Experience with mineral data harmonization and UNFC application – case studies
(Hungary / Central Europe)

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Mineral Resource Management and Concession Affairs
Mining and Geological Surveys of Hungary / EuroGeoSurveys

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• Hungarian cases
  – Construction aggregates and industrial minerals
  – Hydrocarbons
  – Coals
• Cases for mapping and bridging (CE-EU)
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  – Czech Republic
  – Other sources of information
• Summary

Hungarian Team with a Chinese Delegation, Budapest
Introduction

- EuroGeoSurveys with Members of the Mineral Resource Expert Group are committed for data harmonization and maintain the activity of the UNECE EGRC.
- Increasing interest for using international classification systems

Sári (2017) based on data from the UNECE EGRC report (2017)
Modernization of the National Mineral and Geothermal Energy Resources Inventory since 2013
Harmonization of the National Mineral Resources Classification System with International Standards, Codes and UNFC-2009

Meetings/stakeholder consultations: 2013-2015: for all types of mineral commodities with in 5 Working Groups in 3-4 rounds
Steps

- **Bridging** between CRIRSCO family, SPE-PRMS, Geothermal codes and UNFC-2009
- **Stakeholder consultations**: authority, experts, entrepreneurs
- Proposals based on **tests and demonstration** for the harmonization, **communication**
- **Publication** of results, **guideline** (in progress)
Milestone: publication about the potential application of UNFC and international reporting codes

Bulletin of Hungarian Geological Society
- http://epa.oszk.hu/01600/01635/00452/pdf/
- Cs. Baksa, T. Fancsik, G. Katona: Preface to the special volume dealing with the national and international practice of the mineral resource inventories.
- Z. Horváth, K. Sári, B. Fodor: Overview of the international mineral resource classification framework and the reporting standards for solid minerals
- A. Nádor: An overview of the international classification and reporting systems for geothermal energy and the first attempts to bring Hungarian practice in line with these systems
- Zs. Kovács: Domestic practice with reference to the hydrocarbon inventory of Hungary and the uniform interpretation and correlation of classification, in line with international systems
- Z. Horváth, K. Sári: The modernisation of the Hungarian non-metallic mineral resource inventory based on the international mineral classification framework and reporting standards
- Z. Püspöki, Mrs Hámor M. Vidó, K. Sári, R. Szeiler, T. Fancsik: Facilities for, and deficiencies of the registry of Hungarian coal resources
- Gy. Falus, Á. Szamosfalvi: Overview of international systems for the registration of carbon dioxide geological storage potential
Conversion guideline

A+B → Measured Resources → Proved Reserves

C1 → Indicated Resources → Probable Reserves

1-3 complexity groups

4th complexity group

Modifying factors are fulfilled: Technical Operating Plan (active mine)

→ UNFC

Bridging UNFC and CRIRSCO (Bankes, 2013)
### Conversion: Aggregates and industrial minerals

<table>
<thead>
<tr>
<th>National – status of the mine</th>
<th>CRIRSCO</th>
<th>UNFC – E</th>
<th>UNFC – F</th>
</tr>
</thead>
<tbody>
<tr>
<td>Active</td>
<td>Mineral Reserves</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Suspended</td>
<td>Mineral Resources</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>Closed</td>
<td>Mobile Reserves</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Explored area</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>National – geological knowledge</th>
<th>CRIRSCO</th>
<th>UNFC – G</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>Measured Resources or Proved Reserves</td>
<td>1</td>
</tr>
<tr>
<td>B</td>
<td>C1 – 1–3rd complexity</td>
<td></td>
</tr>
<tr>
<td>C1 – 4th complexity</td>
<td>Indicated Resources or Probable Reserves</td>
<td>2</td>
</tr>
<tr>
<td>C2</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Site ID</th>
<th>Raw material</th>
<th>Status of the mine</th>
<th>Complexity group (hypothetic)</th>
<th>A+B</th>
<th>C1</th>
<th>C2</th>
<th>Proved Reserves 111</th>
<th>Probable Reserves 112</th>
<th>Measured Resources 221</th>
<th>Indicated Resources 222</th>
</tr>
</thead>
<tbody>
<tr>
<td>Site 1</td>
<td>Brick clay</td>
<td>active</td>
<td>1</td>
<td>2 158 322</td>
<td>4 062 500</td>
<td>3 460 700</td>
<td>6 220 822</td>
<td>3 460 700</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Site 2</td>
<td>Sand</td>
<td>suspended</td>
<td>1</td>
<td>0</td>
<td>167 638</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>167 638</td>
<td>0</td>
</tr>
<tr>
<td>Site 3</td>
<td>Sand</td>
<td>closed</td>
<td>1</td>
<td>0</td>
<td>17 000</td>
<td>24 000</td>
<td>0</td>
<td>0</td>
<td>17 000</td>
<td>24 000</td>
</tr>
<tr>
<td>Site 4</td>
<td>Basalt</td>
<td>explored area</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>47 708 214</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>47 708 214</td>
</tr>
</tbody>
</table>
From national inventory to the UNFC via CRIRSCO

