

UNFC Workshop

26 April, 2016 Palais des Nations, Geneva

Application of UNFC-2009 to Nuclear fuel Resources

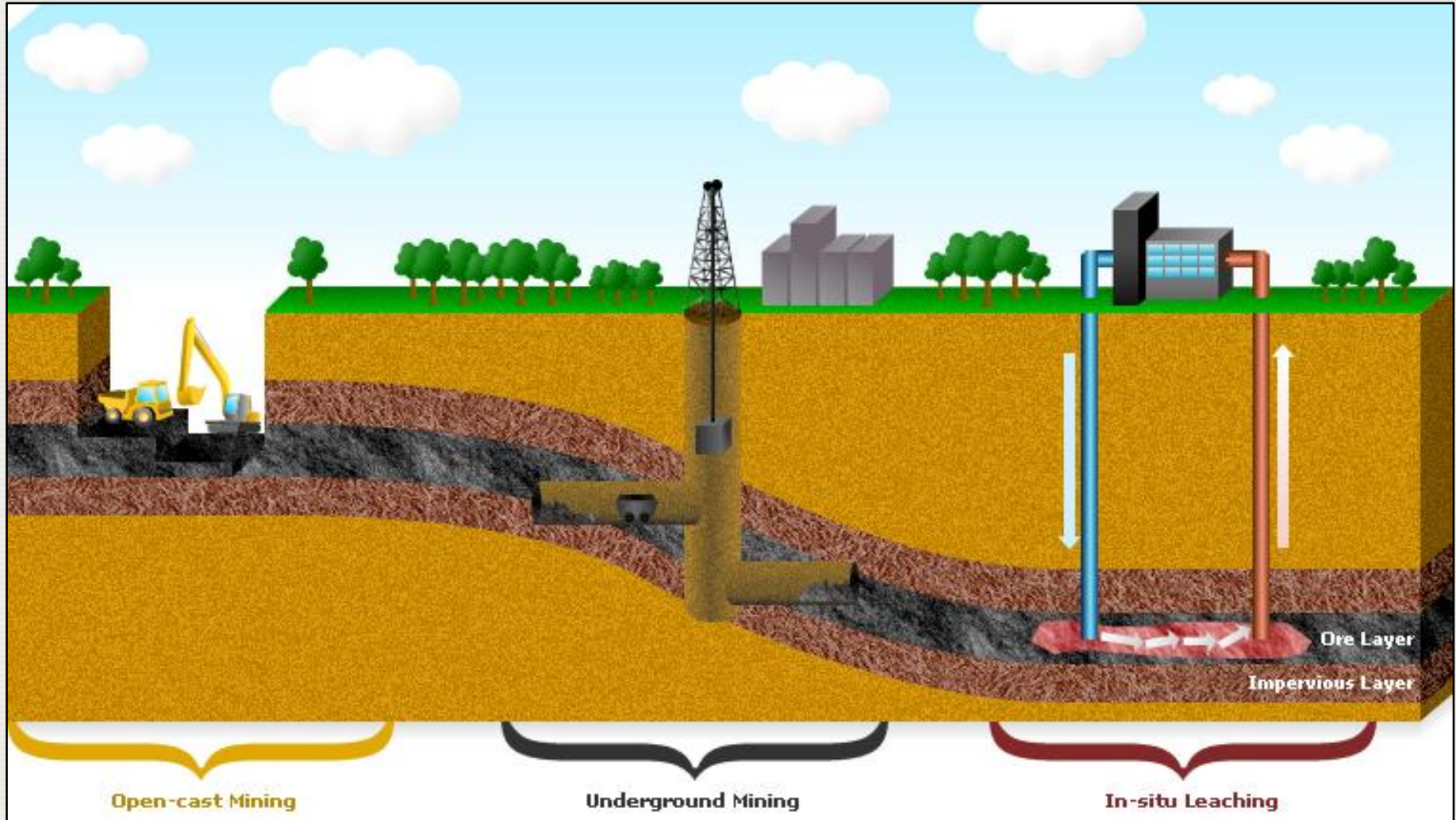
Hari Tulsidas



IAEA

International Atomic Energy Agency

Uranium production can involve different methodologies



Non-uranium producing mines

There are numerous mines, which have never produced U or Th, whose economic minerals have elevated levels of U or Th associated with them.

