# United Nations Framework Classification

# Red Book Classification

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## Why UNFC-2009 ?

The principal objective of UNFC-2009 is to enhance international communication by providing a generic classification framework for the reporting of fossil energy and mineral reserves and resources, even though such estimates may have been generated using classification or reporting systems that:

(i) may use different terminology for comparable estimates, or the same terminology with different meanings;

(ii) incorporate application guidelines that are commodity specific;

(iii) may reflect the extraction of solids by mining or the production of fluids through wells.

UNFC-2009 has been developed to meet, to the extent possible, the needs of applications pertaining to international energy and mineral studies, government resource management functions, corporate business processes and financial reporting standards.

## Why UNFC-2009 ?

A key benefit of UNFC-2009 is the potential to provide a common basis for the minerals and petroleum sectors, whose classification systems have been developed primarily for the mining of solids and the production of fluids respectively, but which now must address the increasing overlap between the two extractive industries.

Examples of this overlap include the mining of natural bitumen or coal for processing into synthetic oil or gas, and the production of minerals as fluids, such as the **in-situ leaching of uranium** and production of salt/potash from sub-surface brines in salt lakes.

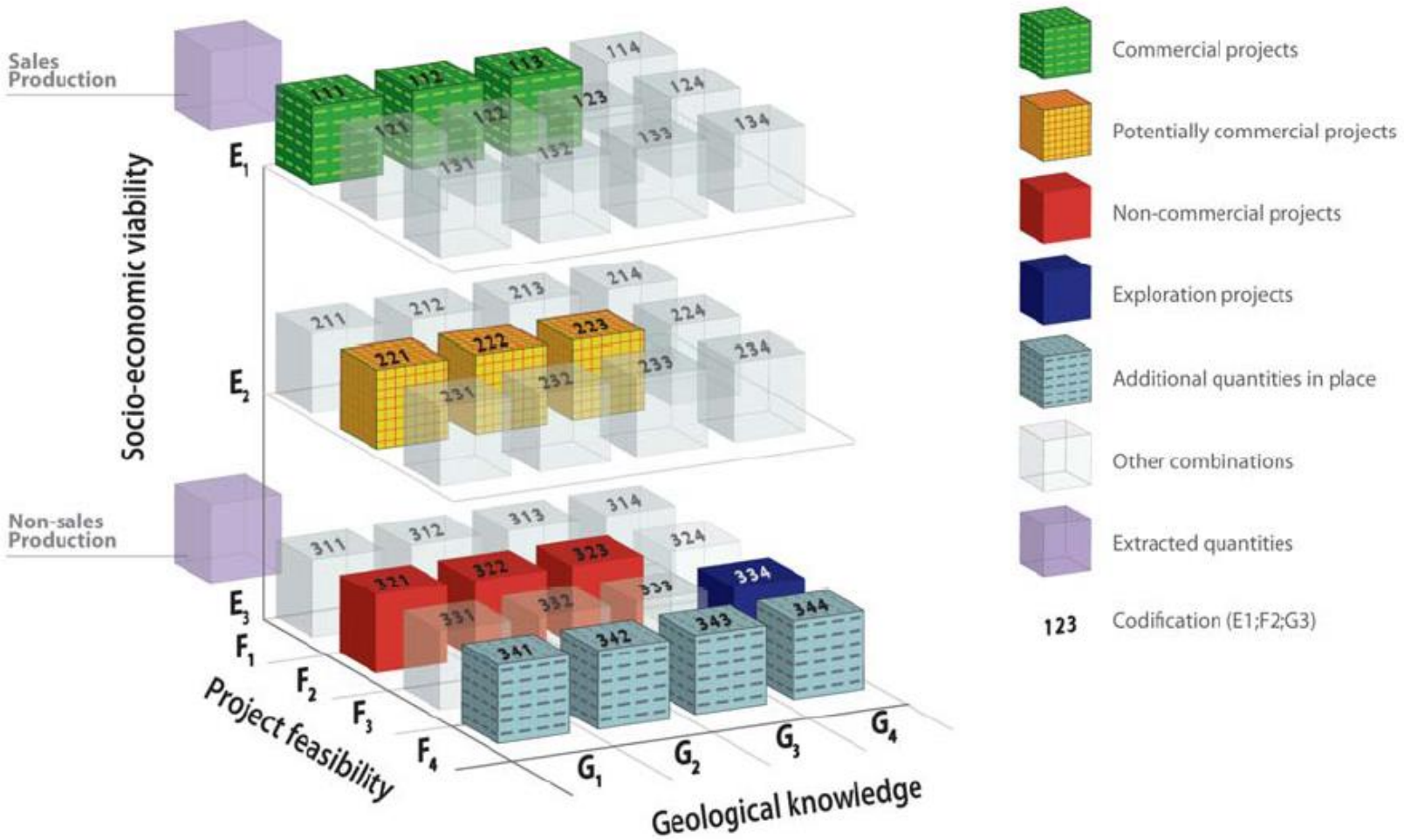
UNFC-2009 is a generic principle-based system in which quantities are classified on the basis of the three fundamental criteria of:

- economic and social viability (E),

- field project status and feasibility (F),

- geological knowledge (G),

using a numerical and language independent coding scheme.


Sales Production
Non-sales Production
Socio-economic viability
E1
E2
E3
F1
F2
F3
F4
Project feasibility
G1
G2
G3
G4
Geological knowledge
111
112
113
114
121
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341
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343
344
Commercial projects
Potentially commercial projects
Non-commercial projects
Exploration projects
Additional quantities in place
Other combinations
Extracted quantities
123 Codification (E1;F2;G3)

## UNFC-2009

The first set of categories (the E axis) designates the degree of favourability of social and economic conditions in establishing the commercial viability of the project, including consideration of market prices and relevant legal, regulatory, environmental and contractual conditions

## UNFC-2009

The second set (the F axis) designates the 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, and reflect standard value chain management principles.

## UNFC-2009

The third set of categories (the G axis) designates the level of confidence in the geological knowledge and potential recoverability of the quantities.

# E - Socio-economics

| Category | Definition |
|---|---|
| E 1 | Extraction and sale has been **confirmed** to be economically viable. |
| E 2 | Extraction and sale is expected to become economically viable in the **foreseeable future.** |
| E 3 | 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. |

# E - Socio-economics

| 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. |
| E2 | Extraction and sale is expected to become economically viable in the foreseeable future.[d] | Extraction and sale has not yet been confirmed to be economic but, on the basis of realistic assumptions of future market conditions, there are reasonable prospects for economic extraction and sale 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.[d] | On the basis of realistic assumptions of future market conditions, it is currently considered that there are not reasonable prospects for economic extraction and sale in the foreseeable future; or, economic viability of extraction cannot yet be determined due to insufficient information (e.g. during the exploration phase).Also included are quantities that are forecast to be extracted, but which will not be available for sale. |

# E - Sub-categories

| Sub -Category | Definition |
|---|---|
| E 1.1 | Extraction and sale is **economic** on the basis of current market conditions and realistic assumptions of future market conditions. |
| E 1.2 | Extraction and sale is not economic on the basis of current market conditions and realistic assumptions of future market conditions, but is made viable through **government subsidies and/or other considerations.** |
| E 2 | |
| E 3.1 | Quantities that are forecast to be extracted, but which will **not be available for sale.** |
| E 3.2 | Economic viability of extraction **cannot yet be determined** due to insufficient information (e.g. during the exploration phase). |
| E 3.3 | On the basis of realistic assumptions of future market conditions, it is currently considered that there are **not reasonable prospects** for economic extraction and sale in the foreseeable future. |

# F - Feasibility

| Category | Definition |
|---|---|
| F 1 | Feasibility of extraction by a defined development project or mining operation has been **confirmed.** |
| F 2 | Feasibility of extraction by a defined development project or mining operation is **subject to further evaluation.** |
| F 3 | Feasibility of extraction by a defined development project or mining operation **cannot be evaluated due to limited technical data.** |
| F 4 | **No development project or mining operation** has been identified. |

# F - Feasibility

| Category | Definition | Supporting Explanation |
|---|---|---|
| F1 | Feasibility of extraction by a defined development project or mining operation has been confirmed. | Extraction is currently taking place; or, implementation of the development project or mining operation is underway; or, sufficiently detailed studies have been completed to demonstrate the feasibility of extraction by implementing a defined development project or mining operation. |
| F2 | Feasibility of extraction by a defined development project or mining operation is subject to further evaluation. | Preliminary studies demonstrate the existence of a deposit in such form, quality and quantity that the feasibility of extraction by a defined (at least in broad terms) development project or mining operation can be evaluated. Further data acquisition and/or studies may be required to confirm the feasibility of extraction. |
| F3 | Feasibility of extraction by a defined development project or mining operation cannot be evaluated due to limited technical data. | Very preliminary studies (e.g. during the exploration phase), which may be based on a defined (at least in conceptual terms) development project or mining operation, indicate the need for further data acquisition in order to confirm the existence of a deposit in such form, quality and quantity that the feasibility of extraction can be evaluated. |
| F4 | No development project or mining operation has been identified. | In situ (in-place) quantities that will not be extracted by any currently defined development project or mining operation. |