MINING AND GEOLOGICAL SURVEY OF HUNGARY
### Conversion: Hydrocarbons (Zsolt Kovács)

<table>
<thead>
<tr>
<th>E category</th>
<th>UNFC Classification</th>
<th>F category</th>
<th>Hungarian inventory</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.1</td>
<td>Commercial Projects</td>
<td>1.1 On Production</td>
<td>Producing reservoirs in <em>producing fields</em></td>
</tr>
<tr>
<td>1.1</td>
<td></td>
<td>1.2 Approved for development/ developed non-producing</td>
<td>Intermission of producing of reservoirs in <em>producing fields</em> (produced but non-producing in the time of evaluation)</td>
</tr>
<tr>
<td>1.1</td>
<td></td>
<td>1.3 Justified for Development/ undeveloped non-producing</td>
<td>Non producing reservoirs in <em>producing fields</em> (never produced)</td>
</tr>
<tr>
<td>2</td>
<td>Potentially Commercial Projects</td>
<td>2.2-2.3 Development On Hold or Unclarified</td>
<td>Non producing reservoirs in <em>non producing fields</em></td>
</tr>
<tr>
<td>3.2-3.3</td>
<td>Non Commercial Projects</td>
<td>2.2-2.3 Development Unclarified or Not Viable</td>
<td>Non producing reservoirs with high inert (CO2, N2) gases &amp; Abandoned reservoirs with minimal resource</td>
</tr>
</tbody>
</table>

**Basin**

**Oli/gas Fields**

G1+G2 quantity data distribution based on reservoir and field production and HC quality
 Analysis Sum recoverable oil = 100%, sum recoverable gases = 100%
Conversion: Hydrocarbons (Zsolt Kovács)

Oil reservoirs
Gas reservoirs
Mining plots
CO2 reservoir

G1, G1+G2, G1+G2+G3 commodities,
Oil, dissolved gas, gas cap gas, free gas
Initially in Place, Recoverable
Production data/ year

Reporting: 1P, 2P, 3P into the Inventory Result may serve a good base for complete application of UNFC.
Selection of a coal project
(Zoltán Püspöki)
Improvement of the status of the selected project

Characterisation of volume calculation blocks
(thickness, calorific value, ash content, sulphur content, volatiles)

Isopach maps for mine planning

Mining plan and pre-estimation of mining costs

Identification of optimal Clean Coal Technologies and accessorial possibilities (e.g. agriculture, REE elements)

Based mostly on archives

Based on recent activities
Case study for mining waste facilities

- Applicability of harmonization between a national classification system (Russian type), an international reporting code (CRIRSCO-family) and the UNFC

- 3 localities of mining wastes in Hungary

- Recommendations for the development of the legislative prescriptions to improve the knowledge on mining wastes

- It supports projects for potential utilization of secondary raw materials.
### Cases for mapping and bridging (CE-EU) - Poland

