United Nations Framework Classification (UNFC) - how it works in practice and its application to solid minerals

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2. What is UNFC? How does it work?

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4. Bridging Documents

5. Summary and observations
Introduction

- UN Economic Commission for Europe (UNECE)

- Why the United Nations is involved in resource classification

- Mandate
  - ECOSOC Decision 2004/233

- History/development of the UNFC
UN regions ...
UNECE – 56 member States
Why the United Nations?

- Sustainable development and Sustainable Energy for All
- UNECE provides a regional forum for Governments to develop practical instruments in the form of conventions, regulations, norms and standards
- Neutral platform, all stakeholders involved
- Open and transparent process
- Convening power – no comparable forum exists
- UNFC is a voluntary system, not mandated by the UN
- UNFC is a global project (ECOSOC Decision 2004/233)
UNFC and ECOSOC

ECOSOC Decision 2004/233

“At its 42nd plenary meeting, on 16 July 2004, the Economic and Social Council, recalling its decision 1997/226 of 18 July 1997, welcomed the endorsement by the Economic Commission for Europe of the United Nations Framework Classification for Fossil Energy and Mineral Resources and decides to invite the Member States of the United Nations, international organizations and regional commissions to consider taking appropriate measures for ensuring worldwide application of the Framework Classification. The Council notes that this new classification for fossil energy and mineral resources, which now includes energy commodities (for example, natural gas, oil and uranium), is an extension of the earlier framework developed for solid fuels and mineral commodities, on which the Council took similar action in 1997 upon endorsement and recommendation by the Economic Commission for Europe.”
Where does the Expert Group on Resource Classification fit in the UN system?

- General Assembly, Security Council, International Court of Justice, Secretariat
  - Intergovernmental body

- Economic and Social Council (ECOSOC)
  - UN Regional Commissions
    - UN Economic Commission for Europe (UNECE)
      - Committee on Sustainable Energy
        - Advisory body
          - Expert Group on Resource Classification (EGRC)
Expert Group on Resource Classification

- **UNFC** (development and governance)
- Inclusive ... open to **all** stakeholders **worldwide**
  - Solid minerals, petroleum and uranium
  - Application to renewables priority area for member States
  - Close collaboration with CRIRSCO (solid minerals) and SPE (oil & gas) – alignment and specifications
  - Close collaboration with IAEA on nuclear fuel resources
  - Works on consensus
- Five year mandate, reports to Committee on Sustainable Energy – *annual meeting in Geneva*
UNFC stakeholders

Governments

Creators of energy & mineral studies

to facilitate formulation of consistent and far-sighted policies

Financial Community

to provide information necessary to allocate capital appropriately so reducing costs

Industry

to provide data and information necessary to deploy technology, management and finance in order to serve their host countries, shareholders and stakeholders

management of resources
1. Introduction

2. What is UNFC? How does it work?

3. Specifications

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5. Summary and observations
What is the UNFC?

● United Nations Framework Classification for Fossil Energy and Mineral Reserves and Resources

● Global, generic, principles-based system
  – Based on three fundamental criteria
  – Uses a numerical coding system
  – Applicable to both solid minerals and fluids
  – Facilitates global communications

● Fully aligned with CRIRSCO Template and PRMS

● Other classification systems can be aligned with the UNFC and linked using Bridging Documents
UNFC – Numerical coding
Why is the UNFC needed?

- Need for common global language for energy and mineral resource estimates
  - What are “proved reserves”?
  - What are “resources”?

- Increasing overlap between mining and oil & gas industries
  - Major issue with respect to “unconventional” resources
  - Which system applies to mined petroleum solids?

- Increasing need to be able to compare renewable energy resources with non-renewable resources
UNFC History

1992 • Started development of system

1997 • UNFC for solid fuels and mineral commodities published

2004 • UNFC extended to cover oil, natural gas and uranium
UNFC History (continued)

- **2007**
  - Cooperation with IASB
  - Mapped UNFC-2004 to CRIRSCO Template and PRMS

- **2007**
  - Proposed simplification of definitions and other changes to ensure harmonization

- **2009**
  - UNFC-2009 approved in late-2009
UNFC History (continued)

2010

- UNFC-2009 published

2013

- Specifications approved by EGRC April 2013
- UNFC + Specifications “ECE Energy Series No. 42” published
A Couple of Anecdotes

• A famous company misrepresents its reserves with collusion of the board of directors
• Application of revised rules significantly alters management’s previous estimate
• Risk mitigation not in-place results in revision of field reserves
• Management found to be trading shares prior to release of revised reserves estimates

Institute of Mining and Metallurgy
London, 1911
UNFC Classification Framework and Category Definitions

