Application of UNFC-2009 to Nuclear Fuel Resources

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International Atomic Energy Agency

Working Group on Nuclear Fuel Resources

- First Consultancy meeting 4-5 April, 2011
- Second Consultancy meeting, 30 April – 1 May, 2012
- Third Consultancy meeting, 22-23 April, 2013
- Final Draft Submitted to EGRC Bureau / TAG – 18 February, 2014

Task Force on Nuclear Fuel Resources

- **Australia – Ian Lambert, Yanis Miezitis, Leesa Carson**
- **Brazil / CYTED - Roberto C. Villas-Bôas**
- **China - Mingkuan Qin, Shengxiang Li**
- **India - Prem Ballabh Maithani, Prathap Singh Parihar**
- **Kazakhstan – Ayim Mukusheva, A Marat**
- **Portugal - Luis Martins**
- **UK – Julian Hilton**
- **USA - Bradley S. Van Gosen**
- **CRIRSCO - Ferdi Camisani, Paul Bankes**
- **OECD-NEA - Robert Vance**
- **UNECE Experts Group - Michael Lynch-Bell, James (Jim) Ross, David MacDonald, Charlotte Griffiths**
- **IAEA – Adrienne Hanly, Hari Tulsidas (Chair)**

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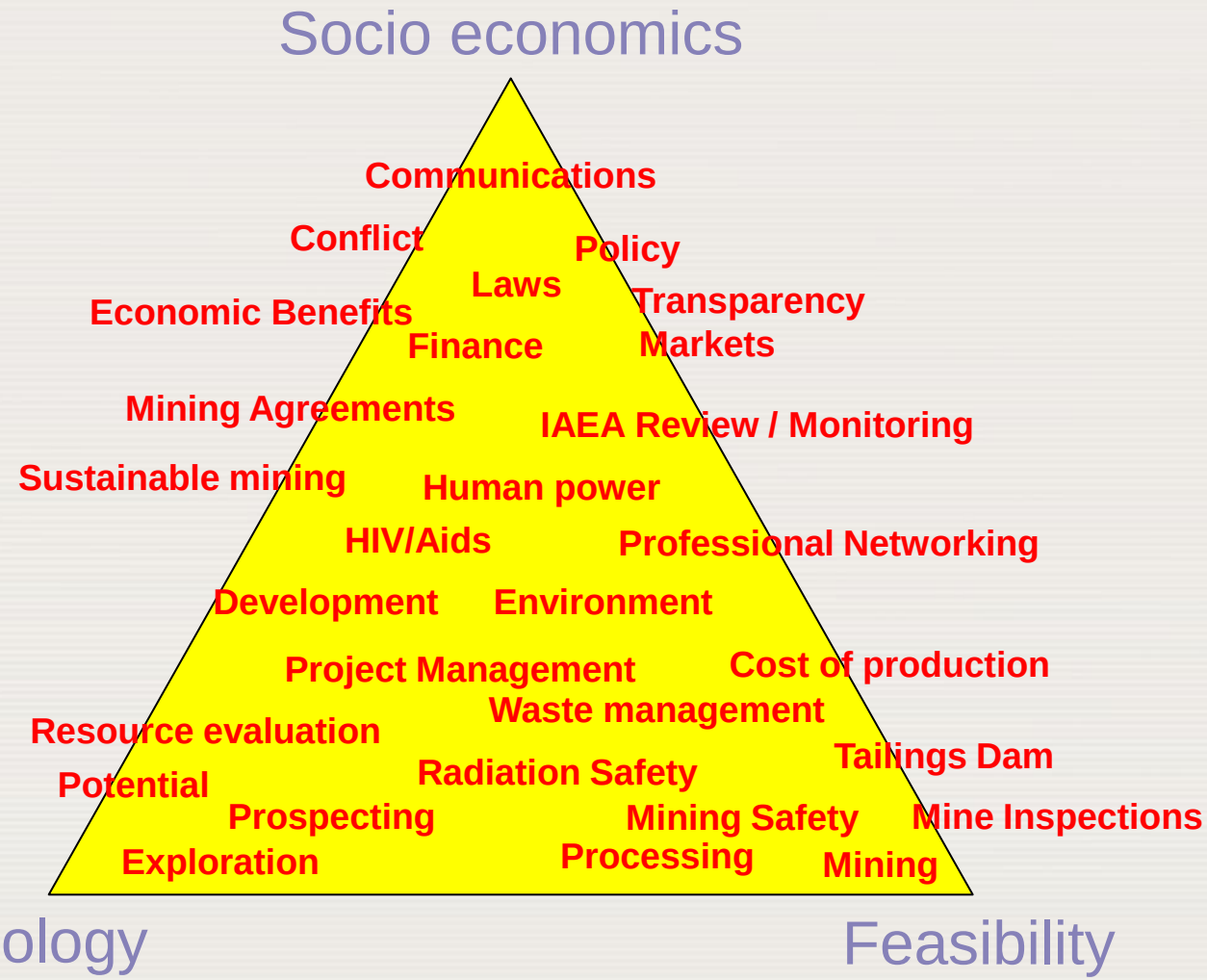
Top Priorities