Generally the associated concentrations (grades) are 1-2 orders of magnitude lower than those of the primary uranium producers.

However, there are a number of mines and deposits where grades can match or exceed those of commercially producing uranium mines.

These mines do not produce uranium usually because the potential returns are too small to justify the outlay on additional specialist metallurgical plant.

Mining operations producing uranium as a by-product

Copper mining (South Africa (formerly) and Australia)

Phosphate rock mining (and production of phosphoric acid) (formerly mostly USA)

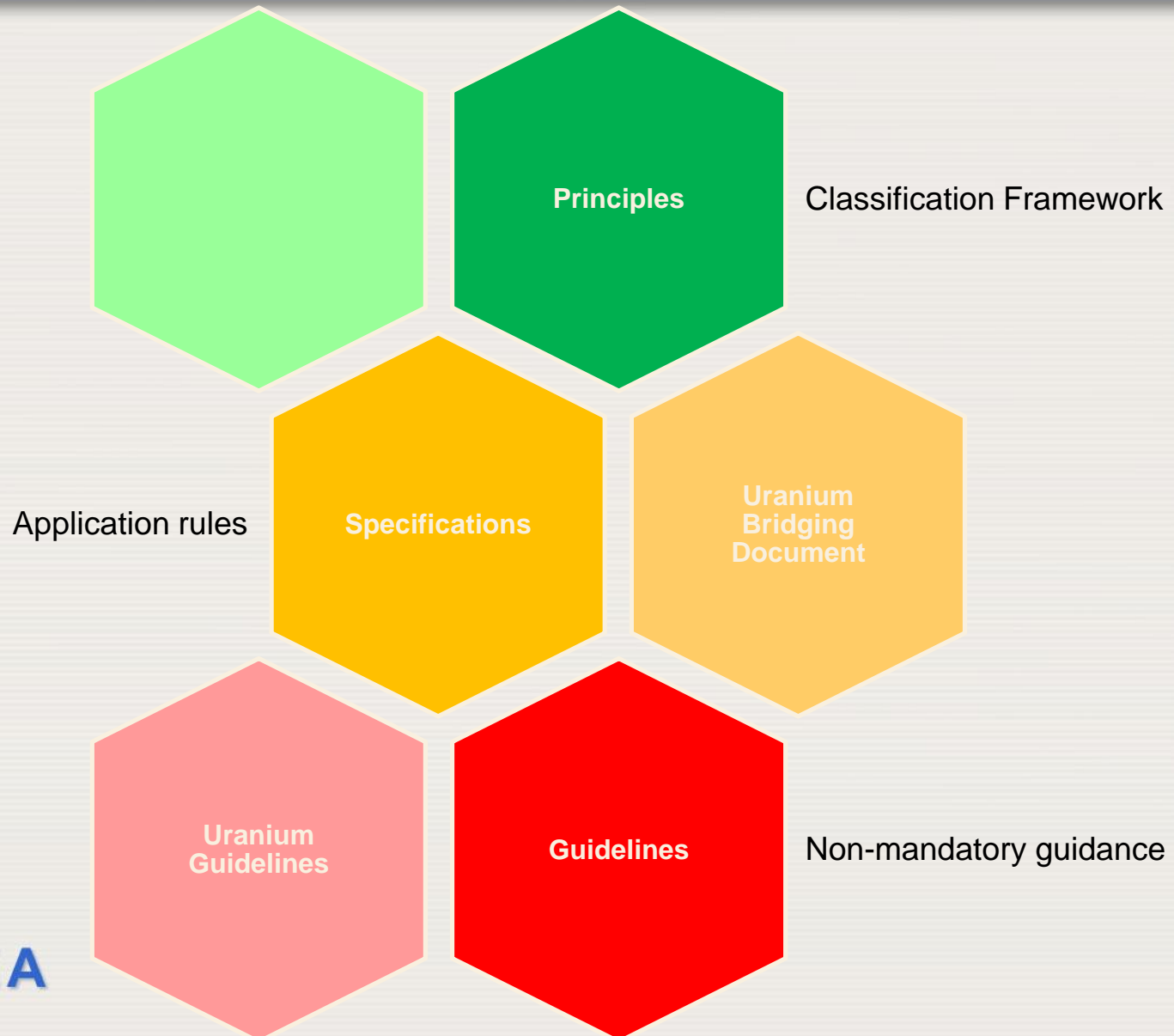
Gold mining (South Africa)

