# Application of United Nations Framework Classification – 2009 (UNFC-2009) to nuclear fuel resources

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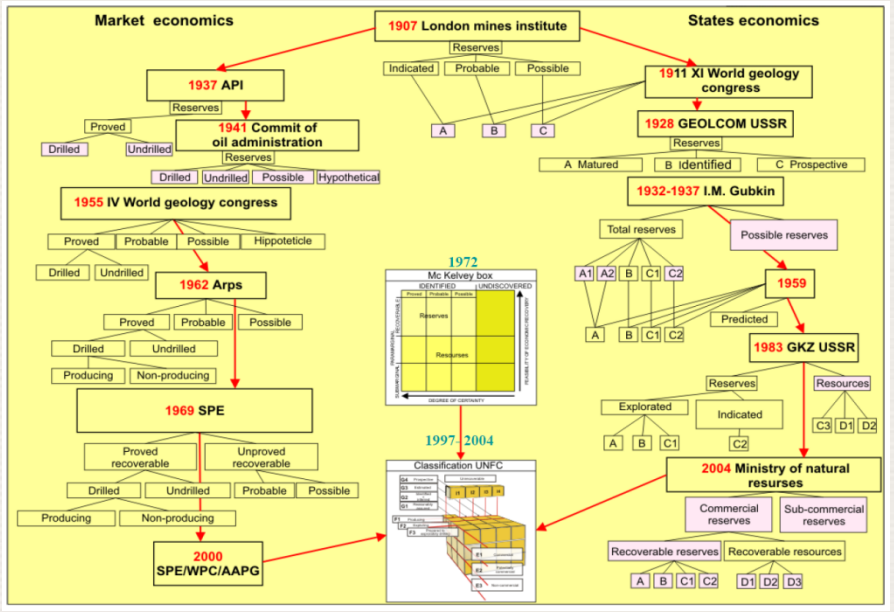
# Modern Definition Attempts

- 1927 – Russian System
- 1976 – USGS Bulletin 1450-A (Precursor to modern codes)
- 1989 - JORC Code (revised 1992, 1996, 2004 and 2012)
- 1992 – First version of UNFC
- 1994 – Council of Mining and Metallurgical Institutions (CMMI) Committee (SME, AusIIM, CIM, IMMM, SAIMM)
- 1997 – “Denver Accord” for standard definitions
- 1999 – MoU between CMMI and UNFC
- 2000 – CIM Standards (Revised 2004, 2010)
- 2002 – CMMI disbanded; Committee for Mineral Reserves International Reporting Standards (CRIRSCO) a separate entity with support of International Council of Mining and Metals (ICMM)
- 2006 – CRIRSCO Template (revised 2013)
- 2010 – Russian system mapped to CRIRSCO
- 2013 – UNFC-2009 adopts CRIRSCO Template as its solid mineral specifications

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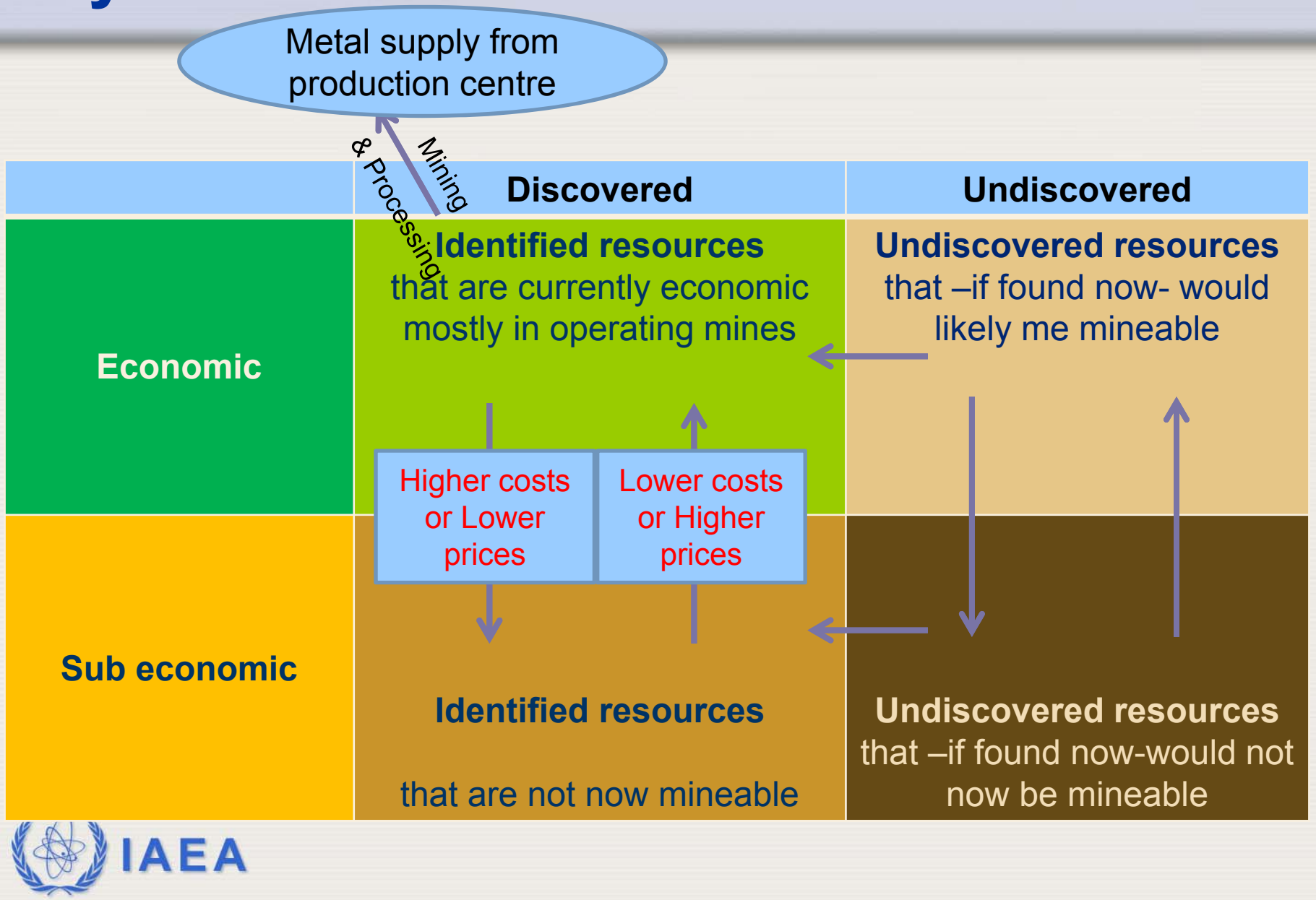
# Dynamic Flow of 'resources'