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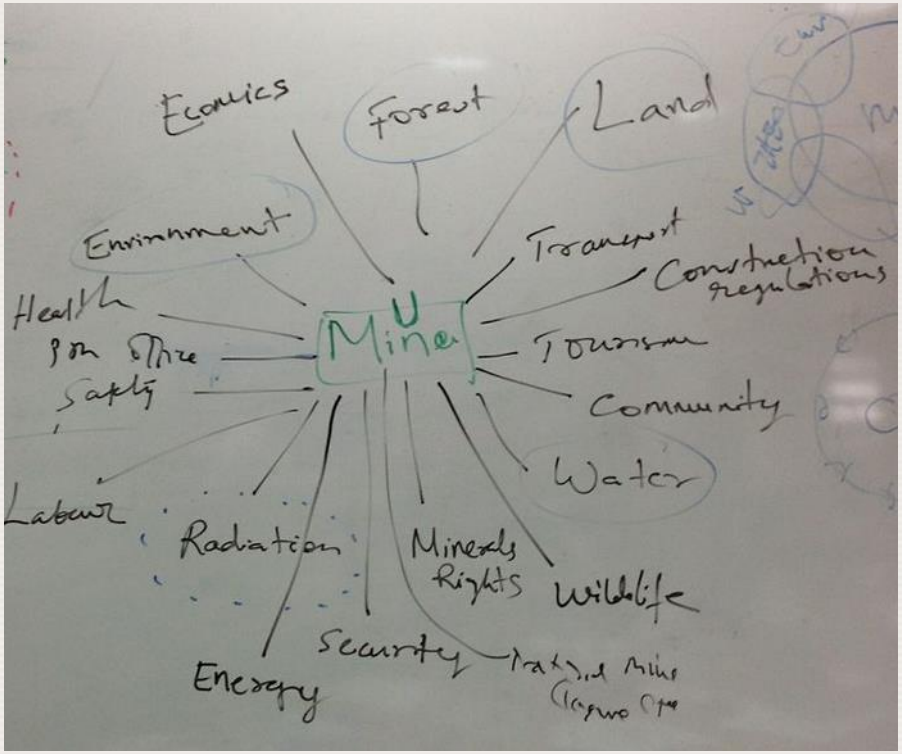
Talking a common language ?

Photo H Tulsidas, IAEA



IAEA Uranium Production Site Assessment Team (UPSAT) reviewing the planned Mkuju River Uranium Project, Tanzania - on the edge of Selous Game Reserve and UNESCO World Heritage Site – 27 May to 5 June, 2013

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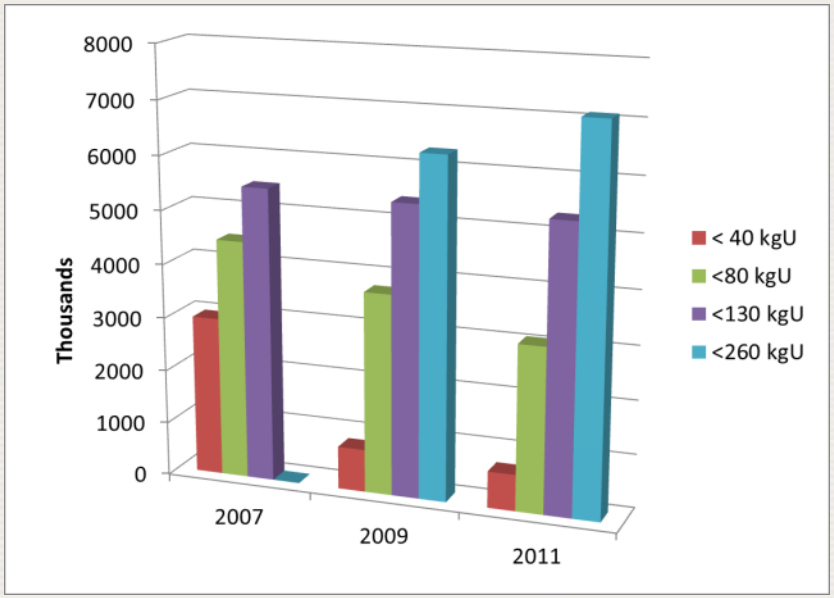
Uranium resources data

