

Conference on
*“Best practice guidelines for mineral
exploration and mining perspectives
in Estonia”*

UNFC – concept and principal Applications

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Ministry of Economic Affairs and Communications,
Suur-Amerika 1, Tallinn, Estonia,
May 16, 2019

No goal is reached without energy and raw materials, all with environmental challenges



Resources are redefined

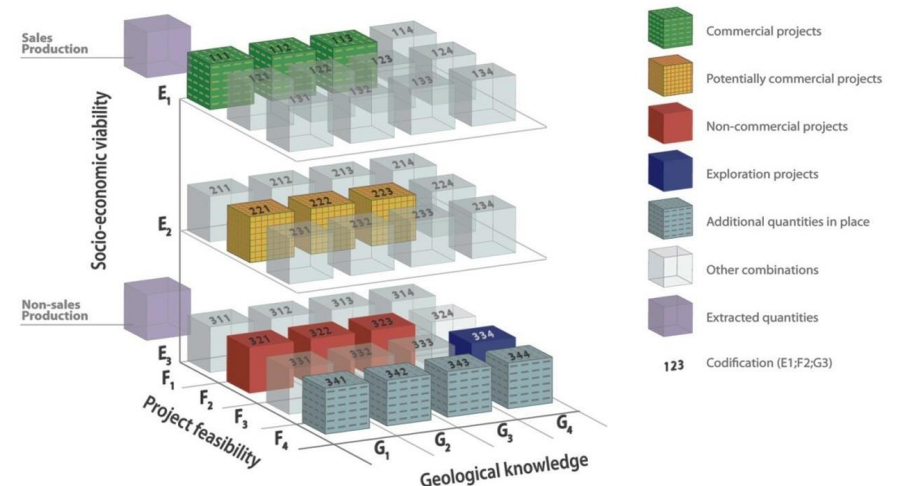
Resource progression is critical



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- UNFC is a **project maturity-based**, resource-progression oriented tool for the management resources.
- UNFC provides a balanced view of **socio-economic** factors, **technology** and **uncertainties** involved in the classification of resources and provides a progression pathway for projects.
- UNFC put emphasis on figuring in **social and environmental considerations** at the centre of resource management.



UNFC is different from other resource classification and management tools in being responsive to requirements of the SDGs, Global Agenda 2030, the aspirations of the society and the modern outlook of the industry.

UNFC domains of application

Consistent classification and management of all resources



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UNECE Expert Group on Resource Management

A global community representing all users



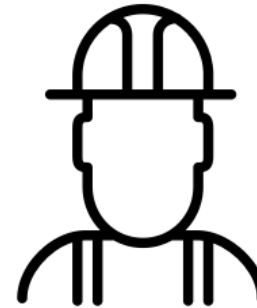
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Academia



Governments (UNECE
and non-UNECE)



Industry



International
organizations



Financial Sector Incl.
standard setters

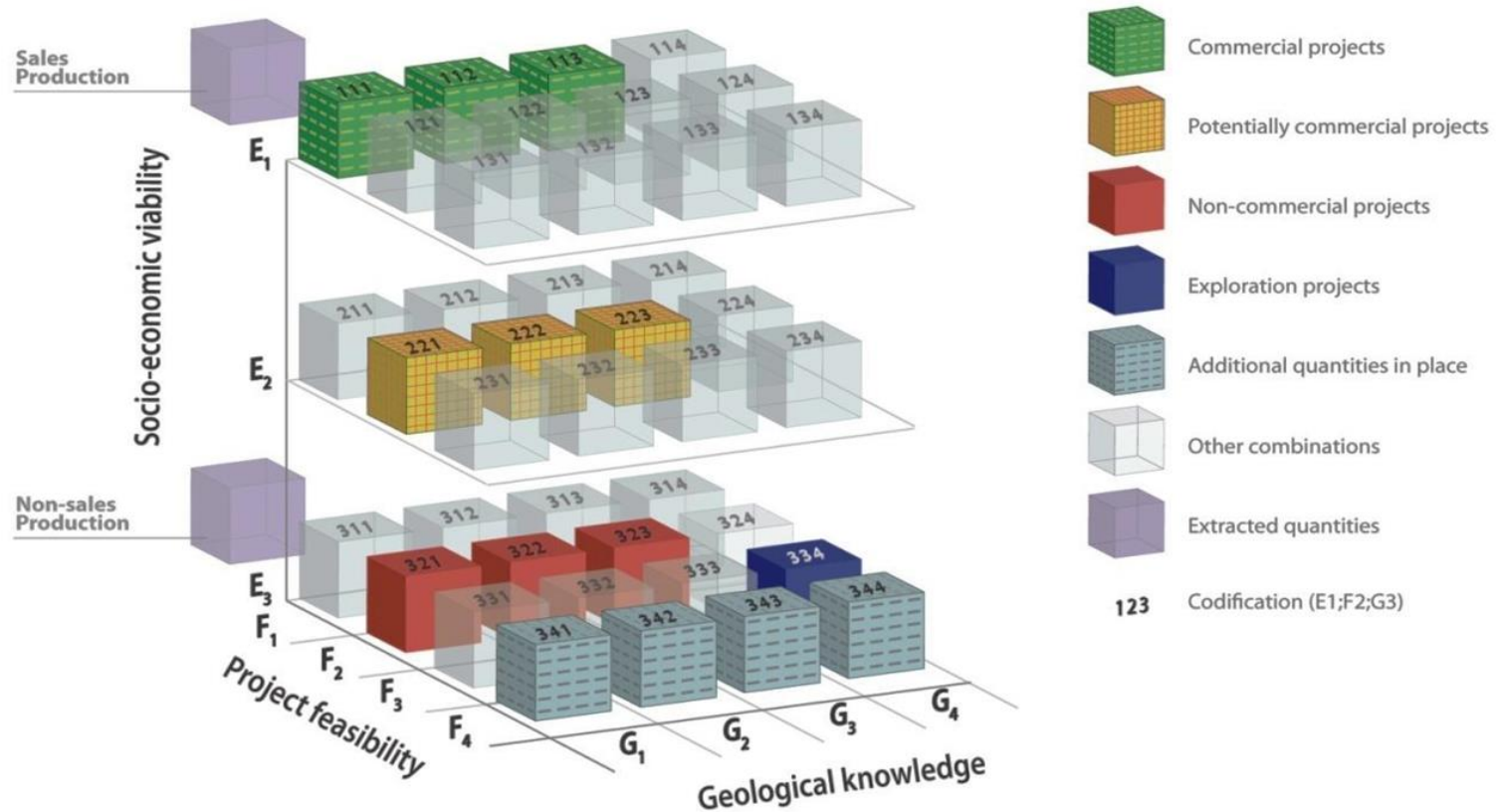


Professional Societies
& Associations

How is it made and how does it work?



