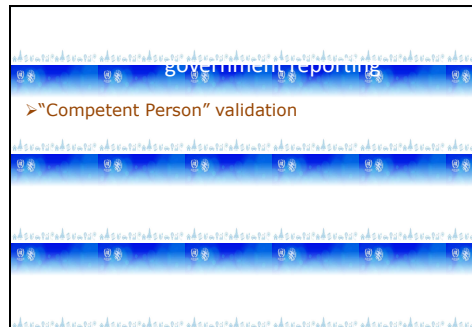
All of the CRIRSCO classes

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- And this is how it fits with the CRIRSCO standard Figure 1.

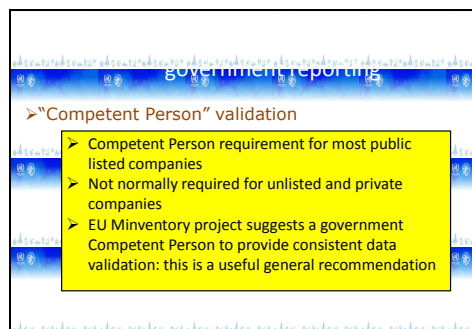
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A brief summary of other conclusions

- The mapping is not automatic. It does need Competent Person validation –

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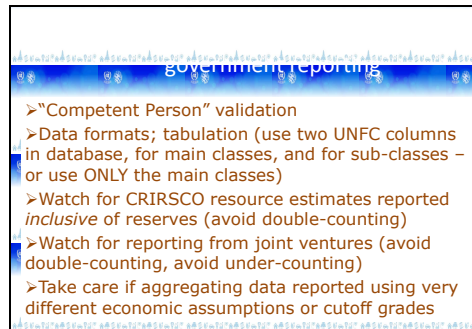


- Competent Person – where not already required,

- should either be required within companies -- or (better) provide a government CP to validate data from all sources – listed and unlisted companies, geological surveys, universities, research institutes, etc.

- It may be of interest that this matches one of the key recommendations from Anne-Sophie Audion of BRGM, in the European Union MINVENTORY project

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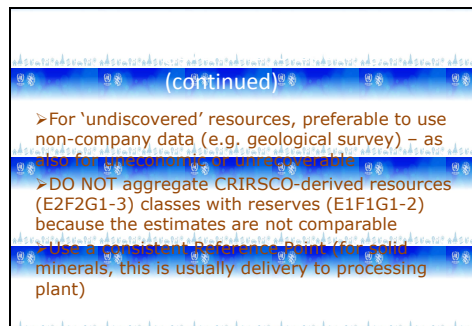
Data formats. Not prescribed in UNFC, but minerals resource/reserves databases need careful design. Separate database columns, for UNFC class (allows aggregation), and UNFC sub-class if needed.

Avoid double-counting if CRIRSCO reports quote estimated resource **INCLUSIVE** of reserves

Avoid possible double-counting when recording data from joint ventures. Need unambiguous identification of projects

Take care if aggregating data with different cutoff grades – using different economic models **OR at different dates** (example – a 2007 project forecast probably won't be comparable with a 2009 project forecast!)

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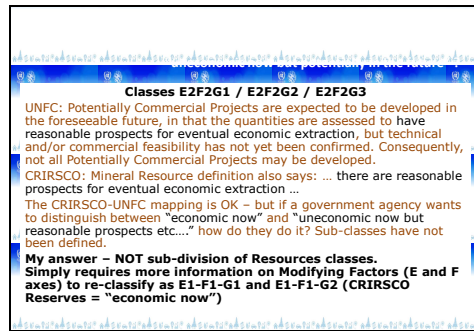
some more conclusions

For undiscovered / uneconomic / unrecoverable – better not to use company data, likely to be incomplete and unreliable. Use geological survey estimates instead

CRIRSCO Reserve estimates allow for dilution and losses. CRIRSCO Resource estimates are mineral in the ground. **Do not aggregate them. This needs to be written into the Specifications.**

Always use the same reference point, for each type of mineral. Usually this will be delivery to a processing plant, though for some minerals which require no processing it could be point of sale.

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Geoscience Australia have raised a question, on how to distinguish resources that are “economic now” from resources that are “uneconomic now but potentially economic in the future”.