NEA/IAEA Red Book 2011



Total 7 096 600 tU

Undiscovered Resources: 10 400 000 tU

IAEA /OECD NEA Uranium 2011: Resources, Production and Demand

IAEA UDEPO

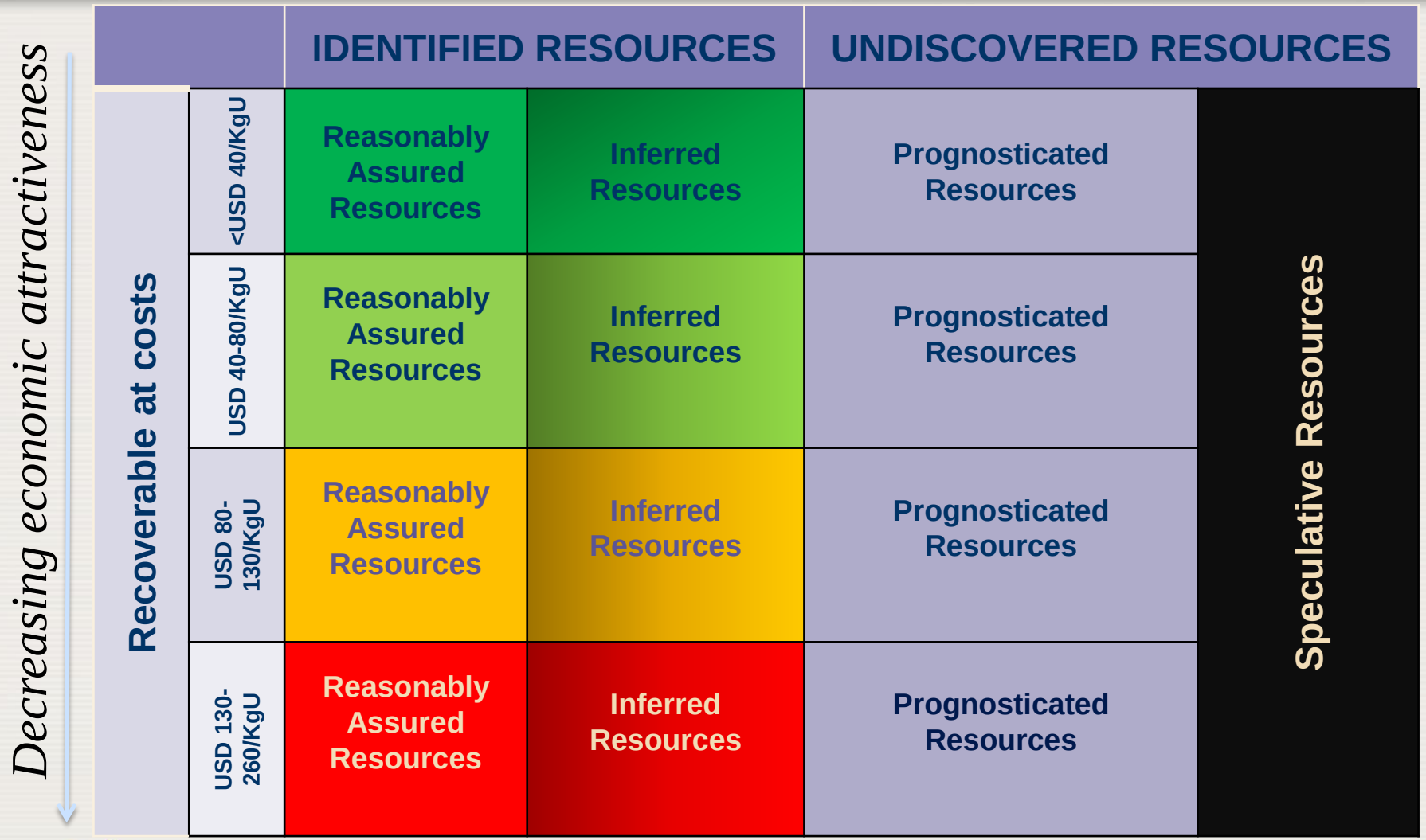
Data of 1 523 uranium deposits from 75 countries

Total Resources

Total 33 881 999 tU

http://infcis.iaea.org

NEA-IAEA Classification Scheme



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Project Maturity – The Third eye

'Red Book' Production Terminology

Existing production centres are those that **currently exist** in operational condition […]

Committed production centres are those that are either **under construction** or are firmly committed for construction.