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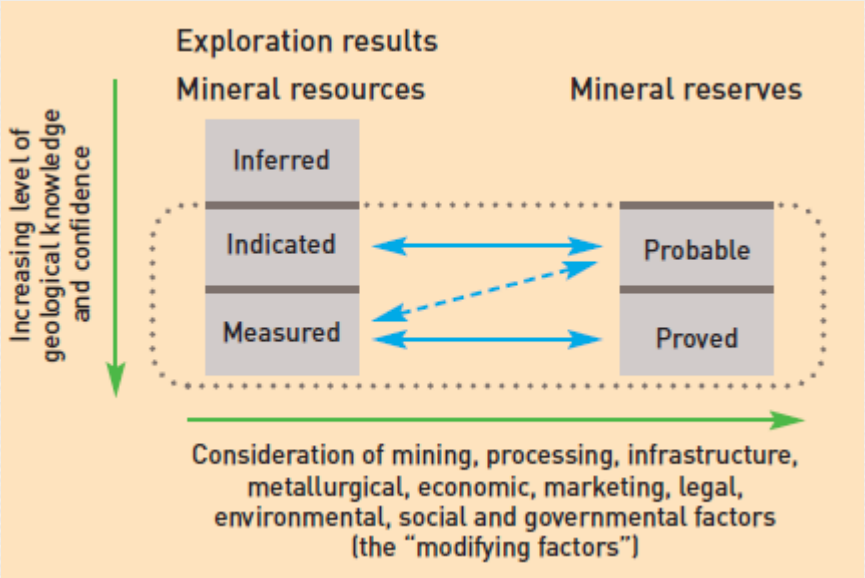
# Company public reporting

- CRIRSCO - Committee for Mineral Reserves International Reporting Standards
- Mineral reporting codes and guidelines in
  - Australasia (**JORC**)
  - Canada (**CIM**)
  - Chile (**National Committee**)
  - Europe (**National Committee PERC**)
  - Russia (NAEN)
  - South Africa (**SAMREC**)
  - USA (**SME**)



# Project maturity in public reporting

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 | | Probable ore reserves at end 2012 | | Total ore reserves 2012 compared with 2011 | | | | Average mill recovery % | Rio Tinto share | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Tonnage | Grade | Tonnage | Grade | | Tonnage | | Grade | | Interest % | Recoverable metal |
| | | | | | | 2012 | 2011 | 2012 | 2011 | | | |
| 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 |

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# National approaches to reporting

**Example Geoscience Australia**

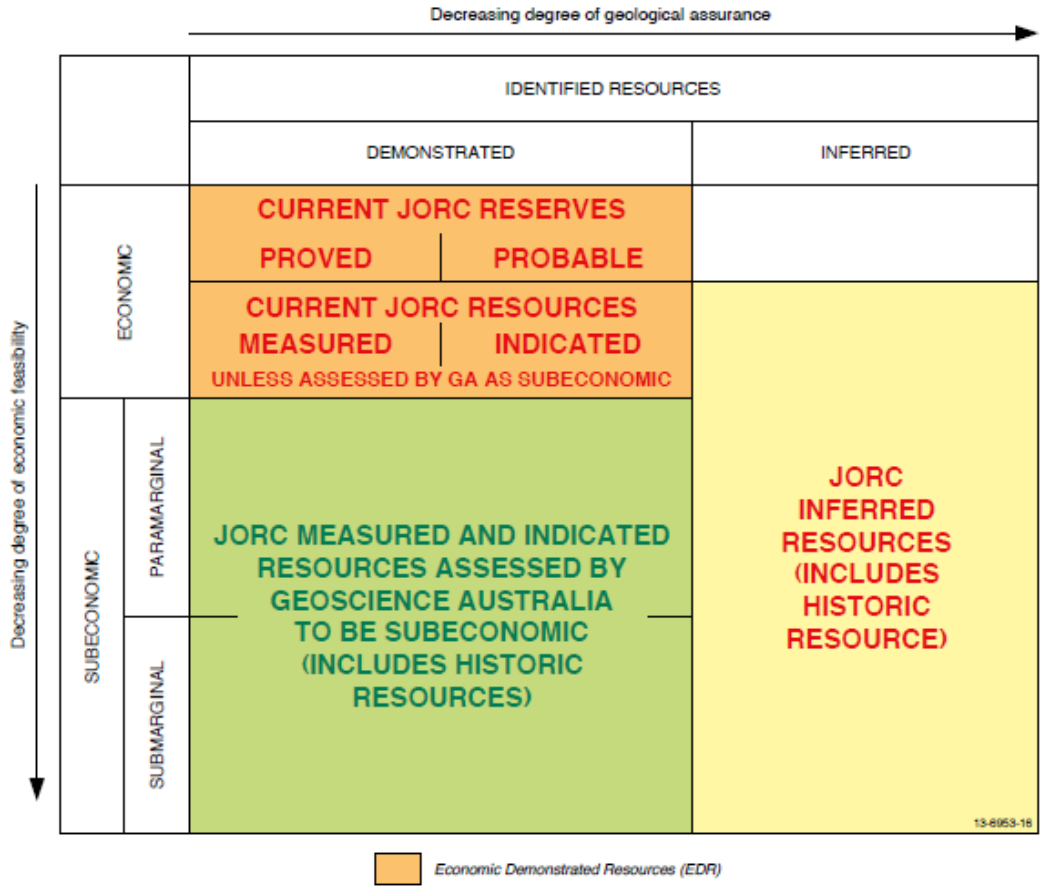


**Figure A2.** Correlation of JORC Code mineral resource categories with Australia's national mineral resource classification system.