Also some other mines perhaps in future, e.g. Morocco, Jordan (phosphate), Finland (Ni-Zn), Zambia (Cu), Australia, Greenland (Rare Earth Elements)



Uranium extraction plant at a phosphate fertiliser plant, Florida USA (not in current use)

UNFC-2009 is a 3-tier system



Bridging Documents explain the relationship between UNFC-2009 and another classification system

UNFC Classification					NEA/IAEA Classification	
UNFC Classes and Sub-classes		UNFC Categories				
Class	Sub-Class	E	F	G	Status	IAEA-NEA Categories
Commercial Projects	On Production	1	1.1	1,2	Existing	Reasonably Assured Resources (RAR)
	Approved for Development	1	1.2	1,2	Committed	
	Justified for Development	1	1.3	1,2	Planned	
Potentially commercial projects	Development Pending	2	2.1	1,2,3	Prospective	Identified Resources RAR IR*
	Development On Hold	2	2.2	1,2,3		
Non-commercial projects	Development Unclassified	3.2	2.2	1,2,3	Unclassified	Identified Resources RAR IR*
	Development not Viable	3.3	2.3	1,2,3	Not viable	
Exploration projects		3.2	3.1	4		Prognosticated Resources
		3.2	3.2, 3.3	4		Speculative Resources

*Inferred Resources





Application of the United Nations Framework Classification for Fossil Energy and Mineral Reserves and Resources 2009 to Nuclear Fuel Resources Selected Case Studies

Economic Commission for Europe

Committee on Sustainable Energy

Twenty-fourth session

Geneva, 18–20 November 2015
Item 5 of the Provisional Agenda

Expert Group on Resource Classification

Guidelines for Application of the United Nations Framework Classification for Fossil Energy and Mineral Reserves and Resources 2009 for Uranium and Thorium Resources*