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Criteria and Categories



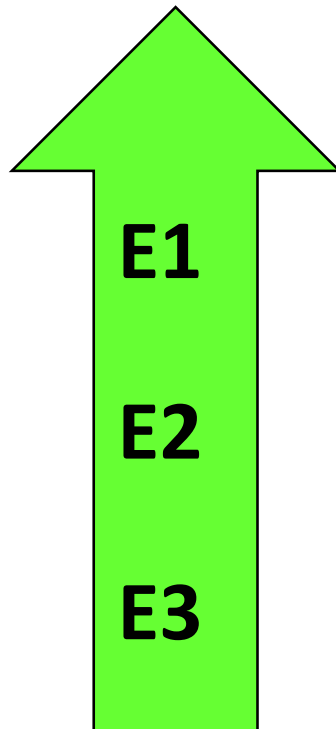
UNEP



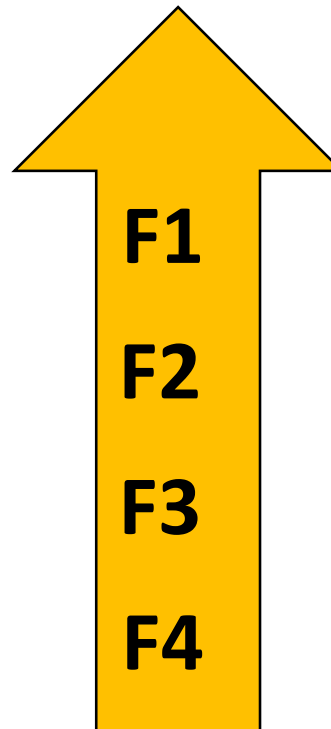
PETRAD

Numerical coding system based on the three criteria, sub-divided by categories:

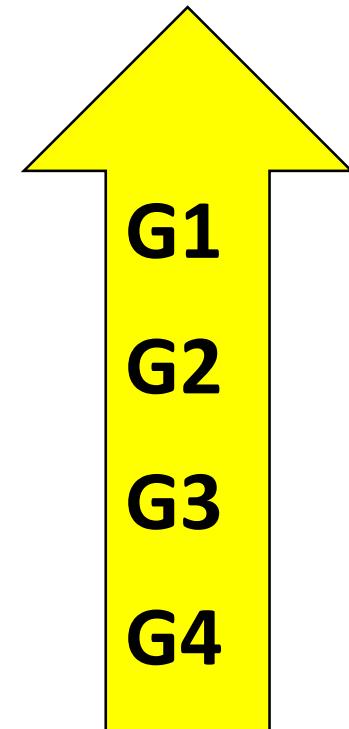
**Economic, social and
environmental viability**

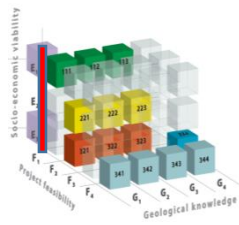


**Field project status
and feasibility**



**Geological
knowledge**





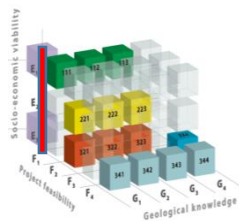
UNFC – E Axis



UNEP



- Degree of favourability of social, economic and environmental conditions in establishing the commercial viability of the project
- Includes consideration of market prices and relevant legal, regulatory, environmental and contractual conditions
- E1, E2 and E3 categories
- E1 is “best”
- Definitions should always be read in conjunction with supporting explanation



E axis category definitions

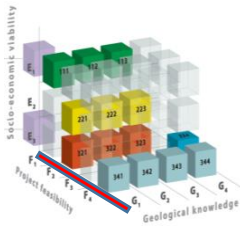


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Category	Definition
E1	Extraction and sale has been confirmed to be economically viable.
E2	Extraction and sale is expected to become economically viable in the foreseeable future.
E3	Extraction and sale is not expected to become economically viable in the foreseeable future or evaluation is at too early a stage to determine economic viability.

The phrase “economically viable” encompasses economic (in the narrow sense) plus other relevant “market conditions”, and includes consideration of prices, costs, legal/fiscal framework, environmental, social and all other non-technical factors that could directly impact the viability of a development project.



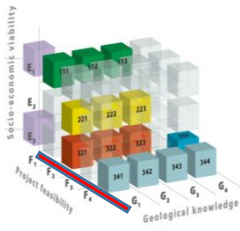
UNFC – F axis



UNECE



- Maturity of studies and commitments necessary to implement mining plans or development projects
- These extend from early exploration efforts before a deposit or accumulation has been confirmed to exist through to a project that is extracting and selling a commodity
- F1, F2, F3 and F4 categories
- F1 is “best”
- Definitions should always be read in conjunction with supporting explanation



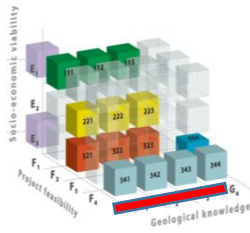
F axis category definitions



UNEP



Category	Definition
F1	Feasibility of extraction by a defined development project or mining operation has been confirmed.
F2	Feasibility of extraction by a defined development project or mining operation is subject to further evaluation.
F3	Feasibility of extraction by a defined development project or mining operation cannot be evaluated due to limited technical data.
F4	No development project or mining operation has been identified.