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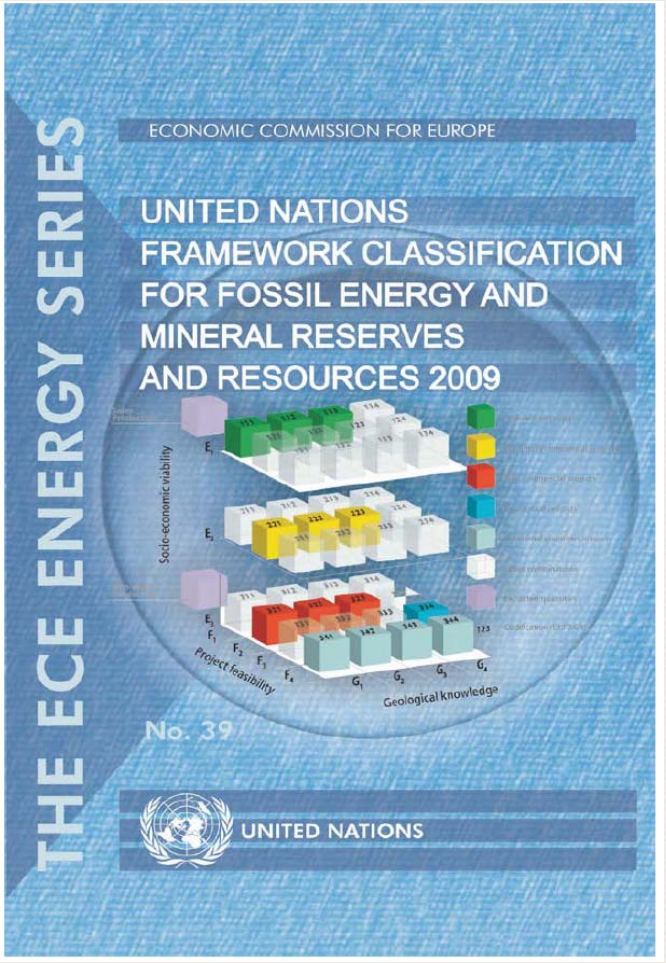
# UNFC 2009 Resource Classification

- United Nations Framework Classification for Fossil Fuel and Mineral Reserves and Resources 2009
- Generic, principles-based system
  - Applicable to both solid minerals and fluids
- Applications in
  - International energy studies
  - National resource reporting
  - Company project management
  - Financial reporting