This is one area where there is actually a word-for-word match between UNFC and CRIRSCO definitions.

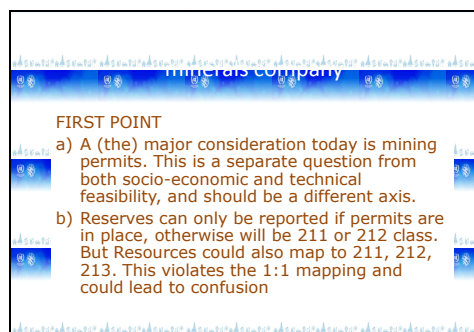
The answer is that it does not require any modifications.

“Economic now” should fall within one of the Reserves classes – but may need additional Modifying Factor data to decide which class.

For example, you can’t use a Reserves class without having a mine plan (and without a mine plan you can't be sure that it is "economic now").

“Uneconomic now but potentially in the future” is simply saying
“...reasonable prospects for eventual economic extraction “ = Resources.

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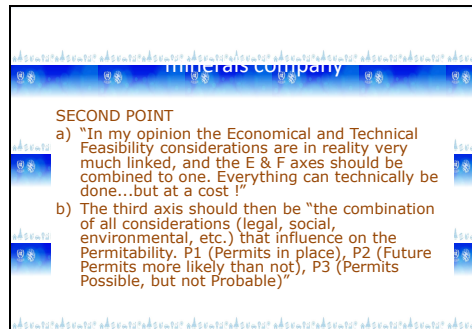


An industrial minerals company has raised a couple of questions.

The company has identified that in all of its current projects, the most critical factor in moving from resources to mining is **permitting**.

It doesn’t lie obviously on any of the E, F, and G axes. Absence of permits leads to the same classes for what they consider to be Reserves, as economic uncertainty in estimated Resources.

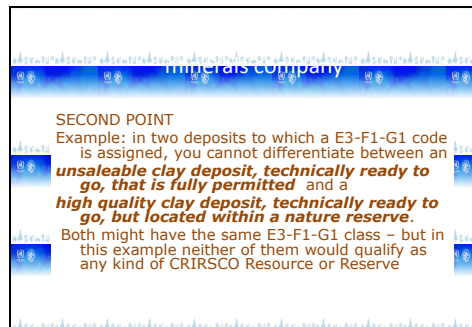
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Their second point is that most of the socio-economic and technical parameters are not really orthogonal as they can be mapped to a single 'economics' axis (combined E and F).

There would then be a third separate ("legal"?) axis which relates purely to permitting.

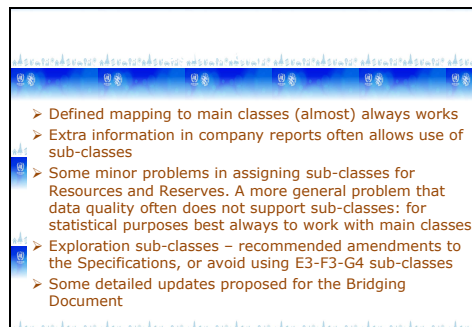
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They give an example – two deposits with different constraints that map to the same UNFC class.

However, since neither of them would be considered as a Resource or Reserve in CRIRSCO, I am not sure if it's too realistic an example.

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I would like to conclude with some general comments.

For government statistical purposes there will often be very variable data quality. Use of Competent Persons for professional quality control is something that I would strongly recommend.

Avoiding use of UNFC-2009 **sub-classes** will help – **the data quality will often not be good enough.**

Restricting consideration to CRIRSCO categories would make this simpler – thus governments can standardise on using appropriate CRIRSCO codes, with confidence that they can extract information to map to UNFC-2009 classes whenever they want.


The advantage is that CRIRSCO codes provide a complete set of principles for reporting, not included in UNFC. This project has provided a demonstration of how the mapping between the two can be done.

There are some detailed updates to the Specifications and Bridging Document which I have identified as necessary, but my own view is that much grief could be avoided simply by not trying to use sub-classes anywhere. **The standard mapping between CRIRSCO and UNFC-2009 main classes works pretty well.**

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I wish to thank
Members of EGRC for their constructive and helpful reviews

- Members and former members of CRIRSCO - Roger Dixon and Ferdi Camisani in particular
- Charlotte Griffiths for constant help and encouragement



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