FRAMEWORK
CLASSIFICATION
FOR
WORLD ENERGY RESOURCES
(OIL & GAS, COAL, URANIUM)

UN- Task Force on Reserves/Resources
Design Principles of UN FRAMEWORK CLASSIFICATION FOR RESERVES/RESOURCES

Andrej Šubelj
<table>
<thead>
<tr>
<th>UN International Framework</th>
<th>Detailed Exploration</th>
<th>General Exploration</th>
<th>Prospecting</th>
<th>Reconnaissance</th>
</tr>
</thead>
<tbody>
<tr>
<td>National System</td>
<td></td>
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</tr>
<tr>
<td>Feasibility Study</td>
<td>1</td>
<td>(111)</td>
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<tr>
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<td></td>
</tr>
<tr>
<td>Geological Study</td>
<td>1-2</td>
<td>(331)</td>
<td>1-2</td>
<td>(332)</td>
</tr>
<tr>
<td></td>
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<td>1-2</td>
<td>(333)</td>
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<td>? (334)</td>
</tr>
</tbody>
</table>

Mineral resource is used to denote all solid, liquid, or gaseous geologic materials exploitable for use.
(a) Massive deposit

(b) Vein deposit
(a.) Massive deposit

(b.) Vein deposit
Determine operating costs

Select mining rate

Calculate cut-off grade

Compute ore reserve
Mineral reserves are measured quantities of minerals and metals which can be exploited profitably with currently available technology in present economic conditions.
Requirements for good classification system

- covers all aspects
- covers all needs
- translation interface
- as simple as possible
Need for unification

two initiatives

- Joint Ore Reserves Committee
- CMMI
- Countries in transition

UN ECE
UN TASK FORCE
D. Kelter, FR Germany
G. Fettweis, Austria
HU KUI, PR China
V. Tverdohlebov, Russian F.
A. Šubelj, Slovenia
G. Riddler, UK
H. Gluskoter, USA
Who needs Classification

• governments (inventory, SEC)
• financial institutions
• companies
• international organizations (WEC, IAEA, OPEC, IASB, CESR)
Classification systems

• states
• international organisations
• companies
History of Classification systems

- 1915 Witwatersrand Basin
- 1920 Shinkolobwe Congo
- 1928 Soviet Union
- 1943 USA
- 1950 Eastern Systems
- 1960 decline in military use of U
- 1973,86 McKelvey, 1981 Canada,
  1978/79 UN, 1981 Fettweis
- 1996 UNFC
- 1999 JORC
- 2001 harmonisation of solid minerals,
  oil, gas and uranium classifications
Eksploitability

Eksp I = f(geol, tech, leg, env, ..., mpr)

Eksp I = f(G, F, E)
Two general groups of classification systems

- “eastern”
- “western” - CMMI
“eastern” systems
<table>
<thead>
<tr>
<th>National Economic Categories</th>
<th>TOTAL RESOURCES</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Degree of knowledge (certainty) and categories</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>RESERVES</th>
<th>PROGNOSTIC RESOURCES</th>
</tr>
</thead>
<tbody>
<tr>
<td>Exploration</td>
<td>Preliminary estimation</td>
<td>P₁</td>
</tr>
<tr>
<td>Balance reserves</td>
<td>A</td>
<td>B</td>
</tr>
<tr>
<td>Out of balance reserves</td>
<td>a</td>
<td>b</td>
</tr>
</tbody>
</table>

- Resources in explored areas, exploration areas and found by prospecting: P₁
- Resources in areas with known deposits: P₂
- Resources in areas with no known deposits: P₃
“eastern systems”
“western” systems
**TOTAL RESOURCES**

- Identified
  - Demonstrated
    - Measured
    - Indicated
  - Inferred
- Undiscovered
  - Hypothetical (in known districts)
  - Speculative (in undiscovered districts)

**Economic RESERVES**

**Subeconomic**
- Submarginal

**Paramarginal**

**Other occurrences**
Includes nonconventional and low grade materials

*Increasing degree of geological assurance*

*Economic feasibility of recovery*
"western" systems
Why numeric code

- semantic problems
- every nation has the right to use its own language
- “soft” globalization
- easy transformation from one to another system
- everybody uses what he needs
Three digit Numerical Code