- 3-D classification of resources on the basis of:
  - Socio-economic criteria (E)
  - Project maturity (technical feasibility) (F)
  - Geological knowledge (G)
- A key goal of UNFC-2009 is to provide a tool to facilitate global communications
  - Uses a numerical coding system
  - Language independent reporting

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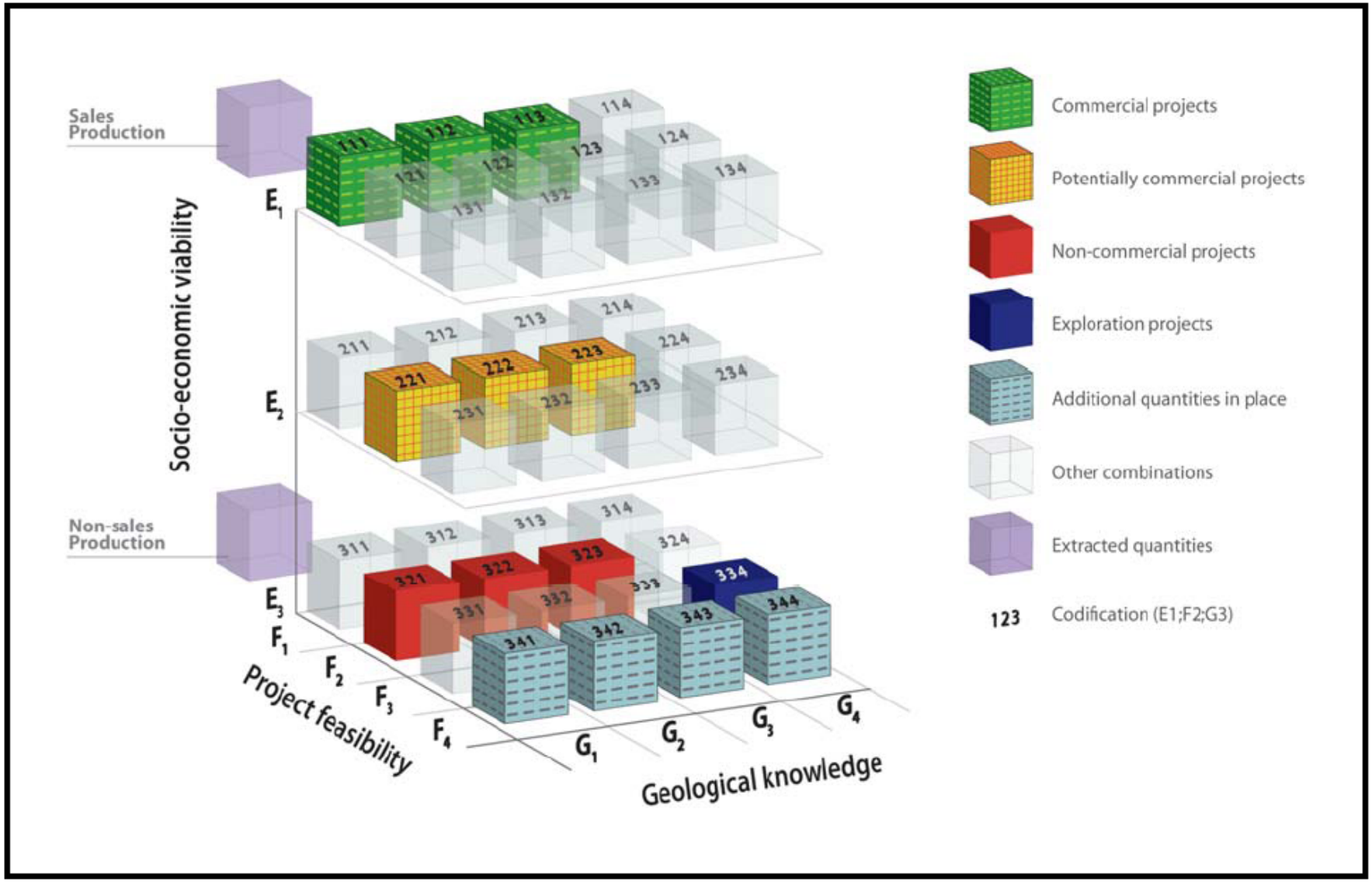
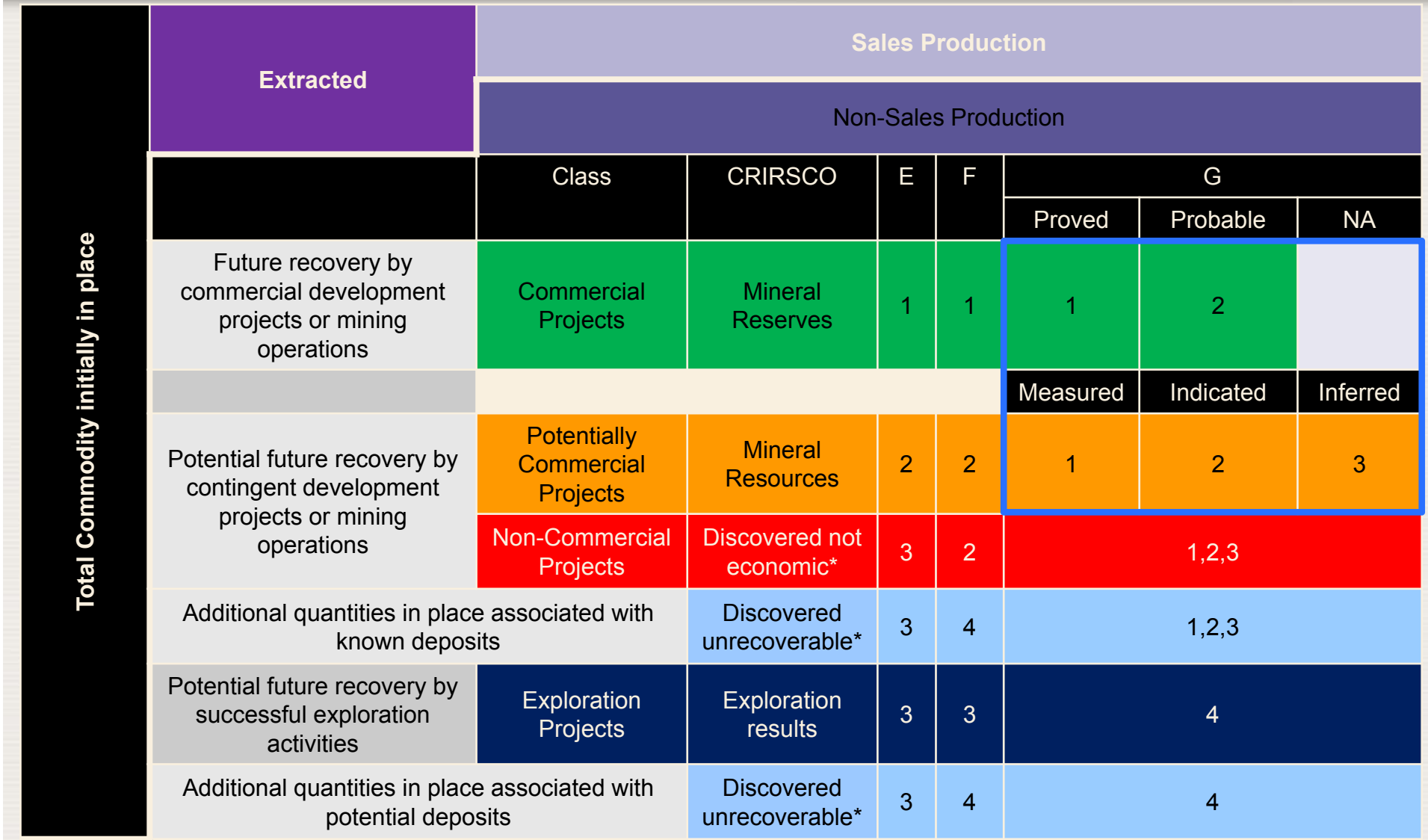
# UNFC 2009 Resource Classification