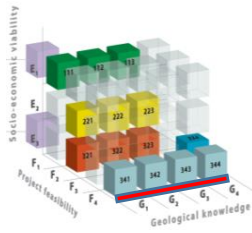
UNFC – G axis



UNEP



- Level of confidence in the geological knowledge and potential recoverability of the quantities, reflecting all significant uncertainties impacting the estimated resource.
- Generally defined as discrete increments for solids, but often defined as scenarios for fluids (G1, G1+G2, G1+G2+G3)
- G1, G2, G3 and G4 categories
- G1 is “best”
- Definitions should always be read in conjunction with supporting explanation



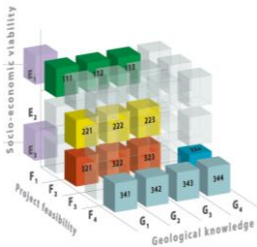
G axis category definitions



UNEP



Category	Definition
G1	Quantities associated with a known deposit that can be estimated with a high level of confidence.
G2	Quantities associated with a known deposit that can be estimated with a moderate level of confidence.
G3	Quantities associated with a known deposit that can be estimated with a low level of confidence.
G4	Estimated quantities associated with a potential deposit, based primarily on indirect evidence.



UNFC – How it works



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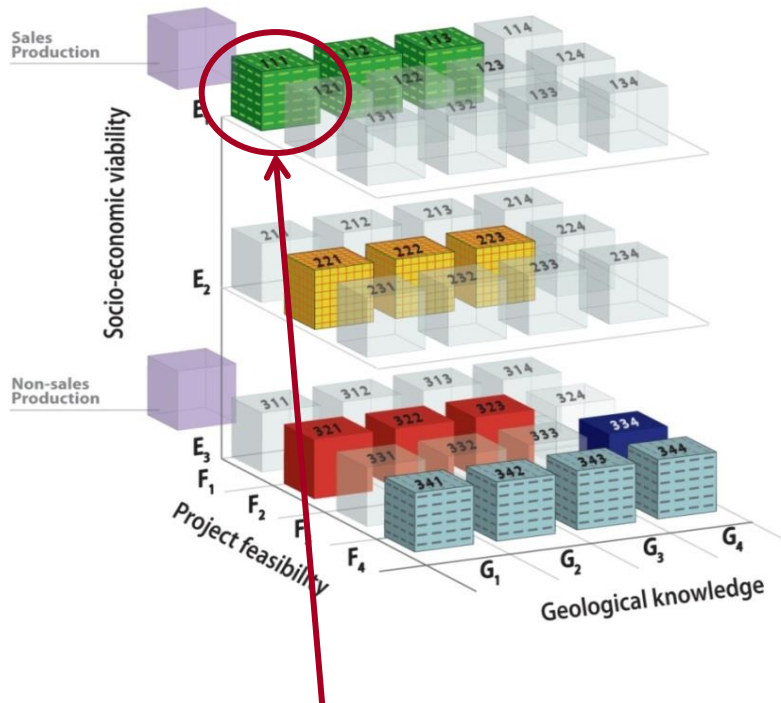


- The category definitions are the building blocks of the system:
 - Select the correct category for each of the three criteria
- These are combined (E, F, G) in the form of classes
- **Class 111** means that the reported quantities have satisfied the definitions for:
 - **E1, F1 and G1**
- There are no constraints on combinations, but not all will be meaningful