# F – Sub-category

| Category | Definition |
|---|---|
| F 1.1 | Extraction is **currently taking place.** |
| F 1.2 | Capital funds have been **committed** and implementation of the development project or mining operation is **underway.** |
| F 1.3 | Sufficiently **detailed studies have been completed** to demonstrate the feasibility of extraction by implementing a defined development project or mining operation. |
| F 2.1 | Project activities are **ongoing** to justify development in the foreseeable future. |
| F 2.2 | Project activities are **on hold** and/or where justification as a commercial development may be **subject to significant delay.** |
| F 2.3 | There are **no current plans** to develop or to acquire additional data at the time due to limited potential. |

# G - Geology

| Category | Definition |
|---|---|
| G 1 | Quantities associated with a known deposit that can be estimated with a **high level of confidence.** |
| G 2 | Quantities associated with a known deposit that can be estimated with a **moderate level of confidence.** |
| G 3 | Quantities associated with a known deposit that can be estimated with a **low level of confidence.** |
| G 4 | Estimated quantities associated with a potential deposit, based **primarily on indirect evidence.** |

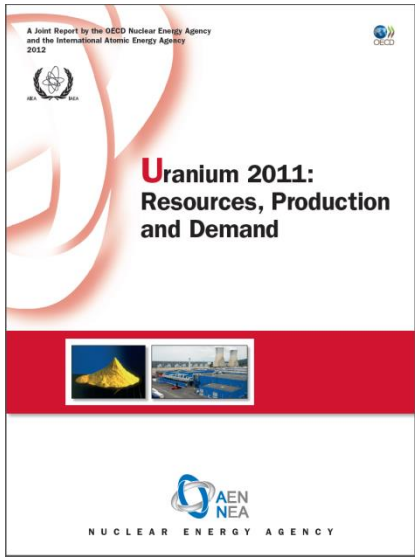
# G - Geology

| | | |
|---|---|---|
| **G1** | Quantities associated with a known deposit that can be estimated with a high level of confidence. | For in situ (in-place) quantities, and for recoverable estimates of fossil energy and mineral resources that are extracted as solids, quantities are typically categorised discretely, where each discrete estimate reflects the level of geological knowledge and confidence associated with a specific part of the deposit. The estimates are categorised as G1, G2 and/or G3 as appropriate.<br>For recoverable estimates of fossil energy and mineral resources that are extracted as fluids, their mobile nature generally precludes assigning recoverable quantities to discrete parts of an accumulation. Recoverable quantities should be evaluated on the basis of the impact of the development scheme on the accumulation as a whole and are usually categorised on the basis of three scenarios or outcomes that are equivalent to G1, G1+G2 and G1+G2+G3. |
| **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. | Quantities that are estimated during the exploration phase are subject to a substantial range of uncertainty as well as a major risk that no development project or mining operation may subsequently be implemented to extract the estimated quantities. Where a single estimate is provided, it should be the expected outcome but, where possible, a full range of uncertainty in the size of the potential deposit should be documented (e.g. in the form of a probability distribution). In addition, it is recommended that the chance (probability) that the potential deposit will become a deposit of any commercial significance is also documented. |

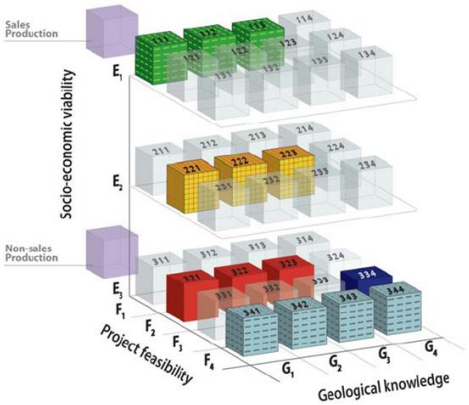
# Transferring volumes

**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

# NEA/IAEA Classification Scheme

Uranium resources are broadly classified as either conventional or unconventional.

Conventional resources are those that have an established history of production where uranium is a primary product, co-product or an important by-product.