# UNFC 2009 Classification (Detailed)

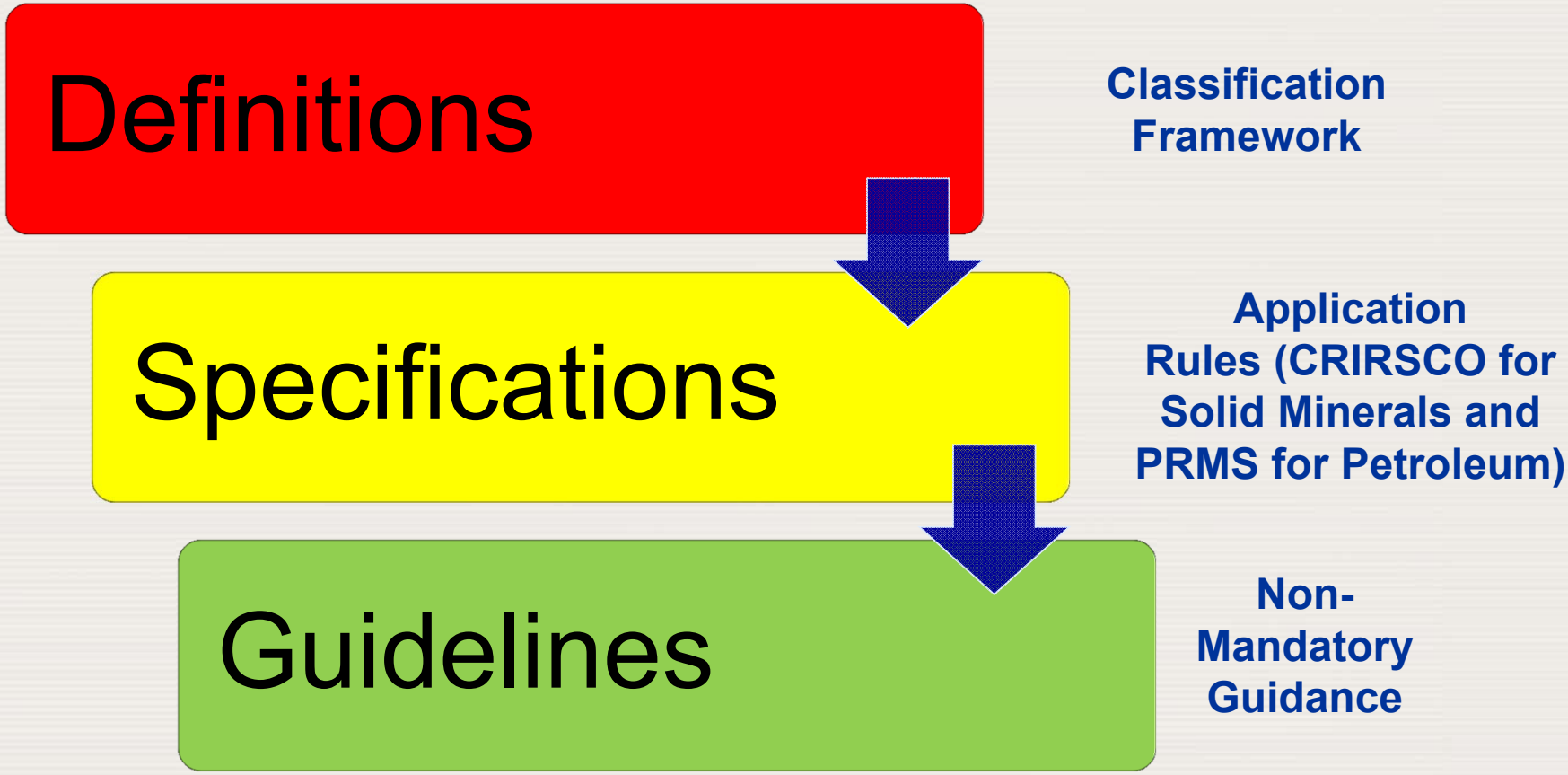
| Total Commodity initially in place | Extracted | Sales Production / Non-Sales Production | Class | Sub-class | Categories E | Categories F | Categories G |
|---|---|---|---|---|---|---|---|
| | Future recovery by commercial development projects or mining operations | | Commercial Projects | On Production | 1 | 1.1 | 1,2,3 |
| | | | | Approved for development | 1 | 1.2 | 1,2,3 |
| | | | | Justified for development | 1 | 1.3 | 1,2,3 |
| | Potential future recovery by contingent development projects or mining operations | | Potentially Commercial Projects | Development Pending | 2 | 2.1 | 1,2,3 |
| | | | | Development on hold | 2 | 2.2 | 1,2,3 |
| | | | Non-Commercial Projects | Development Unclarified | 3.2 | 2.3 | 1,2,3 |
| | | | | Development not Viable | 3.3 | 2.3 | 1,2,3 |
| | Additional quantities in place associated with known deposits | | | | 3.3 | 4 | 1,2,3 |
| | Potential future recovery by successful exploration activities | | Exploration Projects | | 3.2 | 3 | 4 |
| | Additional quantities in place associated with potential deposits | | | | 3.3 | 4 | 4 |

# Mapping of UNFC to CRIRSCO




* *Not part of CRIRSCO template, but may be used for internal project management*

# UNFC-2009 Hierarchy




Classification Framework

Application Rules (CRIRSCO for Solid Minerals and PRMS for Petroleum)

Non-Mandatory Guidance

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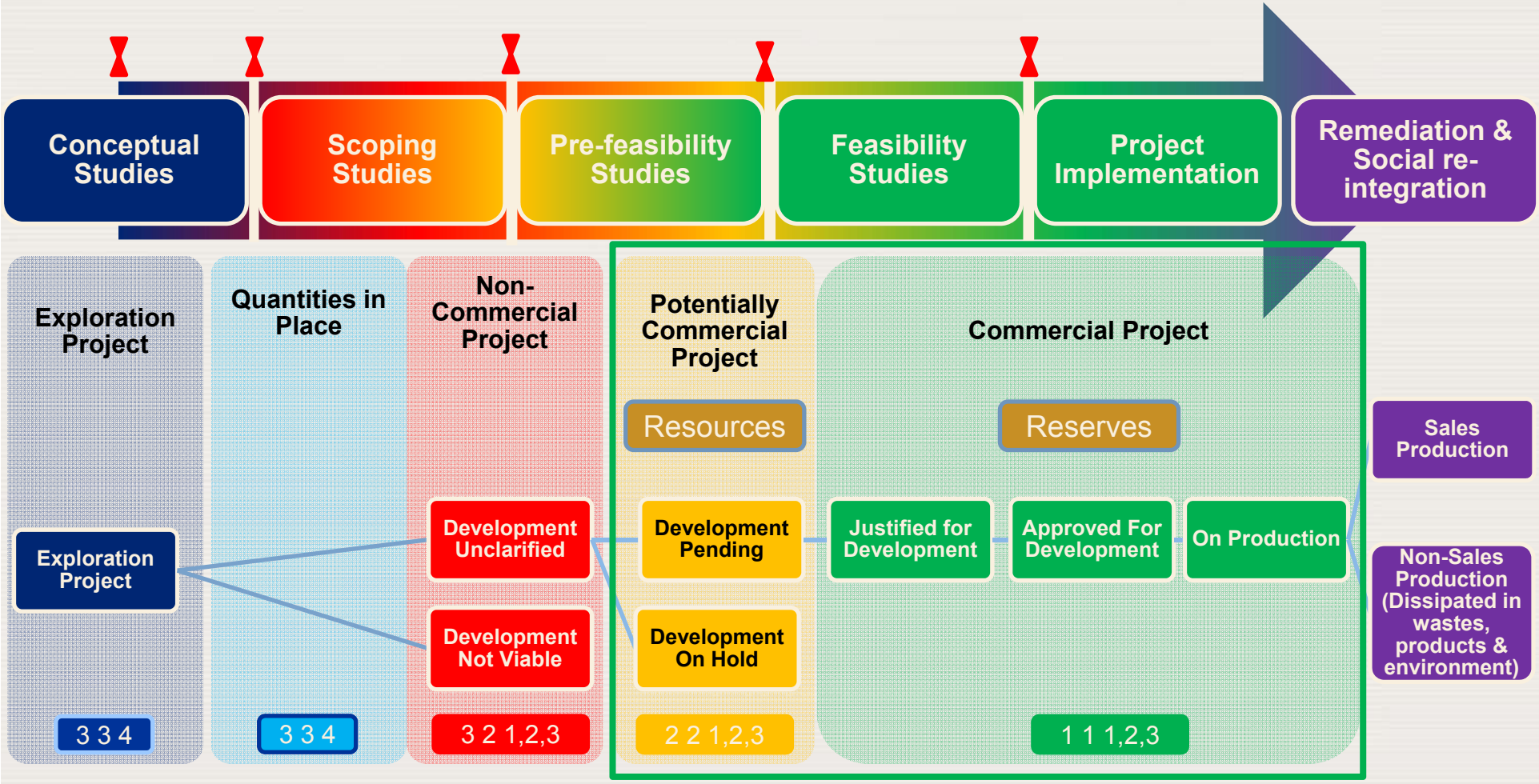
# U mining lifecycle and resources