By courtesy of UN ECE
Question of Potentially Economic Category
UNITED NATIONS INTERNATIONAL FRAMEWORK
CLASSIFICATION FOR RESERVES/RESOURCES
- Solid Fuels and Mineral Commodities -

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Economic Viability Categories: 1 = economic, 2 = potentially economic, 1-2 = economic to potentially economic (intrinsic economy), ? = undetermined.
Classification Code: (E,F,G), where E = degree of Economic Viability, F = stage of Feasibility Assessment, and G = stage of Geological Assessment.
Сопоставление основных принципов
проекта международной
Классификации запасов (ресурсов)
угля и проектов российских
Классификаций.
Декабрь 1994г.

<table>
<thead>
<tr>
<th>A</th>
<th>B</th>
<th>C1</th>
<th>C2</th>
<th>ГКЗ</th>
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<tbody>
<tr>
<td>Detailed Exploration</td>
<td>General Exploration</td>
<td>Prospecting</td>
<td>Appraisal</td>
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<table>
<thead>
<tr>
<th>Классификация запасов</th>
<th>A</th>
<th>B</th>
<th>C</th>
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</thead>
</table>
| Детально изученные | det. studied | pre-det. studied | 1st approx.
| Defined economic | economical | economical |
| Mere | non-economical | non-economical |
| Subeconomical | subeconomical | subeconomical |

Примечания.
1. ВТК-проект временного творческого коллектива при Российской угольной компанией "Росуголь",
2. ГКЗ - совместный проект Роскомнедра и ГКЗ Минприроды РФ (1994)
3. Закреплена площадь несовпадения оценок по проектам ООН и ВТК; по проекту ООН на этой площади технологические
и экономические оценки не делаются.
Increasing level of geoscientific knowledge and confidence

**EXPLORATION RESULTS**

**INFERRED**
Consideration of mining, metallurgical, economic, marketing, legal environmental, social and governmental factors (the 'modifying factors')

**INDICATED**

**MEASURED**

**MINERAL RESOURCES**
Reported as in situ mineralisation estimates

**PROBABLE**
Reported as mineable production estimates

**PROVED**
1. TMW* = resource\(^1\) 
2. TMW* = reserve + resource\(^2\) 
3. resource = reserve + resource  
   (equation only true for reserve = 0) 

\[
\text{total resource} = \text{reserve} + \text{remaining/additional resource}
\]

*TMW = total mineral wealth 
1) usual perception, 2) professional expression
Reserves
Remaining or additional resources
Total resources