Prepared by the Expert Group on Resource Classification**

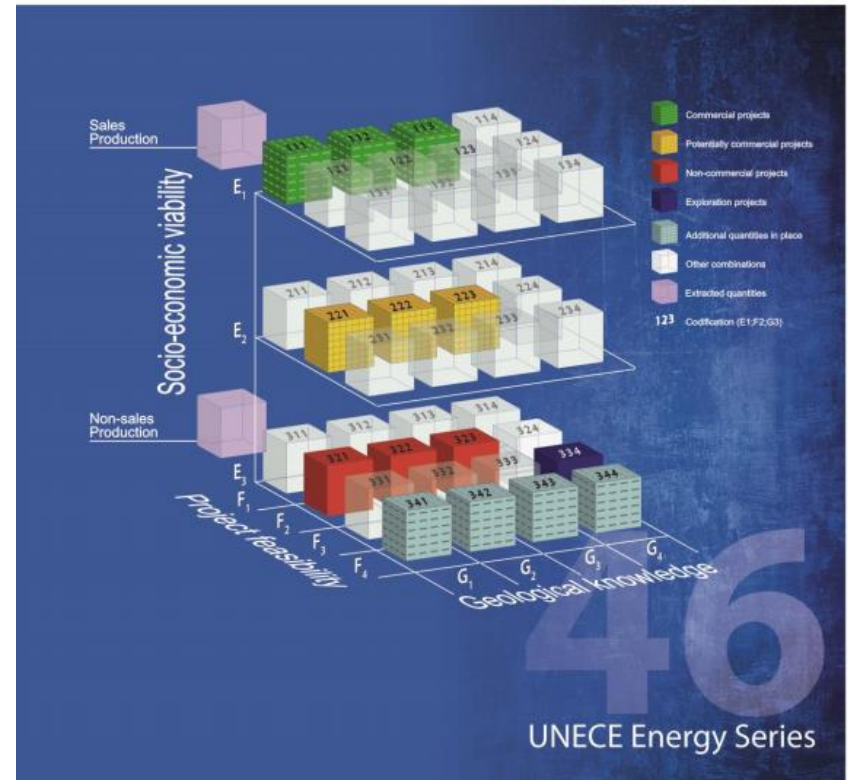
Summary

The purpose of the document is to provide non-mandatory guidance for the application of the United Nations Framework Classification for Mineral Reserves and Resources 2009 (UNFC-2009) to uranium and thorium resources. These Guidelines are intended to assist all those responsible for finding, classifying, quantifying, financing, permitting, mining, and processing these minerals such that they are fit to enter the nuclear fuel cycle. The Guidelines must be used in conjunction with the most recent release of UNFC-2009 (ECE Energy Series No. 42 and ECE/ENERGY/94), which incorporates the specifications or mandatory rules for its use and application. As a living document, the Guidelines will be subject to ongoing review and update. Users of these Guidelines are invited to share their experience in using them with the ECE Expert Group on Resource Classification.

The Guidelines were developed by the Task Force on Application of UNFC-2009 to Nuclear Fuel Resources of the Expert Group. The Work Plan for 2013–2015 of the Expert Group requested that appropriate guidelines be prepared to ensure consistent application of UNFC-2009 to nuclear fuel resources thereby allowing use of the higher granularity of UNFC-2009 and its harmonization advantages.

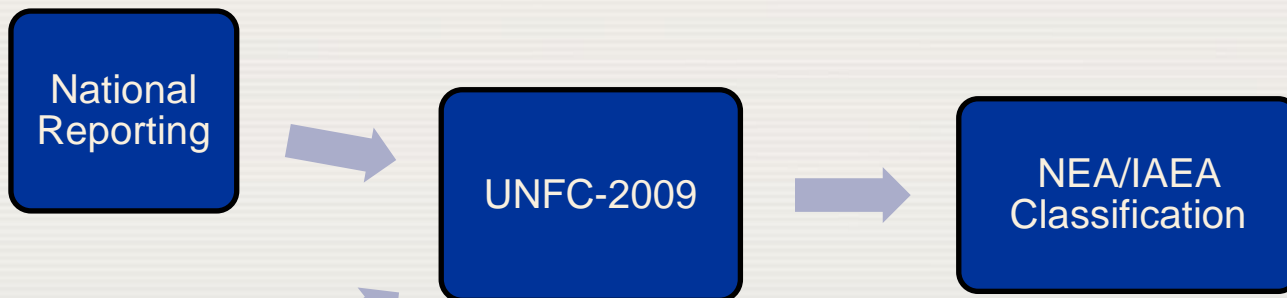
* Please note: the mappings included in these Guidelines are preliminary and hence only an indication of how they might work. They are in no way endorsed or approved by the Expert Group on Resource Classification. As at 5 November 2015, the only UNFC-2009 aligned systems are the CRIRSCO Template, PRMS and the NEA/IAEA 'Red Book'.

** These Guidelines were developed by the Task Force on Application of UNFC-2009 to Nuclear Fuel Resources of the Expert Group on Resource Classification and were issued for public comment from 25 June to 20 August 2015. Development of the Guidelines has followed the Document Approval Procedure agreed by the Expert Group at its fifth session, April 2014. The Guidelines are presented to the Committee on Sustainable Energy at its twenty-fourth session for endorsement.



UNFC-2009 Classification					CRIRSCO Template		NEA/IAEA Classification			
UNFC Classes and Sub-classes		UNFC Categories			CRIRSCO Classes and Sub-classes					
Class	Sub-Class	E	F	G	Class	Sub-Class	IAEA-NEA Categories		Status	
Commercial Projects	On Production	1	1.1	1	Mineral Reserves	Proved	Reasonably Assured Resources (RAR)		Existing	
				2		Probable				
	Approved for Development	1	1.2	1		Proved			Committed	
				2		Probable				
	Justified for Development	1	1.3	1		Proved			Planned	
				2		Probable				
Potentially Commercial Projects	Development Pending	2	2.1	1	Mineral Reserves	Measured	Identified Resources		Prospective	
				2		Indicated				
				3		Inferred				
	Development On Hold	2	2.2	1		Measured				RAR
				2		Indicated				
				3		Inferred				
Development On Hold	2	2.2	3	Inferred	IR*					
					IR*					
Non-commercial Projects	Development Unclassified	3.2	2.2	1,2,3	Inventory (not defined in Template)	Development Unclassified (not defined in Template)	Identified Resources		Unclassified	
	Development Not Viable	3.3	2.3	1,2,3		Not Viable (not defined in Template)				RAR IR*
Exploration Projects		3.2	3.1	4	Exploration Results		Undiscovered Resources	Prognosticated Resources		
		3.2	3.2, 3.3	4				Speculative Resources		

