CO₂ Storage Capacity Estimation: Work at the IEA

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International Energy Agency
IEA CCS Technology Roadmap 2009

- Currently there is no uniform methodology to estimate geological CO2 storage capacity
- Each country or organization uses its own evaluation and estimation method

Recommendations

- Agree on a common global methodology for CO2 storage capacity estimation
- Perform a comprehensive assessment of worldwide capacity for CO2 storage
## Uncertainty prevails

<table>
<thead>
<tr>
<th>Storage Type</th>
<th>Global IPCC 2005</th>
<th>Global IEAGHG</th>
<th>USA NETL 2008</th>
<th>Europe Geocapacity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aquifers</td>
<td>1,000-10,000</td>
<td></td>
<td>3,300-13,000</td>
<td>90-330</td>
</tr>
<tr>
<td>Depleted oil and gas</td>
<td>680-900</td>
<td>160</td>
<td>140</td>
<td>20-32</td>
</tr>
<tr>
<td>CO2-EOR</td>
<td></td>
<td>65</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*Units in Gt CO$_2$*
Numbers and more numbers...

Some world estimates are smaller than some regional estimates

From Bradshaw et al., 2007
Objectives of IEA work

Stimulate and facilitate the international discussion

1. A common estimation framework for countries

2. A sound methodology for arriving at a national-scale CO2 storage resource assessment that could be applied globally

3. A way forward to quantify what proportion of the resource is technically accessible at any particular cost

Deliverable: Guidelines for storage capacity estimation
Work Process

- Two experts workshops in April and November 2011
- Involved geological surveys:
  - Australia - Geoscience Australia
  - Canada - National Resources Canada
  - Germany - BGR
  - Japan - AIST
  - The Netherland - TNO
  - UK - BGS
  - USA - USGS
- Observers: EC, UNFC, OPEC, GCCSI
First Workshop

- 5-6 April 2011, Paris

Contents

- UN Framework Classification for Fossil Energy and Mineral Reserves and Resources
- Review present status of CO2 storage capacity Estimation
- Geological layer - technically accessible storage resource
Second Workshop

16-17 November 2011, Paris

Contents

• Classification of CO2 Storage Estimates
• Economic Layer
• Main elements of draft guidelines for estimating CO2 storage capacity
Guiding principle

- All CO2 storage assessment methodologies are similar at their core; the initial step is to determine the pore space available for storage.
- The disparity between the methods are driven by the constraints placed on what constitutes a storage resource.
- These constraints are physical, economic, regulatory and environmental.
# Comparing methodologies

Methodology 1:  
Methodology 2:  

<table>
<thead>
<tr>
<th>Constraints</th>
<th>Most detailed</th>
<th></th>
<th></th>
<th>Least detailed</th>
</tr>
</thead>
<tbody>
<tr>
<td>Trapping mechanism</td>
<td>Structural</td>
<td>Residual</td>
<td>Solubility</td>
<td>(Hydrodynamic) Mineral</td>
</tr>
<tr>
<td>Resolution</td>
<td>1 km²</td>
<td>10 km²</td>
<td>100 km²</td>
<td>1000 km²</td>
</tr>
<tr>
<td>Time Scale</td>
<td>Injection period (decades)</td>
<td>100 years</td>
<td>Geological</td>
<td></td>
</tr>
<tr>
<td>Boundary conditions</td>
<td>Closed</td>
<td>Semi open</td>
<td>Open</td>
<td></td>
</tr>
<tr>
<td>Treatment of Uncertainty</td>
<td>Deterministic</td>
<td>Semi probabilistic</td>
<td>Probabilistic</td>
<td></td>
</tr>
<tr>
<td>Calculation</td>
<td>Analytical</td>
<td></td>
<td>Numerical</td>
<td></td>
</tr>
<tr>
<td>Cutoffs 1</td>
<td>Depth</td>
<td>Depth</td>
<td>Porosity</td>
<td>Permeability</td>
</tr>
<tr>
<td>Cutoffs 2</td>
<td>Injectivity</td>
<td>Cost</td>
<td>Seals (Faults)</td>
<td>TDS</td>
</tr>
</tbody>
</table>
Principles underlying Guidelines

- For estimates of the TASR, working group proposes to use the general method proposed by USGS.
  - *Technically Accessible Storage Resource is the fraction of the total pore volume that may retain CO2 within storage assessment units*

- To deal with specific policy constraints other methodology may fit needs better

- Intercomparability needs to be ensured
USGS Methodology

- Geologically-based
  - Geological model
  - Trapping modes
    - Buoyant and residual trapping
  - ‘Mild’ constraints

- Transparent – methodology, assumptions
- Probabilistic – range of values to reflect uncertainty
- Regional estimates - not project site specific
Key elements of Guidelines document

- Goal of CO2 storage capacity assessments
- Assessment consideration
  - Science-based
  - Policy-based
  - Probabilistic/deterministic
- Overview of extant CO2 storage resource assessment methodologies
  - Technically accessible storage resource
  - Resource in structural/stratigraphic traps
  - Resource assuming pressure management will be used
  - Resource where CO2 storage will not affect hydrocarbon production
Key elements of Guidelines -2

IEA recommendations

- Main components all methods/assessment should contain
  - TASR
  - Storage efficiency
  - Probabilistic
  - Others

- Continuum of methodologies to choose to fit consideration
  - Basin-scale
  - Only buoyant trapping
  - Pressure restricted
Schedule

- August 2012: Draft Guideline
- September 2012: Review and revision Guideline
- October 2012: Final version
- November 2012: Publication
Thank you

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www.iea.org/ccs