Accurate and transparent management of essential materials throughout the lifecycle

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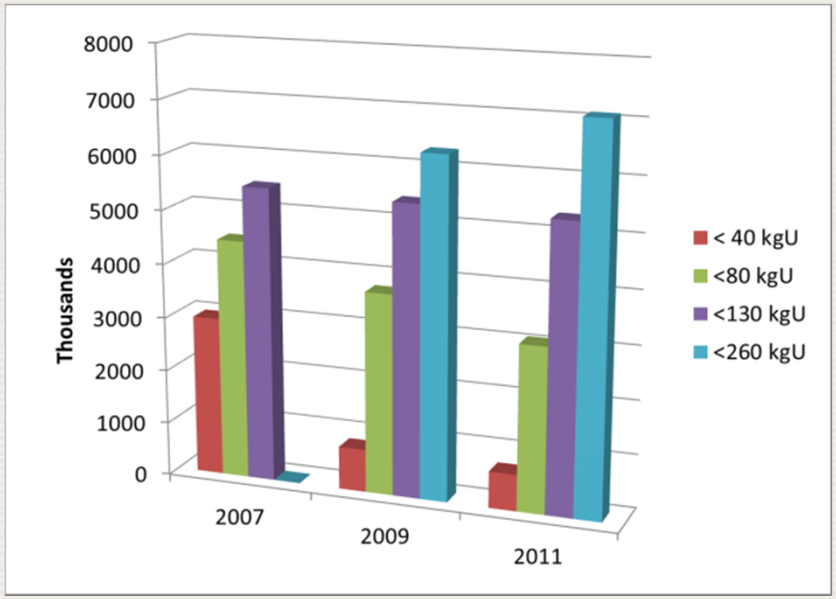
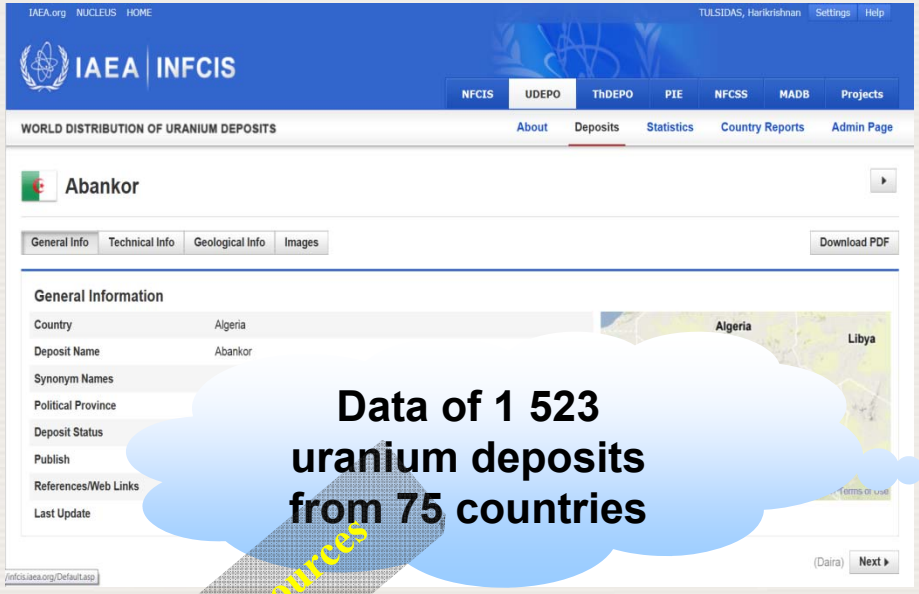
# Uranium resources data