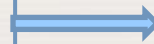
Workflows in national reporting



IAEA

Uranium guidelines are hinged on critical control point and milestone-driven approach

Geologic knowledge
Project feasibility
Socio-economic viability
Policy and regulatory frameworks



Small, critical number of control points in a project life-cycle

(combination approach of E, F, and G axis considerations)

Socio-economic viability issues (E-axis)

Known environmental or social impediments or barriers to projects (E-axis)

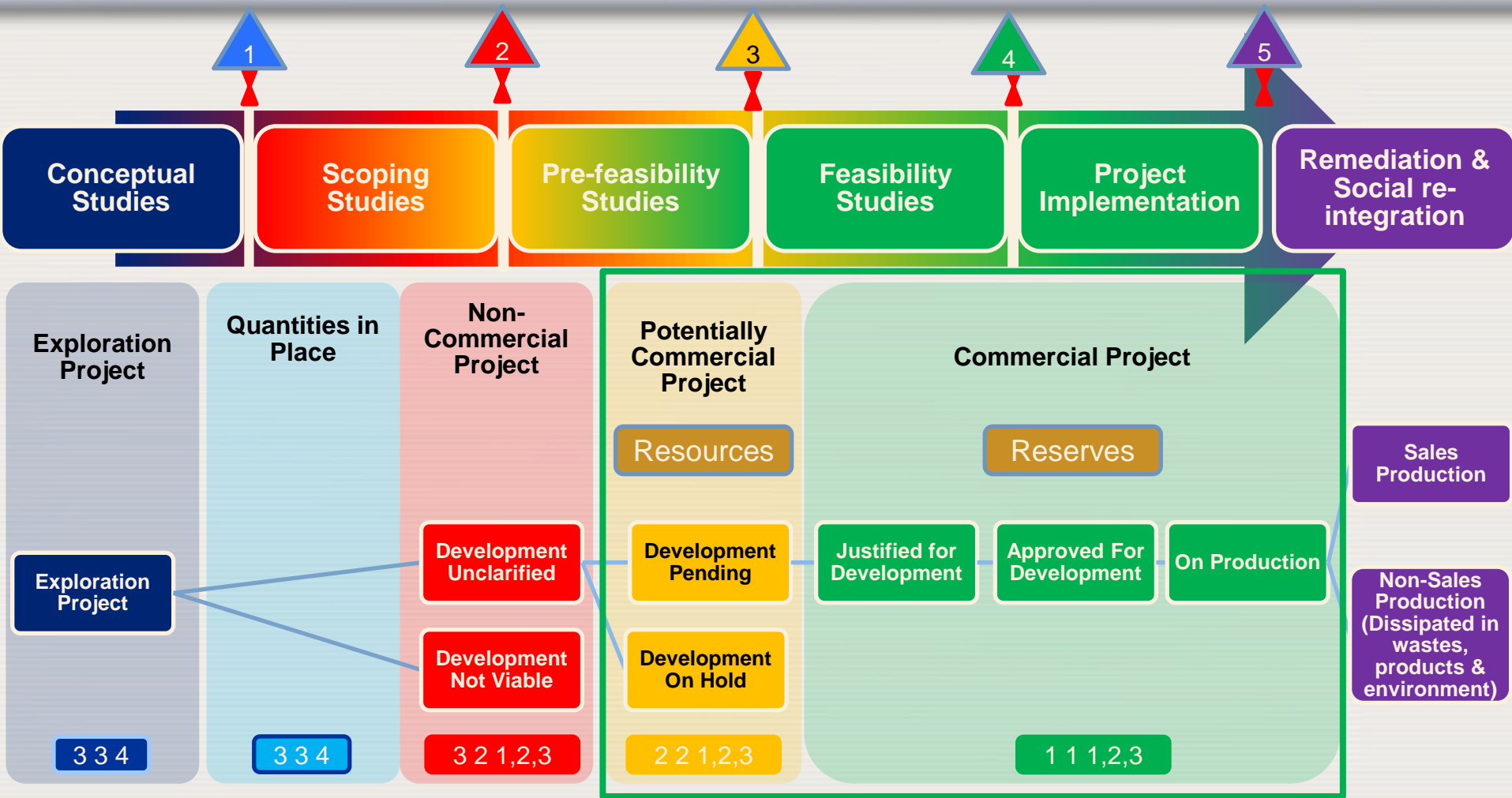
Project viability issues (F-axis)