UNFC – How it works



UNECE



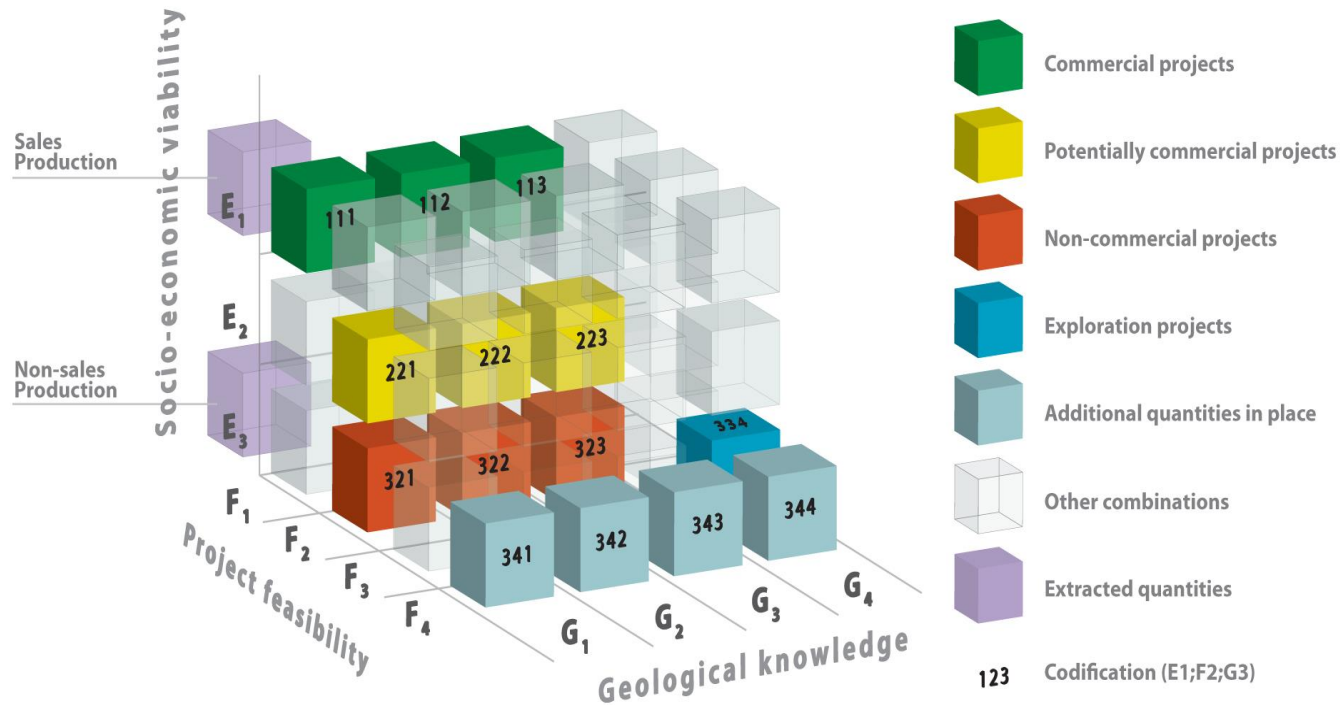
UNFC Class: 111

Category	Definition
E1	Extraction and sale has been confirmed to be economically viable.
Category	Definition
F1	Feasibility of extraction by a defined development project or mining operation has been confirmed.
Category	Definition
G1	Quantities associated with a known deposit that can be estimated with a high level of confidence.

UNFC for resources



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UNFC – 2D representation



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	Extracted	Sales Production			
		Non-sales Production			
		<u>Class</u>	<u>Categories</u>		
			E	F	G
	Future recovery by commercial development projects or mining operations	Commercial Projects	1	1	1, 2, 3
	Potential future recovery by contingent development projects or mining operations	Potentially Commercial Projects	2*	2	1, 2, 3
		Non-Commercial Projects	3	2	1, 2, 3
	Additional quantities in place associated with known deposits		3	4	1, 2, 3
	Potential future recovery by successful exploration activities	Exploration Projects	3	3	4
	Additional quantities in place associated with potential deposits		3	4	4

*Potentially Commercial Projects may satisfy the requirements for E1

UNFC- 2D using all sub-categories



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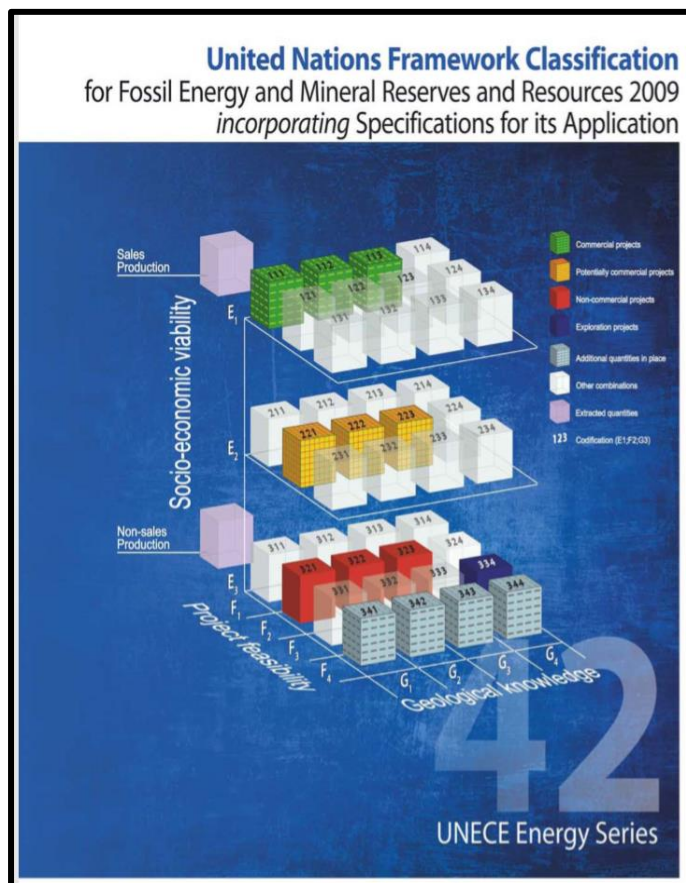
UNFC Classes defined by categories and sub-categories							
Total commodity initially in place	Extracted	Sales Production					
		Non-sales Production					
	Class		Sub-class	Categories			
				E	F	G	
	Known Deposit	Commercial Projects	On Production	1	1.1	1, 2, 3	
			Approved for Development	1	1.2	1, 2, 3	
			Justified for Development	1	1.3	1, 2, 3	
		Potentially Commercial Projects	Development Pending	2*	2.1	1, 2, 3	
			Development On Hold	2*	2.2	1, 2, 3	
		Non-Commercial Projects	Development Unclassified	3.2	2.2	1, 2, 3	
			Development Not Viable	3.3	2.3	1, 2, 3	
		Additional quantities in place			3.3	4	1, 2, 3
		Potential Deposit	Exploration Projects	[No sub-classes defined]	3.2	3	4
	Additional quantities in place			3.3	4	4	