Planned production centres are those for which **feasibility studies** are either completed or under way, but for which construction commitments have not yet been made. […]

Prospective production centres are those that could be supported by tributary RAR and Inferred, i.e., "Identified Resources", but for which construction plans have not yet been made. […]

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Example of Company Public Reporting – Rio Tinto 2012 Annual Report (available at riotinto.com; Please note Cautionary statement about Forward-looking statements provided in the report)

	Type of mine (a)	Proved ore reserves at end 2012 Tonnage	Proved ore reserves at end 2012 Grade	Probable ore reserves at end 2012 Tonnage	Probable ore reserves at end 2012 Grade	Total ore reserves 2012 compared with 2011 2012 Tonnage	2011 Tonnage	2012 Grade	2011 Grade	Average mill recovery %	Rio Tinto share Interest %	Rio Tinto share Recoverable metal
COPPER		millions of tonnes	% Cu	millions of tonnes	% Cu	millions of tonnes	millions of tonnes	% Cu	% Cu			millions of tonnes
Reserves at operating mines												
Bingham Canyon (US)												
– open pit (l)	O/P	417	0.53	287	0.44	**704**	835	**0.49**	0.48	85	100.0	2.940
– stockpiles (m)		40	0.22	41	0.34	**80**	80	**0.28**	0.22	85	100.0	0.191
Escondida (Chile)												
– sulphide (n)	O/P	2,739	0.79	2,145	0.59	**4,884**	1,993	**0.70**	0.97	84	30.0	8.672
– sulphide leach (o)	O/P	1,103	0.49	822	0.44	**1,926**	3,503	**0.47**	0.50	35	30.0	0.954
– oxide (p)	O/P	53	0.95	38	0.88	**91**	111	**0.92**	0.86	69	30.0	0.173
Grasberg (Indonesia)	O/P + U/G	800	1.15	1,624	0.93	**2,424**	2,523	**1.00**	0.97	89	(q)	6.905
Northparkes (Australia)												
– open pit and stockpiles		8.2	0.40			**8.2**	8.4	**0.40**	0.41	86	80.0	0.022
– underground	U/G			66	0.80	**66**	62	**0.80**	0.85	89	80.0	0.377
Oyu Tolgoi (Mongolia)												
– South Oyu open pit (r)	O/P	426	0.54	614	0.40	**1,040**	955	**0.46**	0.49	82	33.5	1.304
– South Oyu stockpiles (s) (r)		9.0	0.44			**9.0**	–	**0.44**	–	85	33.5	0.011
Palabora (South Africa) (t)	U/G			35	0.54	**35**	49	**0.54**	0.57	84	57.7	0.093
Total												21.642
Reserves at development projects												
Eagle (US) (u)	U/G			5.2	2.49	**5.2**	4.3	**2.49**	2.69	97	100.0	0.126
Oyu Tolgoi (Mongolia)												
– Hugo Dummett North (v)	U/G			460	1.80	**460**	410	**1.80**	1.90	92	33.5	2.550
– Hugo Dummett North Extension (w)	U/G			31	1.73	**31**	27	**1.73**	1.85	92	30.5	0.151
Total												2.826

Example of Country Reporting – Canada, "Red Book", 2011

	Centre #1	Centre #2	Centre #3	Centre #4	Centre #5	Centre #6	Centre #7
Name of production centre	McArthur River /Key Lake	McClean Lake	Rabbit Lake	Cigar Lake	Midwest	Millennium	Kiggavik
Production centre classification	Existing	Existing	Existing	Committed	Planned	Planned	Planned
Start-up date	1999/1983	1999	1975	2013	NA	NA	NA
Source of ore:							
Deposit name(s)	P2N et al.	JEB, McClean, Sue A-E, Caribou	Eagle Point	Cigar Lake	Midwest	Millennium	Kiggavik, Andrew Lake, End Grid
Deposit type(s)	Unconformity	Unconformity	Unconformity	Unconformity	Unconformity	Unconformity	Unconformity
Resources	135 500 tU	4 400 tU	11 300 tU	81 000 tU	13 300 tU	19 600 tU	44 000 tU
Grade (% U)	12.2	1.96	0.61	14.0	4.68	3.8	0.47
Mining operation:							
Type (OP/UG/ISL)	UG	OP/UG	UG	UG	OP	UG	OP/UG
Size (tonnes ore/day)	NA	NA	NA	~200	NA	~500	~1 500
Average mining recovery (%)	NA	NA	NA	NA	NA	NA	NA