Geological knowledge challenges (G-axis)

In-situ leach production (solution mining of underground uranium deposits)



U mining lifecycle and resources

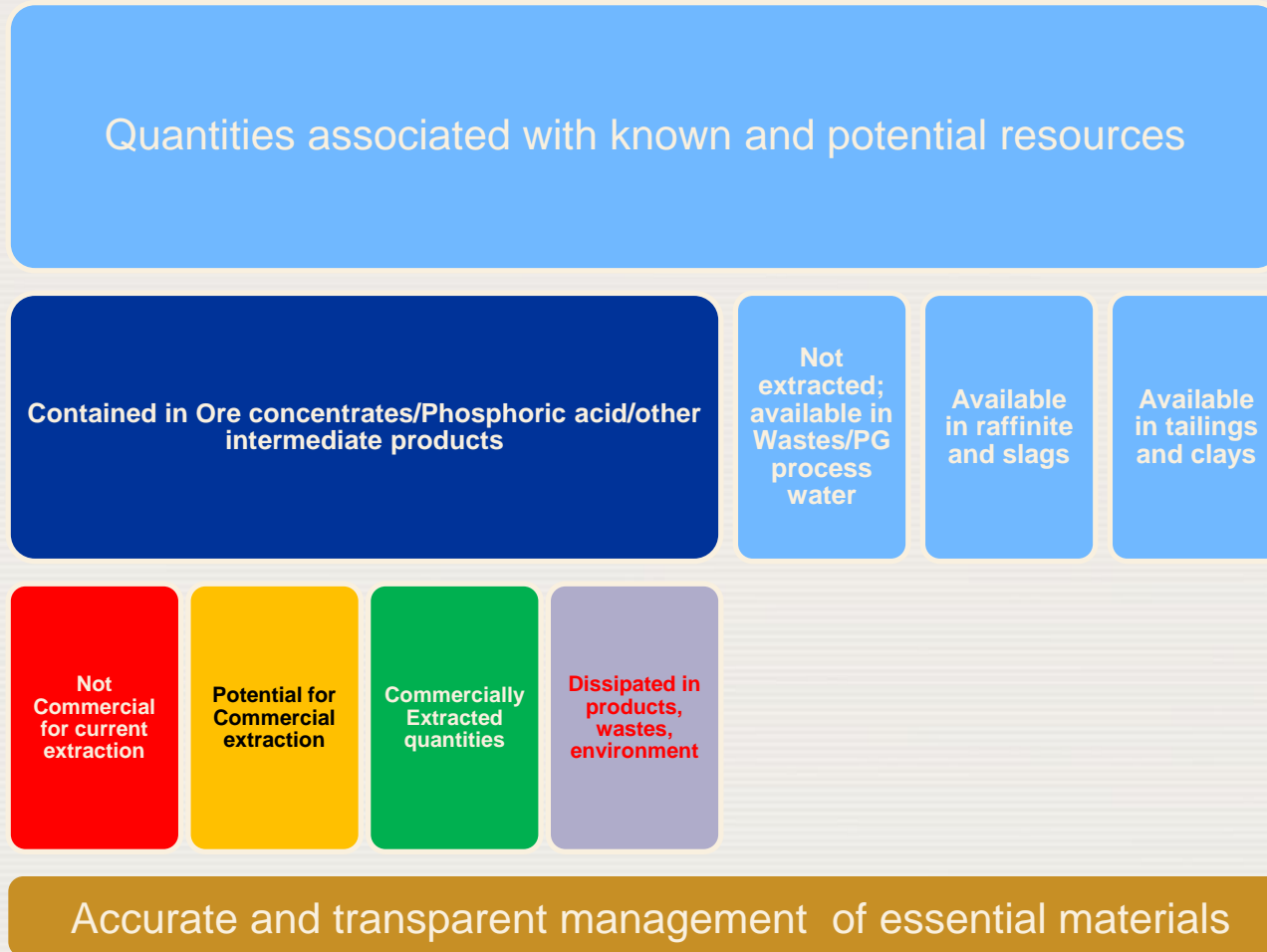


Accurate and transparent management of essential materials throughout the lifecycle