Generic Specifications

Bridging Document

Petroleum Specifications
PRMS

Bridging Document

Solid Mineral Specifications
CRIRSCO

Bridging Document

Other Aligned Systems
Structure of system

Definitions

Specifications

Guidelines

Classification Framework

Application Rules

Non-Mandatory Guidance
UNFC – The three criteria

- Economic and social viability (E axis)
- Field project status and feasibility (F axis)
- Geological knowledge (G axis)
### E axis category definitions

<table>
<thead>
<tr>
<th>Category</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>E1</td>
<td>Extraction and sale has been confirmed to be economically viable.</td>
</tr>
<tr>
<td>E2</td>
<td>Extraction and sale is expected to become economically viable in the foreseeable future.</td>
</tr>
<tr>
<td>E3</td>
<td>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.</td>
</tr>
</tbody>
</table>
### F axis category definitions

<table>
<thead>
<tr>
<th>Category</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>F1</td>
<td>Feasibility of extraction by a defined development project or mining operation has been confirmed.</td>
</tr>
<tr>
<td>F2</td>
<td>Feasibility of extraction by a defined development project or mining operation is subject to further evaluation.</td>
</tr>
<tr>
<td>F3</td>
<td>Feasibility of extraction by a defined development project or mining operation cannot be evaluated due to limited technical data.</td>
</tr>
<tr>
<td>F4</td>
<td>No development project or mining operation has been identified.</td>
</tr>
</tbody>
</table>
## G axis category definitions

<table>
<thead>
<tr>
<th>Category</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>G1</td>
<td>Quantities associated with a known deposit that can be estimated with a high level of confidence.</td>
</tr>
<tr>
<td>G2</td>
<td>Quantities associated with a known deposit that can be estimated with a moderate level of confidence.</td>
</tr>
<tr>
<td>G3</td>
<td>Quantities associated with a known deposit that can be estimated with a low level of confidence.</td>
</tr>
<tr>
<td>G4</td>
<td>Estimated quantities associated with a potential deposit, based primarily on indirect evidence.</td>
</tr>
</tbody>
</table>
## UNFC – How it works

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

### UNFC Class: 111
UNFC – 2D representation

<table>
<thead>
<tr>
<th>Total commodity initially in place</th>
<th>Extracted</th>
<th>Sales Production</th>
<th>Non-sales Production</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Class</td>
<td>Categories</td>
</tr>
<tr>
<td></td>
<td></td>
<td>E</td>
<td>F</td>
</tr>
<tr>
<td>Future recovery by commercial development projects or mining operations</td>
<td>Commercial Projects</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Potential future recovery by contingent development projects or mining operations</td>
<td>Potentially Commercial Projects</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>Non-Commercial Projects</td>
<td>3</td>
<td>2</td>
<td>1, 2, 3</td>
</tr>
<tr>
<td>Additional quantities in place associated with known deposits</td>
<td>3</td>
<td>4</td>
<td>1, 2, 3</td>
</tr>
<tr>
<td>Potential future recovery by successful exploration activities</td>
<td>Exploration Projects</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>Additional quantities in place associated with potential deposits</td>
<td>3</td>
<td>4</td>
<td>4</td>
</tr>
</tbody>
</table>

*Each class is uniquely defined by its code*
Alignment of systems (schematic)

UNFC-2009

- Sales Production
- Non-sales Production
  - Commercial Projects
  - Potentially Commercial Projects
  - Non-Commercial Projects
    - Additional quantities in place
  - Exploration Projects
    - Additional quantities in place

CRIRSCO

- Extracted
  - Class
    - Mineral Reserves
    - Mineral Resources
      - Not reported
    - Exploration Results
      - Not reported

PRMS

- Production
  - Class
    - Reserves
    - Contingent Resources
      - Unrecoverable
    - Prospective Resources
      - Unrecoverable
How can we use alignment?

• Quantities can be estimated using current well-established commodity-specific systems

• Reporting under these systems can continue unchanged

• But the same quantities can also be reported under UNFC using the numerical codes

• The reporting is then independent of commodity type, extraction methodology and ambiguous terminology (e.g. “reserves”)}
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What are specifications?

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Non-Mandatory Guidance
Generic specifications

● In these generic specifications, the following words have specific meanings:
  – “Shall” is used where a provision is mandatory;
  – “Should” is used where a provision is preferred; and,
  – “May” is used where alternatives are equally acceptable.

