The CO$_2$ Storage Resource Management System (SRMS): A Project Maturity Based Classification and Categorization of Storable Quantities

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Underground Injection Control Conference
Groundwater Protection Council
San Antonio, Texas
February 16-19, 2020
SRMS Outline

• Introduction
  • Motivation: Historical Studies Commercialization
  • Analogous System: Petroleum Resources Management System (PRMS)
  • SRMS committee activities

• SRMS
  • Categories (storable quantities)
  • Classifications (project maturity)

• Example: Generic Illinois Basin

• Summary
Introduction: SRMS Motivation

Historical Studies

- Early studies had a wide variety of methods and assumptions used to calculate CO₂ storage
  - Total pore volume to mobile water volume, with free phase CO2 or 100% CO₂ saturated water
- Recognized that uncertainty in CO₂ storage estimates existed due to
  - Data quantity, quality, and type
  - Regional vs. site-specific
- Recognized that well configuration and specific geologic depositional environment (i.e. the project specifications) influenced storage estimates

Commercialization

- Commercial scale CO₂ storage projects involve financial, corporate, government organizations
  - provide common terminology and clear definitions needed to classify storage quantities, the commodity for storage
- Storage quantities are essential part of all projects
  - provide context for investment and tracking the performance of the investment
Introduction: SRMS Seed Document (Analogy)

Petroleum Resources Management System (PRMS)

- Developed to standardize methods used to determine value of the assets of oil and gas producing companies based on projections of future oil and gas production

- Reserves
  - Proved developed producing
  - Proved developed, not producing
  - Proved undeveloped

- Time tested and applied system in the oil and gas industry

- Developed by professional organizations
  - SPE, AAPG, WPC and SPEE

- Supported by financiers, security exchanges, and governments approved
Introduction:
SRMS Committee Activities

• Society of Petroleum Engineers committee formed in 2016.
• Recruited members with storage experience and PRMS experience
• Started with SRMS seed document
• Approved and released by 2017
• Currently completing SRMS Guidelines
• Next, SRMS
SRMS Categories (storable quantities-certainty)

• Low estimate-highest certainty
• Best estimate-most likely
• High estimate –lowest certainty

• Capacity Example
  • Proved Capacity (P1):
    • quantity estimated w/ reasonable certainty (e.g. P90) to be commercial with a defined project within a known geologic formation, operating methods, and government regulations.
  • Probable Capacity (P2)
  • Possible (P3)

1P = P1          2P = P1 + P2
3P = P1 + P2 + P3
SRMS Classifications

- Based on maturation of a project
- Major classifications
  - Discovered vs. Undiscovered
  - Commercial vs. Sub-commercial
- Capacity:
  - Discovered and commercial
- Contingent Storage Resources
  - Discovered and sub-commercial
- Prospective Storage Resources
  - Undiscovered
SRMS Classifications: Capacity

- **On Injection**: development project is currently injecting and storing CO$_2$.
- **Approved for Development**: All necessary approvals have been obtained, capital is committed, and implementation of the development project is underway.
- **Justified for Development**: Implementation of the development project is justified on the basis of reasonable forecast commercial conditions at the time of reporting, and there are reasonable expectations that all necessary approvals/contracts will be obtained.
SRMS Example:
Illinois Basin Generalization
Example SRMS Application
Pre-Storage Assessment: General Knowledge

• Basal sandstone
  • Outcrops and subcrops
  • Crosses two countries, and eight States
  • No known minerals; natural gas storage
  • Few wellbore penetrations
  • Extensive caprock
  • Deep: greater cementation lower p&p
“1995” Study: $250k

- Objective: storage potential, proximity to sources
- Volumetric approach
  - Pore volume replacement
  - Single value
- Boundaries:
  - Perimeter: State lines; Fresh water
  - Depth: Minimum-density of CO2; maximum-low p&p

- Outcome: General Geographical area for a site
  - Estimate: 800 Gtonnes (single value)
  - Classification: Prospective Storage Resources-Play.
  - The categorization of the estimate is 3U
“2000” Study: $1.0M

- Objective: storage potential, site screening
- Volumetric, GIS approach
  - Natural gas storage analog
  - Single Value
- Boundaries:
  - Perimeter: Oilfield structures only; Fresh water
  - Depth: Minimum-density of CO2
- Outcome:
  - Estimate: Structures-6 Gtonnes (single value)
  - Classification: Prospective Storage Resources-Prospect (*Increased certainty of geographical area for a site*)
  - The categorization of the estimate is 2U
“2005” Study: $1.0 M