*Potentially Commercial Projects may satisfy the requirements for E1

Key document



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UNFC Classification

Generic specifications UNFC

Bridging documents

CRIRSCO Template and UNFC
PRMS and UNFC

Explanatory note to UNFC

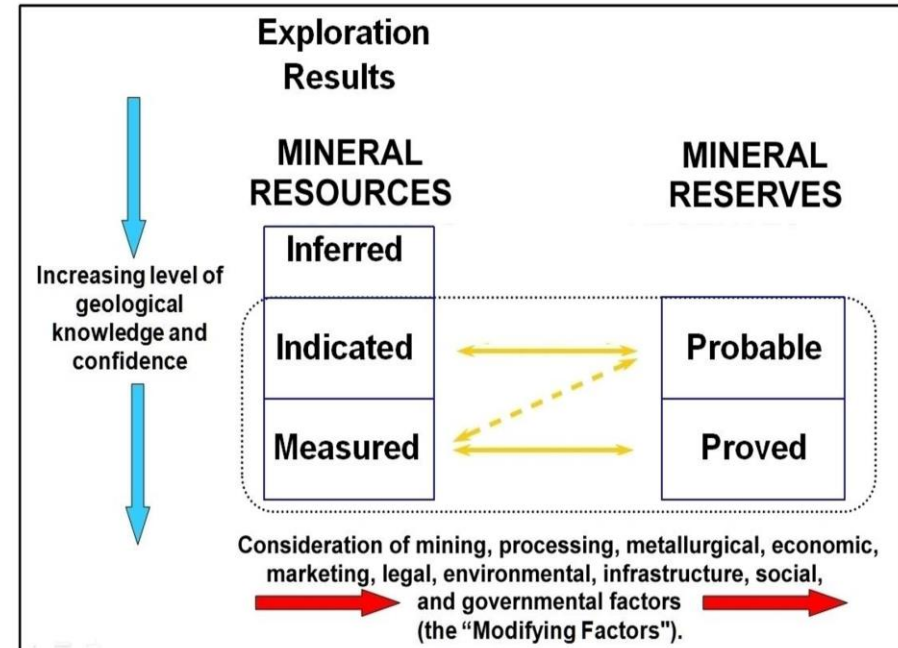
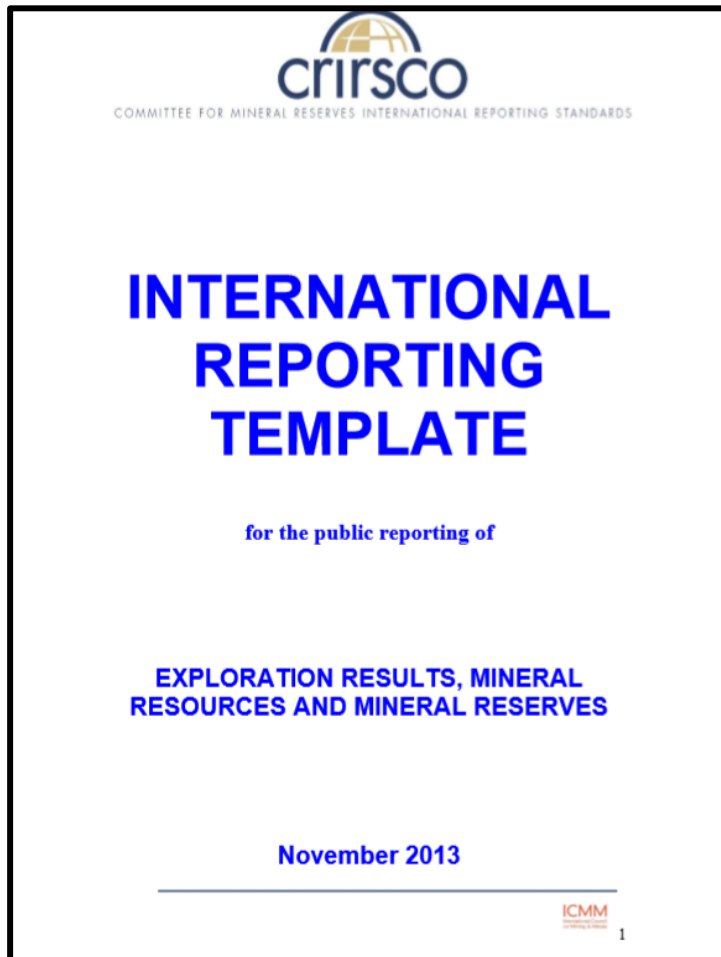
Available in

*Arabic, Chinese, English, French,
Russian, Spanish and Thai*

The CRIRSCO Template (2013)



UNECE



CRIRSCO Template mapped to UNFC



UNECE



CRIRSCO Template		UNFC-2009 “minimum” Categories			UNFC-2009 Class
Mineral Reserve	Proved	E1	F1	G1	Commercial Projects
	Probable			G2	
Mineral Resource	Measured	E2	F2	G1	Potentially Commercial Projects
	Indicated			G2	
	Inferred			G3	
Exploration Results		E3	F3	G4	Exploration Projects

Detailed mapping CRIRSCO to UNFC



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	F1.1	F1.2	F1.3	F2.1	F2.2	F2.3	F3.1	F3.2	F3.3	F4
E1.1										
E1.2										
E2										
E3.1										
E3.2										
E3.3										

UNFC E – F Matrix

CRIRSCO

		UNFC-2009 Sub-Classes	
Mineral Reserve		1	On Production
		2	Approved for Development
		3	Justified for Development
Mineral Resource		4	Development Pending
		5	Development On Hold
Inventory (not defined in Template)		6	Development Unclassified
		7	Development Not Viable
		11	Additional Quantities in Place
Exploration Results		8	
Special Cases	Classification not in Template	12	
	Less Common Mappings		

Detailed mapping CRIRSCO to UNFC



UNECE



	F1.1	F1.2	F1.3	F2.1	F2.2	F2.3	F3	F4
E1.1	1	2	3	4				
E1.2	1	2	3					
E2			4	4	5			
E3.1	12	12	12	12	12	12		
E3.2			6	6	6		8	
E3.3			7	7	7	7		11