<table>
<thead>
<tr>
<th>Raw material</th>
<th>National classification</th>
<th>UNFC-2009</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Deposits licensed for mining</td>
<td>Deposits beyond concession areas</td>
</tr>
<tr>
<td></td>
<td>Economic resources (in Polish &quot;bilansowe&quot;)</td>
<td>Sub-economic resources (in Polish &quot;niebilansowe&quot;)</td>
</tr>
<tr>
<td>High nitrogen gas</td>
<td>11,506.75</td>
<td>920.65</td>
</tr>
<tr>
<td>Natural gas</td>
<td>101,679.10</td>
<td>51,006.78</td>
</tr>
<tr>
<td>Crude oil</td>
<td>22.26</td>
<td>14.07</td>
</tr>
<tr>
<td>Coal bed methane</td>
<td>36,413.05</td>
<td>5,214.78</td>
</tr>
<tr>
<td>Cu and Ag ores</td>
<td>1,389.12</td>
<td>1,162.24</td>
</tr>
<tr>
<td>Ag</td>
<td>81.95</td>
<td>69.15</td>
</tr>
<tr>
<td>Cu</td>
<td>27.18</td>
<td>22.77</td>
</tr>
<tr>
<td>Zn and Pb ores</td>
<td>13.94</td>
<td>5.53</td>
</tr>
<tr>
<td>Pb</td>
<td>0.22</td>
<td>0.10</td>
</tr>
<tr>
<td>Zn</td>
<td>0.55</td>
<td>0.23</td>
</tr>
<tr>
<td>Hard coal</td>
<td>21,107.05</td>
<td>3,561.47</td>
</tr>
<tr>
<td>Lignite</td>
<td>1,418.70</td>
<td>1,112.23</td>
</tr>
<tr>
<td>Rock salt</td>
<td>15,112.70</td>
<td>1,735.79</td>
</tr>
<tr>
<td>Sulfur</td>
<td>19.81</td>
<td>19.44</td>
</tr>
<tr>
<td>Diatomaceous rock</td>
<td>0.64</td>
<td>0.20</td>
</tr>
<tr>
<td>Bentonites</td>
<td>0.49</td>
<td>0.34</td>
</tr>
</tbody>
</table>
Some results

- F4: regional reports on prospective raw material resources.
- F3: geological documentation,
- F2: mineral deposit development plan
- F1: mining report to the

If considering category definitions, geological documentation responds to the F2 category since a deposit has an issued exploitation concession and mineral deposit development plan responds to the F1 category since exploitation starts.

(Geological documentation can be assigned to both the F3 and F2 categories and the mineral deposit development plan to both the F2 and F1 categories.

Compatibility: data on Polish resources should be released separately in the UNFC:

- in exploited deposits (deposits licensed for mining) – economic resources in place (21x according to UNFC-2009), sub-economic resources (31x), anticipated economic resources not qualified for economic and sub-economic resources (22x), anticipated sub-economic resources (32x);
- in non-exploited deposits (beyond concession areas) – anticipated economic resources (23x), anticipated sub-economic resources (33x).

Publication about the Czech mineral classification

• The Czech classification still include potentially economical reserves, i.e. reserves that are currently not recoverable and which are, therefore, potentially economic resources.

• The term reserves as used, by contrast, in standard international classifications represent only the parts of explored resources that are available for immediate or developed extraction.

• All other registered parts are resources, not reserves, of a given mineral.