- **Objective:** storage potential, site screening
- **Volumetric, GIS approach**
  - Efficiency: displacement, and net geologic attributes
  - High, medium, low values (E= 1-4%)
- **Boundaries:**
  - Perimeter: Oilfields and regional dip; Fresh water
  - Depth: Minimum-density of CO2
- **Outcome:** General Geographical area for a site
  - Estimate: Structures-6 Gtonnes; Basin- 25-100 Gtonnes
  - Classification: **Prospective** Storage Resources - **Prospect**
  - Categorization:
    - 1U-25 Gtonnes
    - 2U-50 Gtonnes
    - 3U-100 Gtonnes
“2010” Study: $10 M

- Objective: site selection/ well drilled
- Simulation of single well
  - 3,000 tpd maximum at the site
  - 8,000 tpd maximum simulated injection rate of the geologic unit
- No management commitment
- 25 yr facility life at maximum site CO₂ emission rate

- Outcome (upon active injection)
  - Estimate: 70.0 Mtonnes
  - Classification: Contingent Storage Resources—Development Pending
  - Categorization: 2C (neither optimistic or pessimistic)
“2015” Study: $50 M

- Objective: project economics and permit acquired
- Equipment and infrastructure purchased: 1,000 tpd
- Management commitment: 3 years
- Permit acquired for same rate and duration

- Outcome (upon active injection)
  - Estimate: 1.0 Mtonnes
  - Classification: Capacity — On Injection (No other management commitment to project expansion)
  - Categorization: Proved Developed Injecting (P1)
  - Classification of remaining storage resource: Prospective Storage Resources-Development Unclarified
<table>
<thead>
<tr>
<th>Study Year</th>
<th>Storage Quantity/Class/Category</th>
<th>Method</th>
<th>Comment</th>
</tr>
</thead>
<tbody>
<tr>
<td>1995</td>
<td>800 Gt / Contingent Play</td>
<td>Volumetric</td>
<td></td>
</tr>
<tr>
<td>2000</td>
<td>6.0 Gt / Contingent Prospect</td>
<td>Structure, natural gas storage analog</td>
<td>Consistency amongst RCSP</td>
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<tr>
<td>2005</td>
<td>6.0 Gt / 25-100 Gt / Contingent Prospect</td>
<td>GIS, volumetric, regional dip</td>
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<tr>
<td>2010</td>
<td>70 Gt / Prospective Development Pending</td>
<td>Simulation</td>
<td>Site selection well drilled</td>
</tr>
<tr>
<td>2015</td>
<td>1.0 Gt / Capacity: On injection</td>
<td>GIS, volumetric, regional dip</td>
<td>Active injection with existing facility, permit, and management commitment</td>
</tr>
</tbody>
</table>
SRMS Expected Outcomes

• Standardized terminology and definitions similar to an established and familiar resource assessment methodology
• Different assessors or stakeholders have a methodology to follow to make effective comparisons between projects.
• Elimination of challenge to commercial storage
• Reduce financial risk associated with estimates of storage
Acknowledgements

- Society of Petroleum Engineers’ members are leading and organizing the SRMS guidelines development with support of SPE staff. SPE is the largest individual-member organization serving managers, engineers, scientists and other professionals worldwide in the upstream segment of the oil and gas industry.

- The Oil and Gas Climate Initiative supports the SRMS development. Their mission is to accelerate actions that mitigate greenhouse gas emissions from the industry’s operations, while still meeting the world’s energy needs.

- Project ECO2S is part of the U.S. Department of Energy’s National Energy Technology Laboratory (USDOE-NETL) CarbonSAFE Program and is financially supported by the USDOE-NETL (DE-FE0029465) and Mississippi Power Company. The project is managed by the Southern States Energy Board. Technical Support is provided by Southern Company Research and Development.

- The Midwest Geological Sequestration Consortium is funded by the USDOE-NETL via the Regional Carbon Sequestration Partnership Program (DE-FC26-05NT42588) and by a cost share agreement with the Illinois Department of Commerce and Economic Opportunity, Office of Coal Development through the Illinois Clean Coal Institute. The project is managed by the Illinois State Geological Survey.
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