UNFC E – F Matrix

From CRIRSCO to UNFC:
One-to-many relationship

From UNFC to CRIRSCO:
Many-to-one relationship

An UNFC inventory can be reported to
CRIRSCO Template requirements

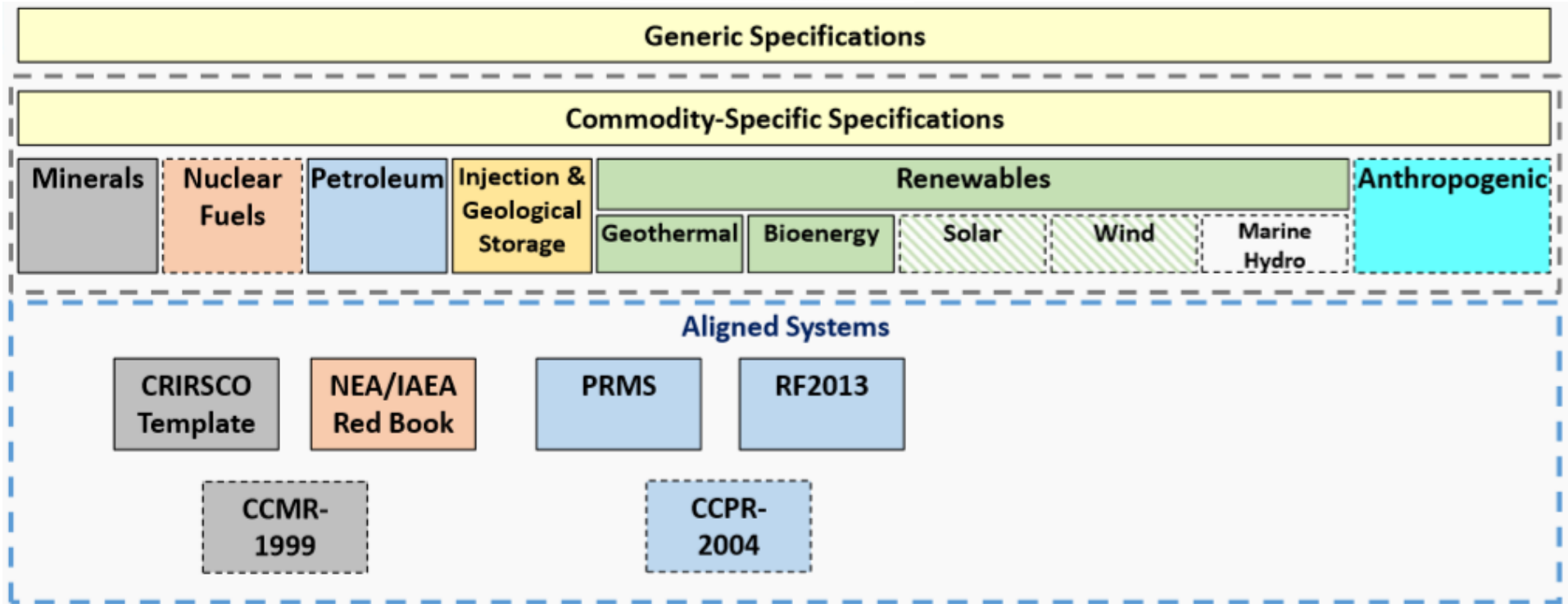
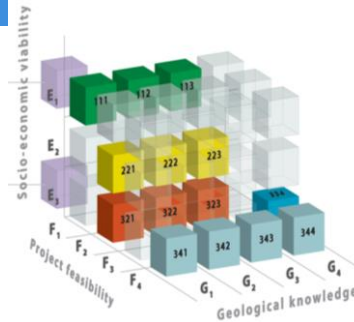
Non-sales production not in CRIRSCO
Quantities remaining in-place not in
CRIRSCO

CRIRSCO		UNFC-2009 Sub-Classes	
Mineral Reserve		1	On Production
		2	Approved for Development
		3	Justified for Development
		4	Development Pending
		5	Development On Hold
Mineral Resource		6	Development Unclassified
		7	Development Not Viable
		11	Additional Quantities in Place
Inventory (not defined in Template)			
Exploration Results		8	
Special Cases	Classification not in Template	12	
	Less Common Mappings		

Aligned systems and commodity-specific Specifications



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Regional initiatives favour UNFC



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Europe

- Several EU research programmes have considered classifications and found great potential in the UNFC (Minfuture, ORAMA, GeoERA and the Cost Minea projects).
- **Guidance for application of UNFC for Mineral resources in Finland, Norway and Sweden.**

African Union initiative «UNFC for Africa»

- An African Mineral and Energy Resource Classification and Management System (UNFC-AMREC) is being designed. UNFC-AMREC will incorporate the Pan-African Resource Reporting Code (PARC) for public disclosure requirements.

“UNFC for Eurasia and the Asia-Pacific”

- UNFC bridged to Chinese and Russian Classifications.
- Philippines consider change mineral classification to UNFC, Thailand uses UNFC for Mineral Resources, India consider update to latest UNFC.
- CCOP is working to establish a regional UNFC project.

Latin America

- Association of Ibero-American Geological and Mining Services and Latin American Mining Organization (OLAMI), pursuing the **development and implementation of a Latin-America-wide system.**
- **Pilot test** in México to classify selected Hydrocarbons Resources using UNFC, E-axis emphasis.

Tested by the Government of Norway

Norwegian Revised National Budget Reporting from the petroleum sector

Types of data to be reported for each project



UNEP

- Quantities
 - In-Place and recoverable volumes
 - Low, Base and High estimates
- Profiles
 - Production sales profiles
 - Oil, Gas, NGL and Condensate,
 - Costs
 - Investments, Operating cost, Tariff expenditures
- Environmental data
 - Emissions (CO₂, NO_x, nmVOC, CH₄)
 - Background data (Water production, Injection profiles)
- Other data
 - Project attributes for contingent resources, Development concepts, Number of production wells to be drilled, etc.....

**C
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NPD classification has to be used in reporting

Tested by the Government of Norway

Norway's petroleum resources on 31.12.2018 transferred to UNFC



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Totale petroleumressursar på norsk kontinentalsokkel pr. 31.12.2018 i henhold til United Nations Framework Classification System 2009

Norwegian resource figures of 31.12.2018 according to the UNFC Numerical codes

UNFC Sub-class	oil mill Sm ³	NGL mill tonn	condensate mill Sm ³	gas bill Sm ³	Total mill Sm ³ o.e
1.1;1.1;1+2	489	66	22	1123	1760
1.1;1.2;1+2	587	25	0	495	1131
1.1;1.3;1+2	101	1	0	4	106
1.1;2.1;1+2	187	17	2	151	371
2.2;1.1+2	29	2	0	20	54
2.2;2.1+2	253	13	2	254	535
3.2;2.2;1+2					0
3.3;2.3;1+2	217	2	5	179	
3.2;3.4	1980	0	130	1830	3940

UNFC Class	oil mill Sm ³	NGL mill tonn	condensate mill Sm ³	gas bill Sm ³	Total mill Sm ³ o.e
1.1;1+2	1177	92	22	1622	2997
1.2;1+2	187	17	2	151	371
2.2;1+2	282	16	2	274	589
3.2;2.2;1+2	0	0	0	0	0
3.2;3.4	1980		130	1830	3940