Czech Republic

<table>
<thead>
<tr>
<th></th>
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<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>111</td>
<td>Proved Mineral Reserve</td>
<td>Proved Mineral Reserve</td>
<td>economic reserves – part of exploitable part* A+B</td>
<td>economic reserves – part of exploitable part* A+B</td>
<td>economic reserves – part of exploitable part* A+B</td>
<td>part of exploitable part* of explored economic reserves</td>
</tr>
<tr>
<td>121 + 122</td>
<td>Probable Mineral Reserve</td>
<td>Probable Mineral Reserve</td>
<td>economic reserves – part of exploitable part* of A + B + C₁</td>
<td>economic reserves – part of exploitable part* of A + B + C₁</td>
<td>economic reserves – part of exploitable part* of A + B + C₁</td>
<td>part of exploitable part* of explored economic reserves</td>
</tr>
<tr>
<td>123</td>
<td>Inferred Mineral Resource</td>
<td>Inferred Mineral Resource</td>
<td>economic reserves – C₂</td>
<td>economic reserves – C₂</td>
<td>economic reserves – C₂</td>
<td>prospected economic reserves</td>
</tr>
<tr>
<td>211</td>
<td>Feasibility Mineral Resource</td>
<td>Measured Mineral Resource</td>
<td>potentially economic reserves – A+B</td>
<td>potentially economic reserves – A+B</td>
<td>potentially economic reserves – A+B</td>
<td>part of explored potentially economic reserves</td>
</tr>
<tr>
<td>221 + 222</td>
<td>Prefeasibility Mineral Resource</td>
<td>Indicated Mineral Resource</td>
<td>potentially economic reserves – C₁</td>
<td>potentially economic reserves – C₁</td>
<td>potentially economic reserves – C₁</td>
<td>part of explored potentially economic reserves</td>
</tr>
<tr>
<td>223</td>
<td>Inferred Mineral Resource</td>
<td>Inferred Mineral Resource</td>
<td>potentially economic reserves – C₂</td>
<td>potentially economic reserves – C₂</td>
<td>potentially economic reserves – C₂</td>
<td>prospected potentially economic reserves</td>
</tr>
<tr>
<td>331</td>
<td>Measured Mineral Resource</td>
<td>Measured Mineral Resource</td>
<td>potentially economic reserves – A + B</td>
<td>potentially economic reserves – A + B</td>
<td>potentially economic reserves – A + B</td>
<td>part of explored potentially economic reserves</td>
</tr>
<tr>
<td>332</td>
<td>Indicated Mineral Resource</td>
<td>Indicated Mineral Resource</td>
<td>potentially economic reserves – C₁</td>
<td>potentially economic reserves – C₁</td>
<td>potentially economic reserves – C₁</td>
<td>part of explored potentially economic reserves</td>
</tr>
</tbody>
</table>
References for publications from CE/SEE-Europe (Slovenia, Slovakia, Czech Republic, Poland, Hungary)

https://www.unece.org/fileadmin/DAM/energy/se/pp/unfc/IntWs_UNFC_Ankara_Sep2011/6_Ersoy.pdf (with European summary including Slovakia)
Summary

• Recommended steps to develop national level projects for the utilization of data harmonization and UNFC application:
  – Development of a Team for relevant types of mineral commodities
  – Collection and translation of relevant reporting codes and UNFC on national languages
  – Understanding the similarities and differences between national and international systems (Bridging)
  – Development of case studies and dissemination of results (communication, publication)
  – Stakeholder Consultation between Geol. Survey/s – Mining Authority and Mining Association and Geol. Society and other parties (e.g. Ministry)
  – Preparation of the Guidance – Finalized Bridging Document
  – Future: preparation of training materials, trainings
  – Improvement of infrastructure and reporting system (e.g. reporting forms) including inventory
  – Improvement of relevant legislations (Mining Law, prescription for reporting, inventory)

• All ways are viable (data transformation from national to CRIRSCO then UNFC, from national to UNFC then to CRIRSCO and from national to PRMS then to UNFC)
Summary

- Careful assessment of available datasets on mineral resources is needed with respect the information-base derived from mining enterprises (specific standards were applied).
- On national level national experts can perform task in the harmonization (informal datasets); involvement of Competent Persons / Euro-Geologists has benefits.

- In the former planned economy general exploration was the most frequent type of prospecting, reserves were over-explored and C1 and C2 categories were mined. Specific standards were used that may not not obviously aligned with CRIRSCO type criteria.

- Sharing knowledge and experiences in Hungary, in CE and EGS MREG is in progress.
- UNFC and CRIRSCO system can be applied for mining wastes as well that supports circular economy objectives.

- It can be confirmed that UNFC is a multifunctional tool supporting the sustainable raw materials management.
THANK YOU FOR YOUR ATTENTION