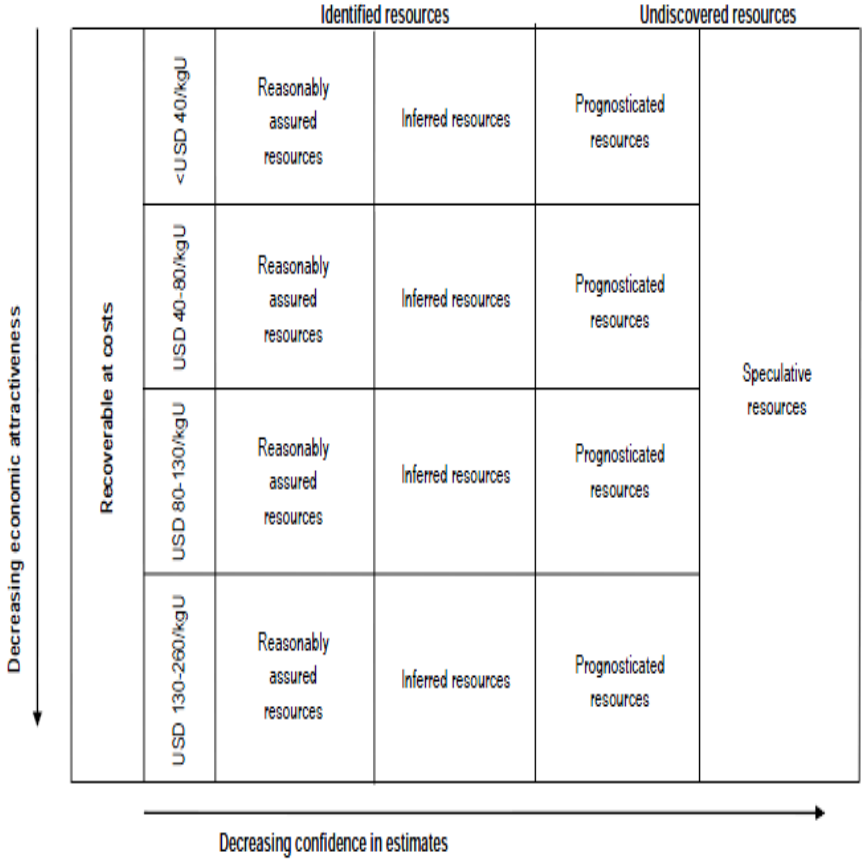
Unconventional resources are very low-grade uranium resources from which the uranium is only recoverable as a minor product of developing and processing a mineral ore.

# NEA/IAEA Classification Scheme

Uranium resources are classified according to geological certainty and costs of production.

The horizontal axis expresses the level of confidence about the actual existence of a given tonnage based on varying degrees of geological knowledge.

The vertical axis expresses the economic feasibility of exploitation separated into cost categories.



# NEA/IAEA Classification Scheme

Conventional uranium resources are sub-divided according to different confidence levels of occurrence, into Identified Resources and Undiscovered Resources.

Identified Resources are further sub-divided into Reasonably Assured Resources (RAR) and Inferred Resources (IR).

Undiscovered Resources are sub-divided into Prognosticated Resources (PR) and Speculative Resources (SR).

# NEA/IAEA Classification Scheme

Identified resources (RAR and IR) refer to uranium deposits delineated by sufficient direct measurement to conduct pre-feasibility studies, and in some cases feasibility studies.

For Reasonably Assured Resources (RAR), high confidence in estimates of grade and tonnage are generally compatible with standards for making the decision to proceed with development of the project.

Inferred Resources (IR) are not defined with a high a degree of confidence and generally require further direct measurement prior to making a decision to develop the project.

# NEA/IAEA Classification Scheme

Undiscovered Resources (Prognosticated Resources and Speculative Resources) refer to resources that are expected to exist based on geological knowledge of previously discovered deposits, regional geological mapping and other geological data sources.

Prognosticated Resources (PR) refers to uranium, in addition to Inferred Resources, that is expected to occur in deposits for which the evidence is mainly indirect and which are believed to exist in well-defined geological trends or areas of mineralization within known deposits.

Estimates of tonnage, grade and cost of discovery, delineation and recovery are based primarily on knowledge of deposit characteristics in known deposits within the respective trends or areas and on such sampling, geological, geophysical or geochemical evidence as may be available.

# NEA/IAEA Classification Scheme

Speculative Resources (SR) refer to uranium, in addition to Prognosticated Resources, that is thought to exist, mostly on the basis of indirect evidence and geological extrapolations, in deposits discoverable with existing exploration techniques.