UNFC Class	oil mill Sm ³ G1	oil mill Sm ³ G1+G2	oil mill Sm ³ G1+G2+G3
E1.1;F1.1	408	489	560
E1.1;F1.2	516	587	661
E1.1;F1.3	70	101	132
E1.1;F2.1	134	187	239
E2;F2.1	20	29	38
E2;F2.2	183	253	321
E3.2;F2.2	122	217	315
E3.3;F2			
	G4.1	G4.1+G4.2	G4.1+G4.2+G4.3
E3.2;F3.4	1 321	1 980	2 787

UNFC Class	gas bill Sm ³ G1	gas bill Sm ³ G1+G2	gas bill Sm ³ G1+G2+G3
E1.1;F1.1	1 031	1 123	1 230
E1.1;F1.2	469	495	531
E1.1;F1.3	4	4	10
E1.1;F2.1	111	151	196
E2;F2.1	14	20	27
E2;F2.2	162	254	368
E3.2;F2.2	109	179	261
E3.3;F2			
	G4.1	G4.1+G4.2	G4.1+G4.2+G4.3
E3.2;F3.4	1 339	1 830	2 464

UNFC Class	Total mill Sm ³ o.e. G1	Total mill Sm ³ o.e. G1+G2	Total mill Sm ³ o.e. G1+G2+G3
E1.1;F1.1	1 561	1 760	1 943
E1.1;F1.2	1 027	1 131	1 237
E1.1;F1.3	75	106	145
E1.1;F2.1	267	371	475
E2;F2.1	37	54	71
E2;F2.2	360	535	724
E3.2;F2.2	233	406	585
E3.3;F2			
	G4.1	G4.1+G4.2	G4.1+G4.2+G4.3
E3.2;F3.4	2 839	3 940	5 240

Source: NPD:<https://www.npd.no/en/facts/resource-accounts-and-analysis/resource-accounts-at-31-december-2018/>

Guidance for Application of UNFC for Mineral Resources in Finland, Sweden and Norway



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Public – private partnership



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The planning and building legislation

Zoning plan

Environmental legislation

Generally applicable

Consultation

EIA

Application process
Environmental permit

Environmental permit

Mining legislation

Exploration permit

Application process
Exploitation permit

Exploitation permit

Industry operations

Exploration

Conceptual study

Pre-feasibility study

Feasibility study

Pre-planning and design

Construction

Operation

Mine closure
Monitoring

UNFC value chain

Exploration project
E3, F3, G4

Potentially commercial project
Containing categories E2 and/or F2; G1/G2/G3

Commercial project
E1, F1, G1/G2/G3

Extractable non sales quantities(E3.1) and quantities remaining in place(F4)

Areas of work for the EGRM

Develop the United Nations Resource Management System (UNRMS)



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- **Develop, maintain and promote** a comprehensive UNRMS compliant with UNFC and applicable to the resource life cycle and value chains.
- **Provide a UNRMS toolkit** to support stakeholders needs.
- **Develop** principles, specifications, bridging documents, guidelines and protocols supporting project lifecycle.
- **Elaborate guidelines** for recognition and strengthening the capabilities of **competent persons**
- Conduct related capacity building, training courses, promotion and outreach programmes;

**It is about Resource Management,
not volumetric assessments!**

In summary ...



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- **UNFC is a generic, principles-based system**
 - Applicable to both solid minerals, fluids, renewables, injection projects and anthropogenic resources.
 - Uses a numerical coding system
- **Based on three fundamental criteria**
 - Economic, social and environmental viability
 - Field project status and feasibility
 - Geological knowledge (confidence)
- **Each criterion is sub-divided into 3 or 4 defined categories**
 - Optional use of sub-categories for more granularity
- **Classes are defined by a combination of a single category or sub-category for each of the three criteria**
 - Numerical category or sub-category for E, for F and for G
 - Always quoted in same sequence: E – F – G
 - Axis letters can be dropped: e.g. Class 221

In summary ...



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UNFC will be the core of the United Nations Resource Management System, **UNRMS**

Find more information:

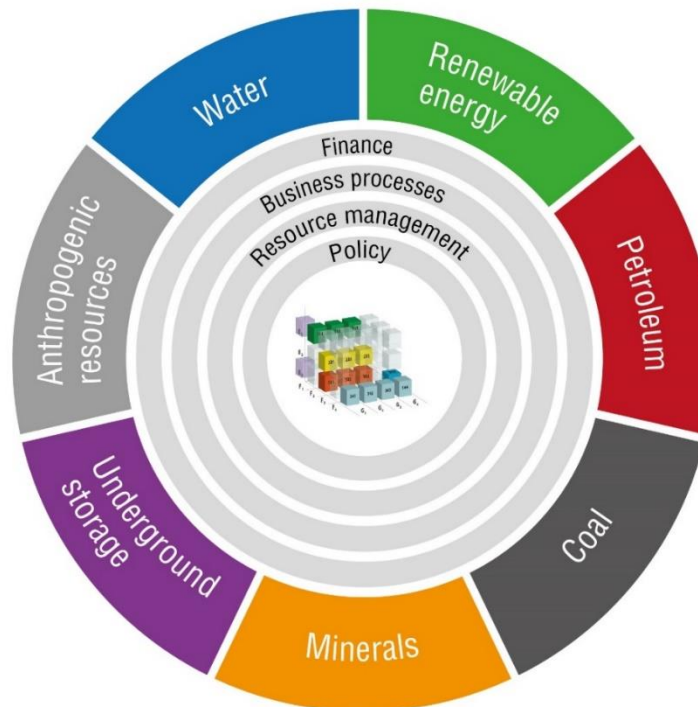
<https://www.unece.org/energy/se/reserves.html>

A global capital market, industry and governments benefit from **one classification** for multiple commodities...