## NEA/IAEA Red Book 2011




**Total 7 096 600 tU**

## IAEA UDEPO




**Data of 1 523 uranium deposits from 75 countries**

**Total Resources**

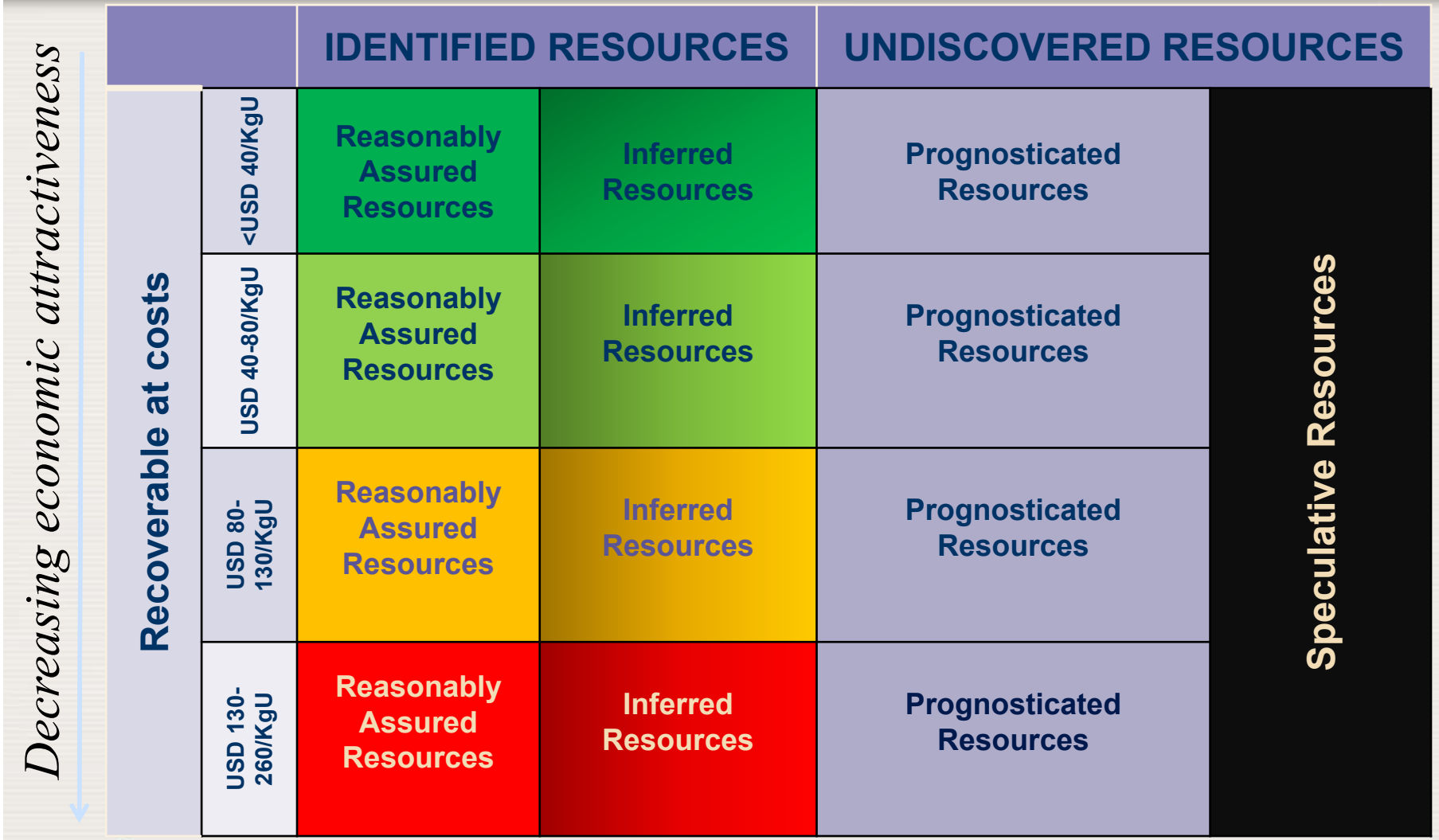
**Total 33 881 999 tU**

**Undiscovered Resources: 10 400 000 tU**

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

**http://infcis.iaea.org**

# NEA-IAEA Classification Scheme



# Production terminology

- **Production centres -** a production unit consisting of one or more ore processing plants, one or more associated mines and uranium resources that are tributary to these facilities.
  - **Existing** production centres are those that currently exist in operational condition and include those plants which are closed down but which could be readily brought back into operation.
  - **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. This class also includes those plants that are closed which would require substantial expenditures to bring them back into operation.
  - **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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# 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.

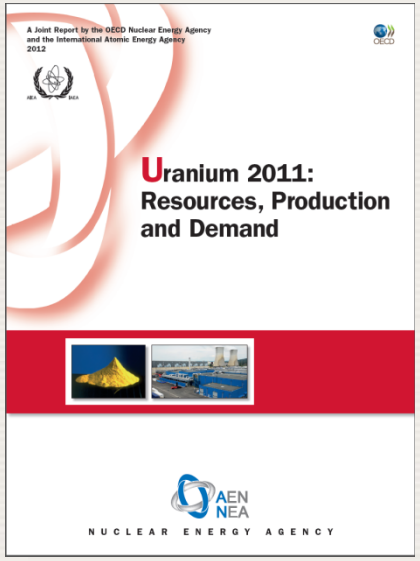
| UNFC Classification | | | | | NEA/IAEA Classification | |
|---|---|---|---|---|---|---|
| UNFC Classes and Sub-classes | | UNFC Categories | | | | |
| Class | Sub-Class | E | F | G | Status | IAEA-NEA Categories |
| Commercial Projects | On Production | 1 | 1.1 | 1,2 | Existing | Reasonably Assured 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 |