The location of deposits envisaged in this category could generally be specified only as being somewhere within a given region or geological trend. As the term implies, the existence and size of such resources are speculative.

SR are normally expressed in terms of uranium contained in mineable ore, i.e. in situ quantities.

# 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.

# NEA-IAEA Classification Scheme

| | | IDENTIFIED RESOURCES | | UNDISCOVERED RESOURCES | |
|---|---|---|---|---|---|
| Recoverable at costs | <USD 40/KgU | Reasonably Assured Resources | Inferred Resources | Prognosticated Resources | Speculative Resources |
| | USD 40-80/KgU | Reasonably Assured Resources | Inferred Resources | Prognosticated Resources | |
| | USD 80-130/KgU | Reasonably Assured Resources | Inferred Resources | Prognosticated Resources | |
| | USD 130-260/KgU | Reasonably Assured Resources | Inferred Resources | Prognosticated Resources | |

*Decreasing economic attractiveness*

*Decreasing confidence in estimates*

# Mapping of NEA/IAEA Classification to E-F matrix of UNFC-2009

Reasonably Assured Resources where sufficiently detailed studies have been completed to demonstrate the feasibility of economic extraction by implementing the defined development project or mining operation corresponds to classification E1F1.

The resources can be attributed to “Existing”, “Committed” or “Planned” production centres. Optionally, it may be further sub-classified on the F axis into F1.1, F1.2 or F1.3 and on the E axis into E1.1 or E1.2, with appropriate corresponding production centre status

# Mapping of NEA/IAEA Classification to E-F matrix of UNFC-2009

Quantities of Identified Resources (Reasonably Assured Resources + Inferred Resources) shall correspond to UNFC-2009 requirements of E2 and F2.1 or F2.2 where:

(a) project activities are on-going to justify development in the foreseeable future;

(b) or are on hold and/or where justification as a commercial development may be subject to significant delay.

This shall correspond to “Prospective” production centre status.

# Mapping of NEA/IAEA Classification to E-F matrix of UNFC-2009

Quantities of Identified Resources shall correspond to UNFC-2009 requirements of E3 and F2.2 or F2.3, where the quantities are technically recoverable, however

(a) economically viability cannot yet be determined due to insufficient information (subcategories E3.2, F2.2)
(b) or the resources are not expected to become economically viable in the foreseeable future (sub-categories E3.3, F2.3).

The production centre status may be unclarified for these quantities.

# Mapping of NEA/IAEA Classification to E-F matrix of UNFC-2009

UNFC-2009 does not use cost categories as a basis for classification. It is recognized that uranium prices are volatile and any forecasts of future prices are subject to significant uncertainty. In addition, uranium may be extracted on a non-economic basis for other commercial or strategic reasons.

Under UNFC-2009, quantities are classified as E1 on the basis that, as at the date of evaluation, there are no known commercial reasons (which include consideration of prices, costs, legal/fiscal framework, environment, social and all other non-technical factors) that would stop the project from proceeding.

The possibility of a project being implemented despite being sub-economic is recognized in the sub-category of E1.2, though it should be noted that there is no obligation to make such a distinction in any reporting (the use of sub-categories is optional).

# Undiscovered Resources

Undiscovered Resources (Prognosticated Resources and Speculative Resources) refer to resources that are expected to exist based on geological knowledge of previously discovered deposits, regional geological mapping and other geological data sources.

In UNFC-2009, the quantities estimated for Undiscovered Resources can correspond to E3, F3 and G4.

# Undiscovered Resources

Prognosticated Resources refer to those expected to exist in known uranium provinces, generally supported by some direct evidence.

Quantities estimated shall correspond to UNFC-2009 E3.2 and F3.1

# Undiscovered Resources

Speculative resources refer to those expected to exist in geological provinces that may host uranium deposits based on favourable regional geological features for uranium occurrence.

Quantities estimated will correspond to UNFC-2009 E3.2 and F3.2 and/or F3.3.

# Mapping of NEA/IAEA uranium resource Categories to UNFC-2009 Classes and Sub-classes.

| UNFC Classes and Sub-classes | | UNFC Categories | | | NEA/IAEA Classification | |
|---|---|---|---|---|---|---|
| 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<br>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<br>RAR IR* |
| | Development not Viable | 3.3 | 2.3 | 1,2,3 | | |
| Exploration projects | | 3.2 | 3.1 | 4 | | Prognosticated Resources |
| | | 3.2 | 3.2, 3.3 | 4 | | Speculative Resources |

Thank You