Attempting alignment

UNFC Class	Sub-class	E	F	G	Status	Description
Commercial Projects	On Production	1	1.1	1,2	Existing	Extraction taking place
	Approved for development	1	1.2	1,2	Committed	Funds committed and implementation under way
	Justified for development	1	1.3	1,2	Planned	Detailed feasibility studies completed
Potentially commercial projects	Development Pending	2	2.1	1,2,3	Prospective	Project activities ongoing to justify development in foreseeable future
	Development on hold	2	2.2	1,2,3		Project activities on hold; may be subject to significant delay
Non-commercial projects	Development Unclarified	3.2	2.2	1,2,3		Economic viability cannot be determined due to insufficient information
	Development not Viable	3.3	2.3	1,2,3		No reasonable prospects for economic extraction in foreseeable future
Exploration projects		3.2	3.1	4.1	Prognostic.	Based primarily on indirect data in well defined trends
		3.2	3.2, 3.3	4.2, 4.3	Speculative	Based primarily on indirect data

Bridging document

- Bridging Documents explain the relationship between UNFC-2009 and another classification system
- Bridging Document between NEA/IAEA Classification and UNFC-2009 prepared after wide consultation and preliminary testing
- Also in alignment with solid mineral CRIRSCO specifications in general.

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 Unclarified	3.2	2.2	1,2,3	Unclarified	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

E- F Matrix

	F1.1	F1.2	F1.3	F2.1	F2.2	F2.3	F3.1	F3.2	F3.3	F4
E1.1	1	2	3	4						
E1.2	1	2	3							
E2			4	4	5					
E3.1										
E3.2				6	6		8	9	9	
E3.3					7	7				11

E and F Categories set minimum standards for the UNFC-2009 Classes.

NEA/IAEA Classification	NEA/IAEA Classification	NEA/IAEA Production Terminology	UNFC-2009 Sub-classes	Mapping
Identified Resources	Reasonably Assured Resources	Existing	On Production	1
		Committed	Approved for Development	2
		Planned	Justified for Development	3
	Reasonably Assured Resources + Inferred Resources	Prospective	Development Pending	4
			Development on Hold	5
		Unclarified	Development Unclarified	6
		Not Viable	Development Not Viable	7
			Unrecoverable	11
Undiscovered Resources	Prognosticated Resources			8
	Speculative Resources			9
			Unrecoverable	11
			Less Common Mappings	

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Changes suggested

- Add a short glossary explaining “Red Book” terms
- Develop a Guidebook on “Application of United Nations Framework Classification – 2009 for uranium and thorium projects”.

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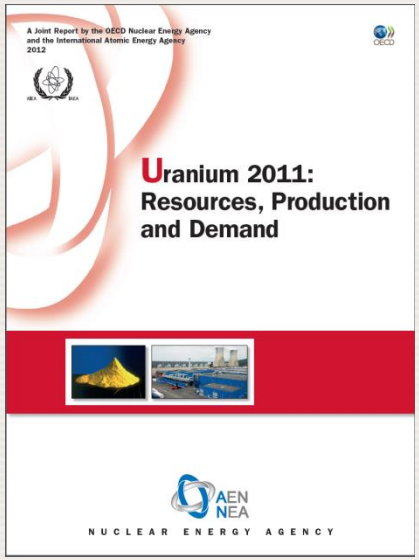
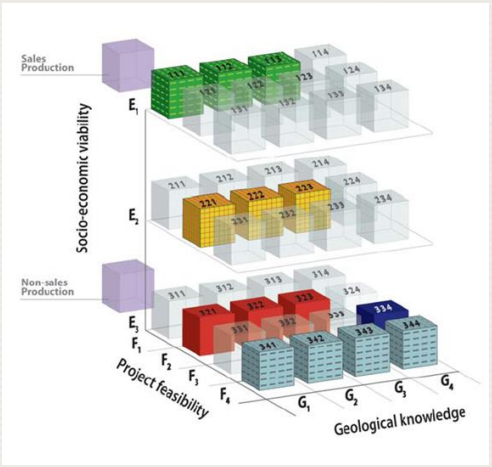
Transferring volumes