● Mandatory generic specifications set a minimum standard for reporting
  – Commodity-specific specifications for the same issue may be adopted provided they fully meet the requirements
Generic specifications

20 generic specifications, covering:

- Mandatory disclosure issues
- Project maturity
- Distinction between categories
- Aggregation
- General obligations
- Optional additional sub-categories and labels
- Extracted quantities that may be saleable in the future
Specification S: Classification of additional quantities in place

- In some situations, it may be helpful to sub-classify Additional Quantities in Place on the basis of the current state of technological developments. In such cases, the following specification shall apply:
  
  (a) F4.1: the technology necessary to recover some or all of the these quantities is currently under active development, following successful pilot studies on other deposits, but has yet to be demonstrated to be technically feasible for the style and nature of deposit in which that commodity or product type is located;
  
  (b) F4.2: the technology necessary to recover some or all of the these quantities is currently being researched, but no successful pilot studies have yet been completed;
  
  (c) F4.3: the technology necessary to recover some or all of these quantities is not currently under research or development.
Bridging documents

“A document that explains the relationship between UNFC-2009 and another classification system, including instructions and guidelines on how to classify estimates generated by application of that system using the UNFC-2009 Numerical Codes.”

- Explains the relationship between an Aligned System and UNFC-2009
- Consistent format
- Generally more granularity in UNFC-2009
- Facilitates transfer of quantities to correct class or sub-class
Bridging documents

Aligned systems – commodity-specific basis

- **Solid minerals**
  - CRIRSCO Template of 2006 developed by the Committee for Mineral Reserves International Reporting Standards (CRIRSCO) and the reporting codes and standards that are based on it

- **Petroleum**
  - Petroleum Resources Management System of 2007 (PRMS) which has been endorsed by SPE, WPC, AAPG, SPEE and SEG

- **Uranium**
  - OECD NEA/IAEA uranium classification (“Red Book”)

- **Further bridging documents are being developed for other classification systems**
  - Must be aligned with UNFC and lead to results that are comparable to those based on CRIRSCO Template/PRMS
Bridging documents – CRIRSCO Template

<table>
<thead>
<tr>
<th></th>
<th>F1.1</th>
<th>F1.2</th>
<th>F1.3</th>
<th>F2.1</th>
<th>F2.2</th>
<th>F2.3</th>
<th>F3</th>
<th>F4</th>
</tr>
</thead>
<tbody>
<tr>
<td>E1.1</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>E1.2</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>E2</td>
<td></td>
<td></td>
<td></td>
<td>4</td>
<td>4</td>
<td>5</td>
<td></td>
<td></td>
</tr>
<tr>
<td>E3.1</td>
<td>12</td>
<td>12</td>
<td>12</td>
<td>12</td>
<td>12</td>
<td>12</td>
<td></td>
<td></td>
</tr>
<tr>
<td>E3.2</td>
<td></td>
<td></td>
<td></td>
<td>6</td>
<td>6</td>
<td>6</td>
<td>8</td>
<td></td>
</tr>
<tr>
<td>E3.3</td>
<td></td>
<td></td>
<td></td>
<td>7</td>
<td>7</td>
<td>7</td>
<td>7</td>
<td>11</td>
</tr>
</tbody>
</table>

**Using Sub-categories**

**UNFC-2009 Sub-Classes**

<table>
<thead>
<tr>
<th>Sub-Class</th>
<th>Code</th>
</tr>
</thead>
<tbody>
<tr>
<td>On Production</td>
<td>1</td>
</tr>
<tr>
<td>Approved for Development</td>
<td>2</td>
</tr>
<tr>
<td>Justified for Development</td>
<td>3</td>
</tr>
<tr>
<td>Development Pending</td>
<td>4</td>
</tr>
<tr>
<td>Development On Hold</td>
<td>5</td>
</tr>
<tr>
<td>Development Unclarified</td>
<td>6</td>
</tr>
<tr>
<td>Development Not Viable</td>
<td>7</td>
</tr>
<tr>
<td>Additional Quantities in Place</td>
<td>11</td>
</tr>
<tr>
<td>Classification not in Template</td>
<td>12</td>
</tr>
<tr>
<td>Less Common Mappings</td>
<td></td>
</tr>
</tbody>
</table>
UNFC is a Process

• Understand the deposit
• Develop the project
• Test the social/economic impacts
What is the goal?