Over 45 million tonnes of U; and what else?

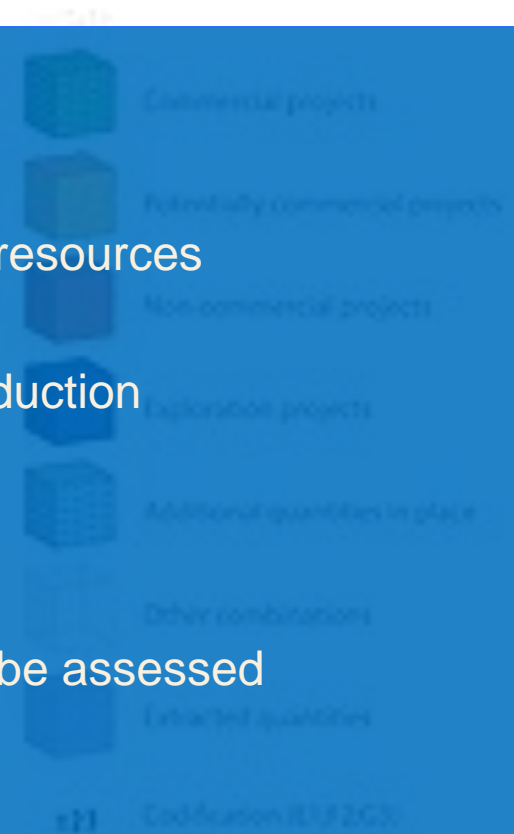
No	Type	Number of reported world deposits	No of U deposits in UDEPO	Total Resources in UDEPO (t U)	Average Grade (ppm U)	Remarks
1	Intrusive (Plutonic sub-type)	646 – Porphyry copper deposits ^b 125 – Peralkaline complexes ^c 527 - Carbonatites ^y	32	651 773	40 – 6 400	REE, Nb, Ta, Zr, U, Cu, Au, Ag, Mo
2	Polymetallic Iron Oxide Breccia Complex	33 ^z (Over 100 ³)	16	2 438 773	60 - 850	Cu, Au, Ag, U
3	Lignite-coal	2700 ⁴ (23 057 billion tonnes Reserves + Resources ^a)	35	7 378 159	20 – 1 700	
4	Phosphate	1635 ⁵ (300 billion tonnes ^x)	57	13 941 025	10 – 3 033	P, S, F, REE, U
5	Black shale		50	20 962 042	17 - 1200	Ni, Co, Cu, U
6	Heavy mineral sands		77 ⁷			REE, Ti, Th, Zr, Sn
7	Lignite-coal ash	21 billion tonnes ⁸				Ge, U
8	Mine tailings		8 ⁹	250 000	30 - 80	U, Ag
9	Mine wastes					U
10	Mine water					U
11	Phosphogypsum	2.6 – 3.7 billion tonnes ¹⁰				REE, F, S, U
12	Metal slags					Sn, Nb-Ta slags with U
13	Sea water			4 500 000 000	3.3 ppb	Multiple elements, U
Total (excluding seawater)				45 621 772		

Assessing comprehensive extraction



UNFC can have many dimensions beyond what is obvious

- International best practice for sustainable management of resources
- Standard for reporting base-line data on natural resources
- Tool for managing mineral resources required for food production
- Interconnected tool to manage impact on water systems
- Unified management system for all energy resources
- Value-addition possibilities can be quantified
- Issues related to environmental impact and mitigation can be assessed
- Sustainability reporting can be linked to UNFC-2009
- Promotes multi-stake holder global partnership
- Provides a frame-work for high-quality data for monitoring progress



Thank you

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