NEA/IAEA Red Book System

UNFC-2009





Bridging document will aid transfer of resources reported in Red Book system to UNFC-2009 or vice-versa

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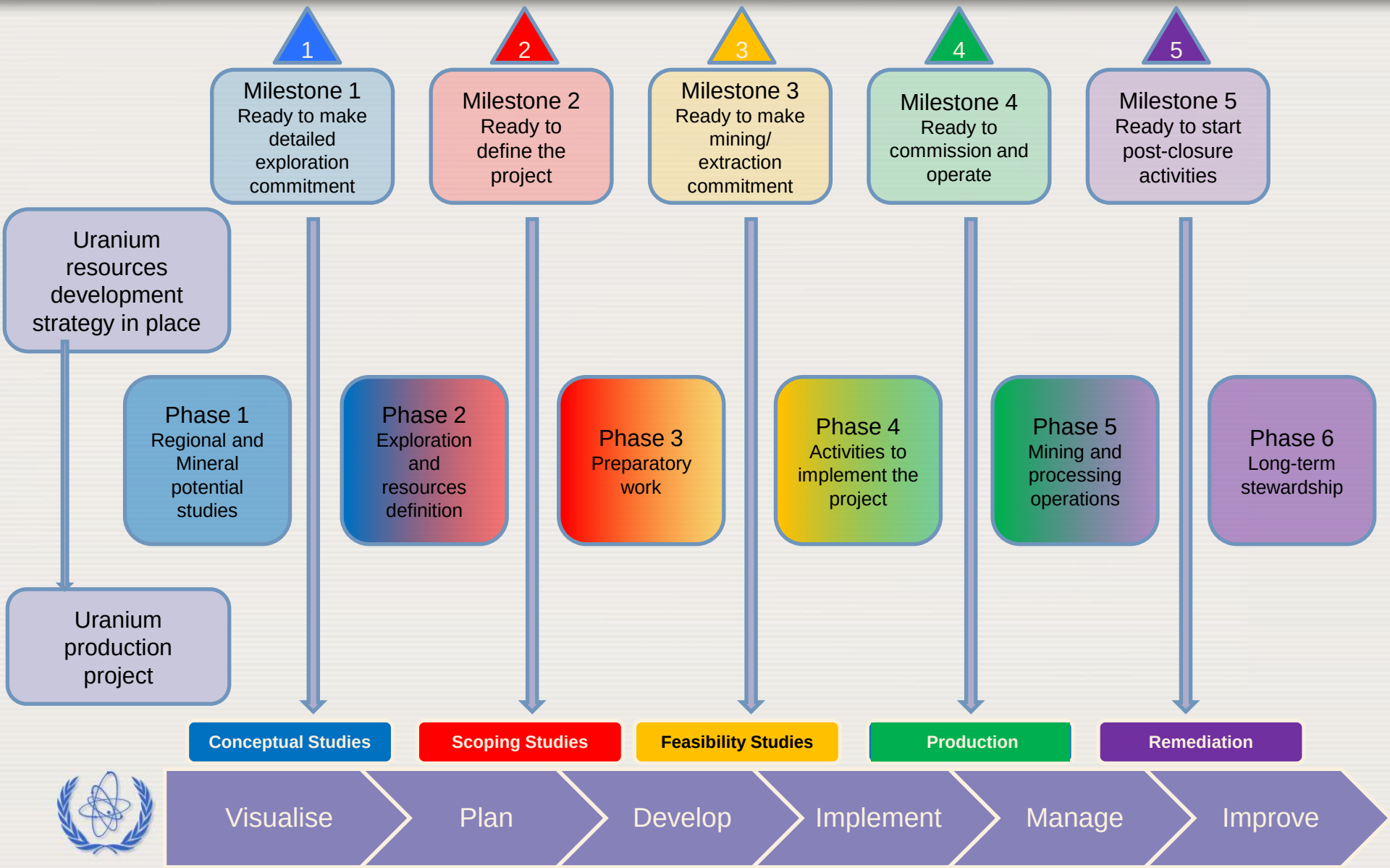
Key milestones in U/Th production cycle



Thank you

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