By courtesy of UN ECE
| Economic Viability Categories: | 1 = economic, 2 = potentially economic, 1-2 = economic to potentially economic (intrinsically economic), ? = undetermined |
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<td>1-2 (332)</td>
<td>1-2 (333)</td>
<td>? (334)</td>
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</table>
```
UNFC System is universal, very flexible and covers all different needs - close to “global system”
UNFC System is very flexible

it can be adapted to specific needs:
- low capital commodities
- proposal for oil and gas
<table>
<thead>
<tr>
<th>Countries</th>
<th>Prefeasibility Study, Feasibility Study and/or Mining Report</th>
<th>Geological Study</th>
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<tr>
<td></td>
<td>Economic</td>
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<td>(222)</td>
</tr>
<tr>
<td></td>
<td>(123)</td>
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</tr>
</tbody>
</table>

Total World

---

= International System

Code: (123)

Date: ..................
SME - CMMI type system

EXPLORATION INFORMATION

MINERAL RESOURCES
“Reported as potentially mineable mineralization”

MINERAL RESERVES
“Reported as mineable production estimates”

INFERRED

MEASURED
Consideration of mining, metallurgical, economic, marketing, legal, environmental, social and governmental factors (the “modifying factors”)

PROVED
<table>
<thead>
<tr>
<th></th>
<th>PROVEN RESERVES</th>
<th>POTENTIAL RESERVES - RESOURCES</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>A</td>
<td>B</td>
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<tr>
<td>BALANCE RESERVES</td>
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<td>EXTRACTED TOTAL</td>
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<td>CONDITIONAL</td>
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<td>BALANCE RESERVES</td>
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<tr>
<td>OUT OF</td>
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<td></td>
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<tr>
<td>BALANCE RESERVES</td>
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</tbody>
</table>
Figure 1  Relationship between Mineral Resources and Mineral Reserves

EXPLORATION RESULTS → MINERAL RESOURCES → MINERAL RESERVES

- Increasing level of geological knowledge and confidence

- Consideration of mining, metallurgical, economic, marketing, legal, environmental, social and governmental factors (the ‘modifying factors’)

INFERRRED → INDICATED → MEASURED

PROBABLE → PROVED
Lagerstätteninhalt
Volume of the deposit

Voreinteilung:
First classification:

I. Bergbauliche Vorräte
Mineable resources

<table>
<thead>
<tr>
<th>A</th>
<th>B</th>
</tr>
</thead>
<tbody>
<tr>
<td>sicher</td>
<td>wahrscheinlich</td>
</tr>
<tr>
<td>proved</td>
<td>probable</td>
</tr>
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</table>

C1
angedeutet
indicated

C2
vermutet
inferred

möglicher
possible

II. Potentielle Vorräte
Potential resources

<table>
<thead>
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<th>b</th>
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C1
angedeutet
indicated

C2
vermutet
inferred

d
prognostisch
prognostic

Grenzwerke der potentiellen Vorräte
Limits of the potential resources

Geologische Beurteilung,
Vorhandensein:
Geological assessment,
existence:
<table>
<thead>
<tr>
<th>Cumulative production</th>
<th>IDENTIFIED RESOURCES</th>
<th>UNDISCOVERED RESOURCES</th>
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<tbody>
<tr>
<td></td>
<td>Demonstrated</td>
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<tr>
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<tr>
<td>ECONOMIC</td>
<td>Reserves</td>
<td>Inferred reserves</td>
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<tr>
<td>MARGINALLY ECONOMIC</td>
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<tr>
<td>SUB-ECONOMIC</td>
<td>Demonstrated subeconomic resources</td>
<td>Inferred subeconomic resources</td>
</tr>
<tr>
<td>Other occurrences</td>
<td></td>
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</tr>
</tbody>
</table>
Implementation:
- over 60 countries
directly (Indonesia, Malaysia, Ukraine, India)
indirectly (Russia, China, Turkey, Germany, Austria, …)
partly (US, South Africa, …)

- education very important
Cooperating institutions:
UN Task Force
CMMI with national associations
SPE/WPC/AAPG
NEA/IAEA
STATOIL, OPEC
WEC
EFG
National Govt. & Nongovt. Agen.
Current Documentation:
UNECE
- UNECE Information Unit
  E-mail: info.ece@unece.org
  http://www.unece.org
- Sustainable Energy Division
  E-mail: info.energy@unece.org
  http://www.unece.org
Ad hoc Group of Experts on Energy Reserves/Resources Terminology

- **Chairman:** S. Heiberg, N
  Vicechairmen: T. Ahlbrandt, USA; A. Šubelj, SI; O. Zaborin, RF
- **Subgroup Coal:**
  Chairman: A. Šubelj, SI
- **Subgroup Petroleum:**
  Chairman: P. Blystad, N
- **Subgroup Uranium:**
  Chairman: J.R. Blaise, IAEA
Oil and Gas (SPE/WPC/AAPG, Statoil)
# Uranium (NEA/IAEA)

<table>
<thead>
<tr>
<th>NEA/IAEA</th>
<th>RAR</th>
<th>EAR-1</th>
<th>EAR-2</th>
<th>Speculative</th>
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<tbody>
<tr>
<td>&lt; 40 $/kg_{\text{u}}</td>
<td>111</td>
<td>121,122</td>
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<tr>
<td>40-80 $/kg_{\text{u}}</td>
<td>211</td>
<td>221,222</td>
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<tr>
<td>80-130 $/kg_{\text{u}}</td>
<td>311</td>
<td>321,322</td>
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<tr>
<td>&gt; 130 $/kg_{\text{u}}</td>
<td>331</td>
<td>332</td>
<td>333</td>
<td>334</td>
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</table>
International UNFC system

By courtesy of UN ECE