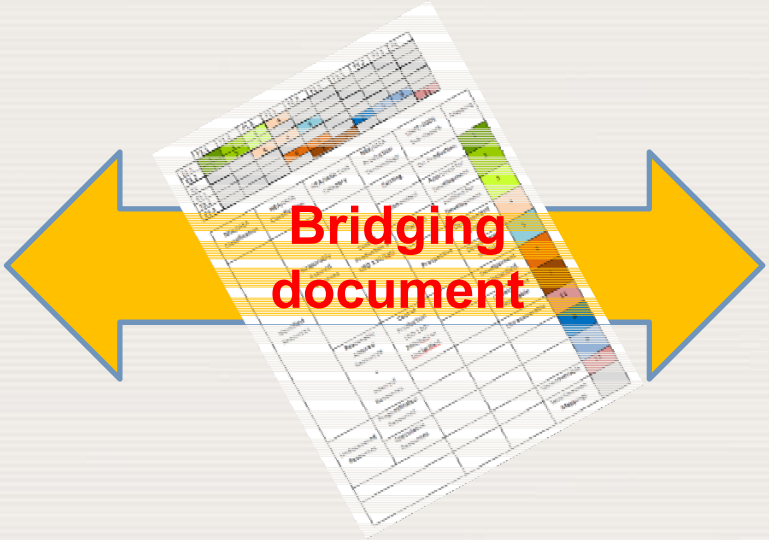
*Inferred Resources

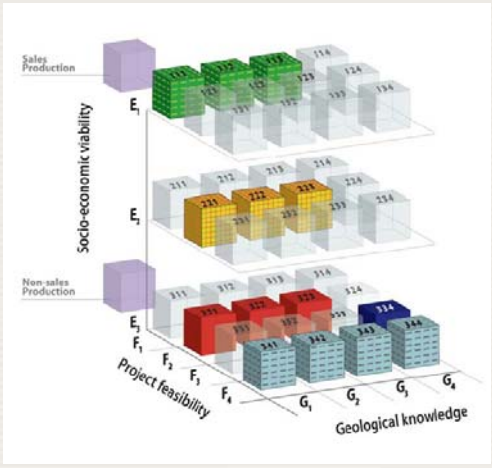
# Transferring volumes

**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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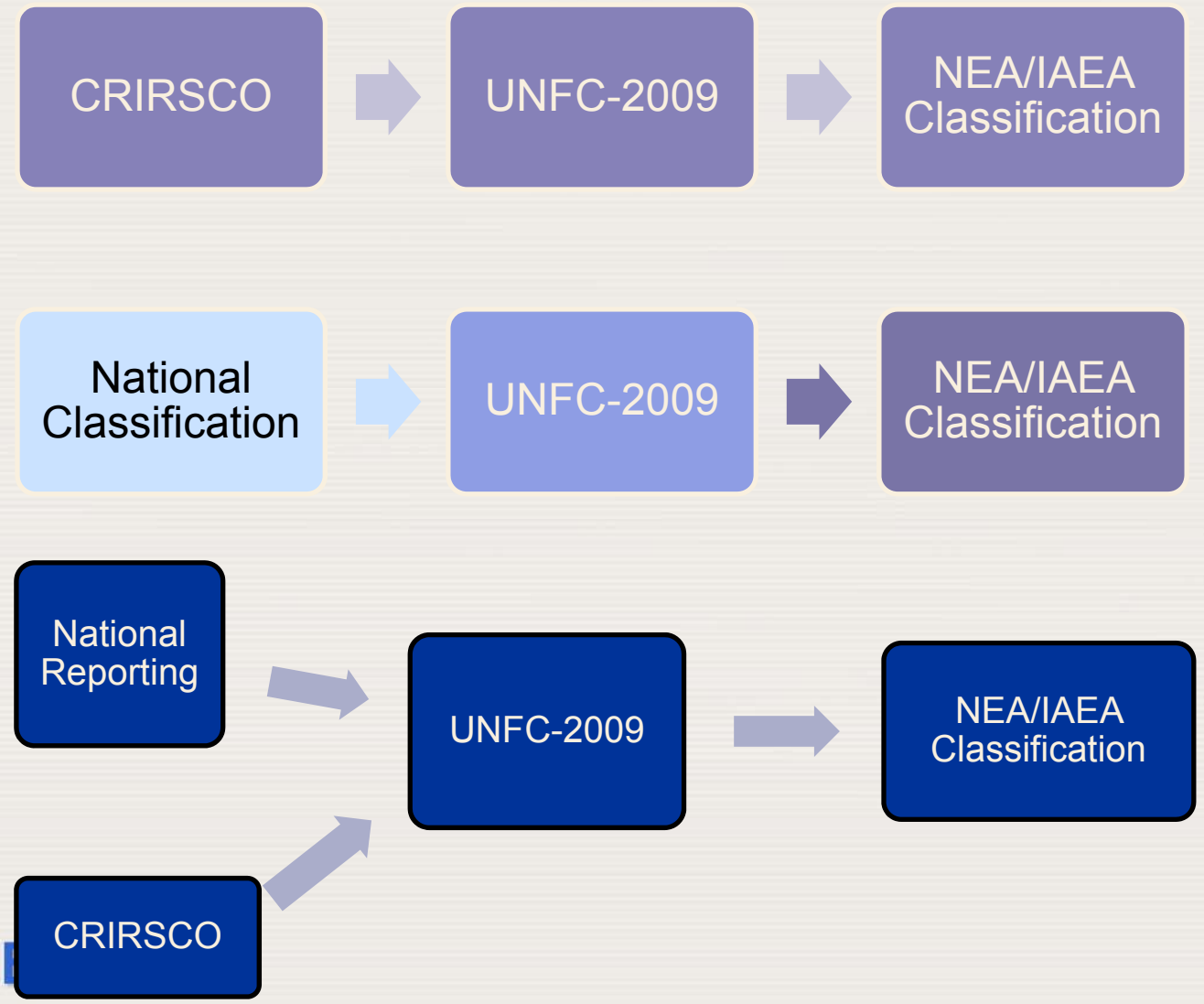
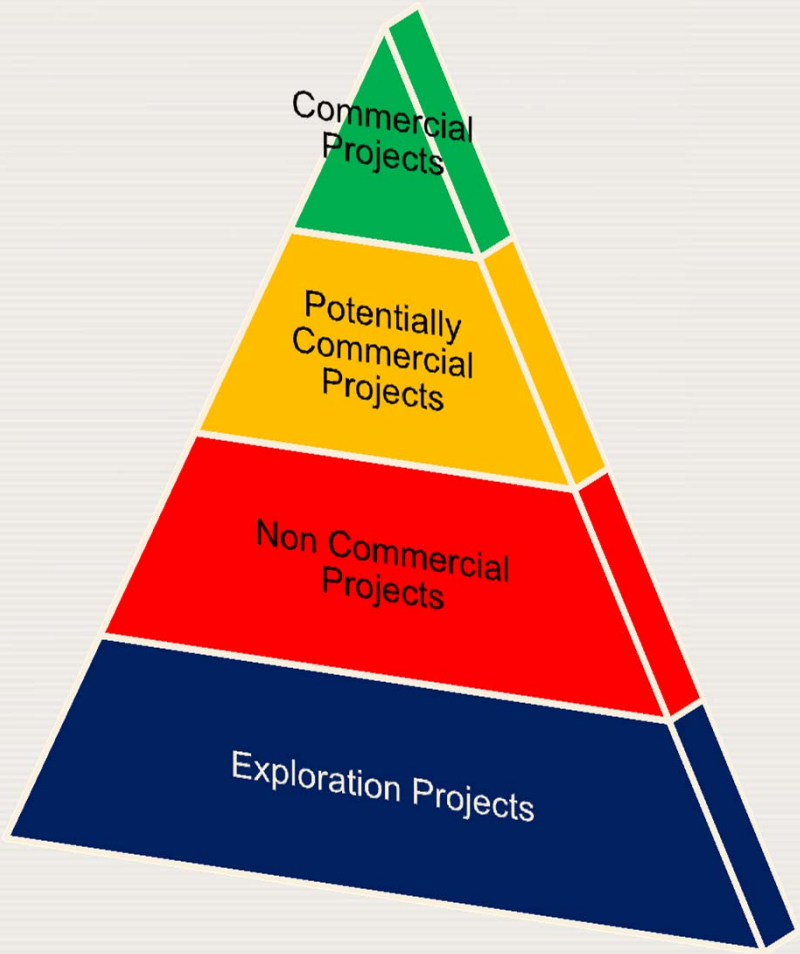
# Workflows in national reporting



# Takeaway messages

1. Use UNFC-2009 to report uranium and thorium resources **alongside other energy and other mineral resources**
2. **'Technical feasibility'** axis is unique to UNFC-2009, and is applicable throughout the exploration – mining lifecycle
3. Use UNFC-2009 to classify **'comprehensive extraction'** projects
4. UNFC-2009 to study the potential of **'energy basins'** and in its synergistic development
5. UNFC-2009 can aid **stakeholder engagement.**

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# Thank you

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