UNECE

...the UNFC



More information

<https://www.unece.org/energy/se/reserves.html>



Thank you

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PETRAD

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Expert Group on Resource Management,
EGRM
EGRM Communication Group

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Back-up slides

UNFC and ECOSOC

A call for global application



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The Economic and Social Council (ECOSOC) is at the heart of the United Nations system to advance the three dimensions of sustainable development – economic, social and environmental.

ECOSOC Decision 2004/233

Member States of the United Nations, international organizations and regional commissions to consider taking appropriate measures for ensuring worldwide application of the Framework Classification.



E 1 category definition

With supporting explanation



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Category	Definition ^b	Supporting Explanation ^c
E1	Extraction and sale has been confirmed to be economically viable. ^d	Extraction and sale is economic on the basis of current market conditions and realistic assumptions of future market conditions. All necessary approvals/contracts have been confirmed or there are reasonable expectations that all such approvals/contracts will be obtained within a reasonable timeframe. Economic viability is not affected by short-term adverse market conditions provided that longer-term forecasts remain positive.

Case study Mountain Pass Deposit, California

REE and Thorium Resources classified in UNFC



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Molycorp, Inc. reports that the Mountain Pass ore body – the Sulphide Queen carbonatite – contains “**proven**” and “**probable reserves**” of 16.7 Mt of ore with an average grade of 7.98 per cent REE oxides, applying a cut-off grade of 5 per cent REE oxides [64].

A recent U.S. Geological Survey **reconnaissance** bulk sampling of ore exposed in the open-pit mine (about 1 t of composited ore was collected) found an average thorium content of approximately 0.025 per cent within high-grade REE ore (carbonatite). Applying an ore body estimated to comprise at least 16.7 Mt of carbonatite, with an average thorium content of about 0.025 per cent, there would be an estimated resource of at least 4,200 t of thorium at Mountain Pass.

Since the estimates are based on limited sampling and extrapolation, it should be considered as an estimate in the lowest level of geological confidence.

Mountain Pass Deposit	Quantities (t)	Average Grade (%)	CRIRSCO Classification	UNFC-2009 Categories			UNFC-2009 Class	UNFC-2009 Sub-class
				E	F	G		
Total REE oxides	1,333,000 ^a	7.98 (as oxide)	Proven + Probable Reserves	1.1	1.1	1,2	Commercial Project	On Production
Thorium	4,200	0.025 (elemental weight %)	Inventory ^b	3.3	2.3	3	Non Commercial Project	Development not Viable

^a Proven and probable REE reserves based on an estimated 16,700,000 t of carbonatite ore (grades and tonnages for the REE reserves categories are combined in the public reporting).

^b Not defined in the CRIRSCO Template.

Industry is bound to use existing classifications predating UNFC. ESMA specifies the most common and SEC's



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INTERNATIONALLY RECOGNISED MINERAL STANDARDS ACCEPTABLE TO THE EUROPEAN SECURITIES AND MARKET AUTHORITY (EUROPEAN AND MARKET AUTHORITY, 2013)

For the purposes of meeting the exemption in paragraph 133(ii) above¹¹, predecessors of these following reporting standards (Mining Reporting and Oil and Gas Reporting) are acceptable.

Mining Reporting

- The Australasian Code for Reporting of Exploration Results, Mineral Resources and Ore Reserves published by the Joint Ore Reserves Committee of the Australasian Institute of Mining and Metallurgy, Australian Institute of Geoscientists and Minerals Council of Australia, as amended ('JORC');
- The South African Code for the Reporting of Exploration Results, Mineral Resources and Mineral Reserves published by the South African Mineral Resource Committee under the joint auspices of the Southern African Institute of Mining and Metallurgy and the Geological Society of South Africa, as amended ('SAMREC');
- The various standards and guidelines published and maintained by the Canadian Institute of Mining, Metallurgy and Petroleum ('CIM Guidelines'), as amended;
- A Guide for Reporting Mineral Exploration Information, Mineral Resources and Mineral Reserves prepared by the US Society for Mining, Metallurgy and Exploration, as amended ('SME');
- The Pan European Resources Code jointly published by the UK Institute of Materials, Minerals, and Mining, the European Federation of Geologists, the Geological Society, and the Institute of Geologists of Ireland, as amended ('PERC');
- Certification Code for Exploration Prospects, Mineral Resources and Ore Reserves as published by the Instituto de Ingenieros de Minas de Chile, as amended; or
- Russian Code for the Public Reporting of Exploration Results, Mineral Resources and Mineral Reserves prepared by the National Association for Subsoil Examination (NAEN) and the Society of Russian Experts on Subsoil Use (OERN) (The 'NAEN Code')

Oil and Gas Reporting

- The Petroleum Resources Management System jointly published by the Society of Petroleum Engineers, the World Petroleum Council, the American Association of Petroleum Geologists and the Society of Petroleum Evaluation Engineers, as amended;
- Canadian Oil and Gas Evaluation Handbook prepared jointly by The Society of Petroleum Evaluation Engineers and the Canadian Institute of Mining, Metallurgy & Petroleum ("COGE Handbook") and resources and reserves definitions contained in National Instrument 51-101 Standards of Disclosure for Oil and Gas Activities; or
- Norwegian Petroleum Directorate classification system for resources and reserves.

Valuation

- The Code for Technical Assessment and Valuation of Mineral and Petroleum Assets and Securities for Independent Expert Reports, prepared by a joint committee of the Australasian Institute of Mining and Metallurgy, Australian Institute of Geoscientists and the Mineral Industry Consultants Association, as amended ('VALMIN');
- The South African Code for the Reporting of Mineral Asset Valuation, prepared by the South African Mineral Valuation Committee under the joint auspices of the Southern African Institute of Mining and Metallurgy and the Geological Society of South Africa, as amended ('SAMVAL');
- Standards and Guidelines for Valuation of Mineral Properties endorsed by the Canadian Institute of Mining, Metallurgy and Petroleum, as amended ('CIMVAL')

¹¹ The appendix is copied from reference 8.