• Of businesses
• Of governments
• Of stakeholder groups
• Of communities
Corporate Responsibility and the Triple Bottom Line

• John Elkington, California Business Review 1994
• Three components in equilibrium for optimum enterprise or organisational performance:

- Environmental
- Social
- Financial
Sustainable Development Fundamentals

Zero Waste

Environmental

Comprehensive Extraction

Financial

Social

Social Licence to Operate

Financial
Key Performance Indicators

• De-risked financials/ROI (protects lender/investor)
• Stable, equitable, long-term partnerships with stakeholders
• Reduced risk of project-related social conflicts/conflict-free supply chain/compliance with EITI objectives
• Reduced impact health, culture and heritage
• Equitable balance of economic and environmental interest
Uptake of Comprehensive Extraction

- Conceptual roots in Russia and China during 1990s
- Initial focus on unconventional U resources
  - by-product U - mainly Phosphates
- Now seen to be generally applicable
  - copper, coal, oil shale
- Applies to primary and secondary resources
  - 70% of mine tailings presently seen as a resource for other commodities
  - increasing attention to residues, effluents and slags
- A chance to rethink
  - The balance sheet
  - The flowsheet
Comprehensive Extraction Methodology

• Whole life-cycle, addressing all available resources from a given site/ deposit
• Multi-target resource management, eg energy basin management models
• Primary and secondary resources seen as single, complex resource
• Reuse and recycling – leading to zero waste
• Develop new product development as strategic alternative to waste disposal (eg from recycling tailings or residues)
• Net positive contribution to Food Energy and
Resource assessment for comprehensive extraction (CX)

Quantities associated with known and potential resources

- Contained in Ore concentrates/Phosphoric acid/other intermediate products
- Not extracted; available in Wastes/PG process water
- Available in raffinate and slags
- Available in tailings and clays

- Not Commercial for current extraction
- Potential for Commercial extraction
- Commercially Extracted quantities
- Dissipated in products, wastes, environment

Accurate and transparent management of essential materials
United Nations Framework Classification

- 3D framework
  - Socio-economic
  - Project Feasibility
  - Uncertainty
- Multiple commodities
- International cooperation across diverse stakeholder groups
- Uniquely placed to aid in comprehensive extraction
3G Model – Kazakhstan: “Smart Mining” (URAM 2014) and multi-target energetic basin management

Possible link between oil & gas and uranium, with associated migration of gas along faults, tectonic control of the localisation of roll fronts...

Diagrammatic - not to scale

Cenozoic:
- Sedimentary basins underlain by Palaeozoic sediments
- Archaean, Proterozoic and Palaeozoic metasediments and granitoids

Mesozoic:
- Redox from Palaeogene
- Redox from Cretaceous - upper sand
- Redox from Cretaceous - middle sand

U-rich source rocks:
- Oxidised waters dissolved U
- Roll front bodies
- CH₄ & H₂S
- Tabular bodies
- Mudstone
- Gas Oil
- Caprock

Jaireth et al. 2008
4G Extraction

• 4G Whole basin =
  – Oil
  – Gas
  – Coal
  – Phosphates
  – Uranium
  – Rare Earths...

An integrated management and extraction process
In summary ...

- **UNFC-2009 is a generic, principles-based system**
  - Applicable to both solid minerals and fluids
  - Uses a numerical coding system

- **Based on three criteria**
  - Economic and social viability
  - Field project status and feasibility
  - Geological knowledge

- **Direct linkage to CRIRSCO Template and PRMS**
  - Quantities can be estimated using these systems and reported using the UNFC numerical codes

- **Key goal is to provide a tool to facilitate global communications**
  - Other systems can be linked to it using bridging documents
  - Bridging document finalized for NEA/IAEA “Red Book” system
  - Bridging documents currently in preparation for new Russian Federation petroleum classification and for application to renewable energy sources and CCS projects
Observations

● UNFC-2009 suitable for application to seabed mineral resources
   – Ability to distinguish between E and F
   – Sub-divisions of F4 relevant (Specification S)

● Until the economics of the deposits can be evaluated should be classified as E3.2
   - *economic viability of extraction cannot yet be determined due to insufficient information (e.g. during the exploration phase)*
   – no inferred resources

● Classify with UNFC and disclose with CRIRSCO Template once resources become more “mature” eg commercial extraction agreements in place. Governments well placed to continue with UNFC for national reporting purposes
Delivering on Sustainable Energy for All

- Securing affordable and sustainable energy for the future requires a common standard for:
  - Global communications about energy
  - Recognition of environmental and social considerations
  - Developing long-sighted policies for global markets
  - Government resources management for security and efficiency
  - Cost effective allocation of financial resources
  - Industry processes to ensure common understanding of impact of new technologies and optimization of project management decisions
For more information on UNFC and the Expert Group

- [www.unece.org/energy/se/reserves.html](http://www.unece.org/energy/se/reserves.html)
- E-mail: reserves.energy@unece.org charlotte.griffiths@unece.org
- Sixth EGRC Meeting, Geneva, 29 April – 1 May 2015 incl. UNFC Workshop on 28 April
Contacts

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