IEAGHG Information Paper: 2017-IP25; Summary and Background of SPE's SRMS Document

IEAGHG has recently released an information paper regarding the Society of Petroleum Engineer's (SPE) drafted report the "CO_2 Storage Resources Management System". The full draft report (out for comments until the 31st May) can be found on the SPE website:

http://www.spe.org/industry/geologic-storage-resources-management-system.php

This text aims to provide a brief summary of how this Storage Resource Management System (SRMS) compares to other classification systems and the context in which it was developed. An important factor in setting the background for this report is that the SPE CCUS subcommittee is working with the United Nations Economic Commission for Europe (UNECE) to develop the resource management system.

UNECE Background

This UNECE published a classification system in 2009, the "United Nations Framework Classification for Fossil Energy and Mineral Reserves and Resources". This was an overarching system which pertained to energy and mineral studies, resources management functions, corporate business processes and financial reporting standards. The UNECE then released a series of publications on how this classification system could be applied to more specific areas.

This included a report applying the classification system specifically to injection projects for geological storage which was published in 2016. The report titled "Specifications for the Application of the United Nations Classification for Fossil Energy and mineral Reserves and Resources 2009 (UNFC-2009) to Injection Projects for the Purpose of Geological Storage" outlines a broad classification system which the new SPE system aims to be consistent with. This (as well as the original 2009 report) can be found on the UNECE website:

Original UNFC-2009 document:
http://www.unece.org/fileadmin/DAM/energy/se/pdfs/UNFC/unfc2009/UNFC2009_ES39_e.pdf

Application to Injection Projects:
http://www.unece.org/fileadmin/DAM/energy/se/pdfs/UNFC/UNFC_specs/UNFC.IP_e.pdf

The focus of the 2016 UNECE document is on classifying Injection Projects related to CO_2 storage (although it could be applied to other fluid injection projects.) In this context the 'resource' that the document refers to is the storage potential of a site (rather than the extraction potential used for oil and gas reserves). In this system projects are classified by commercial attractiveness, i.e. the quantity of CO_2 that can be stored given a defined technical solution and certain investment.

The 2016 UNECE document "is a generic principle-based system in which quantities are classified on the basis of the three fundamental criteria of economic and social viability (E), field project status and feasibility (F), and geological knowledge (G), using a numerical coding system. Combinations of these criteria create a three-dimensional system." The classification system is highlighted below (Figure 1) and shows the 'E-F-G' categories. The classes, categories and subcategories are the same as the UNFC-2009 application for extractive activities.

The

UNFC-2009 Classes Defined by Categories as Applied to Injection Projects for the Purpose of Geological Storage					
Total Storage Potential	Injected and Stored Quantities				
		Class	Categories		
			E	F	G
	Future storage by commercial injection projects	Commercial Injection Projects	1	1	1, 2, 3
	Future storage in known reservoirs by injection projects	Potentially Commercial Injection Projects	2	2	1, 2, 3
		Non-Commercial Injection Projects	3	2	1, 2, 3
	Storage Not Feasible		3	4	1, 2, 3
	Potential future storage in undiscovered reservoirs by injection projects	Screening Projects	3	3	4
	Storage Not Feasible		3	4	4

Fig 1 UNECE Classification - Abbreviated version of the classification system when applied to injection projects, (i.e. the primary classes and categories have been adapted for the application of injection projects for the purpose of geological storage from the original 2009

UNECE document includes an extensive table detailing the category definitions from E1 to G4 and makes a comparison between the non-specific UNFC-2009 definitions and UNFC-2009 when applied to Injection Projects definitions. There are also supporting explanations.

Previous Classification Systems

Many organizations have worked towards providing a universally accepted classification system for the storage of CO_2 but none have yet become a 'standard' method. Over the past 10 years a variety of work has been conducted to establish the best methodology for calculating the storage capacity for a CCS site. A succinct comparison of methods for conducting storage capacity assessments was conducted by Liu et al. 2014[1] which studies the feasibility, superiority and limitations of three commonly used methods. A frequently used figure when describing storage capacity is CSLF Techno-Economic Resource-Reserve Pyramid (Figure 2). This pyramid was developed for classification once an estimate has been performed and is based on the certainty of storage potential. This CSLF report and the background leading to its development are described in a study by the EERC and IEAGHG[2]:

http://ieaghg.org/docs/General_Docs/Reports/2009-13.pdf

A succinct summary is also available at the GCCSI website:

https://hub.globalccsinstitute.com/publications/development-storage-coefficients-carbon-dioxide-storage-deep-saline-formations-3

1 Changlin Liao, Xinwei Liao, Xiaoliang Zhao, Hongna Ding, Xiaopeng Liu, Yongge Liu, Jing Chen, Ning Lu; Comparison of different methods for determining key parameters affecting CO2 storage capacity in oil reservoirs; International Journal of Greenhouse Gas Control; Volume 28, September 2014, Pages 25-34

2 IEA Greenhouse Gas R&D Programme (IEA GHG); "Development of Storage Coefficients for CO2 Storage in Deep Saline Formations"; 13 October 2009.

As demonstrated in the summary, a range of definitions for different types of capacity are in common use making CCS discussions at an international level (and especially a comparison of projects) difficult. The SPE Storage Resource System is therefore designed to provide a common reference to help improve clarity for national reporting and regulatory purposes, aiding global communications regarding CO_2 storage. The SRMS draft states that the “sub-committee will work closely with other organizations to update this document periodically to keep current with common practices and changing commerciality criteria”.

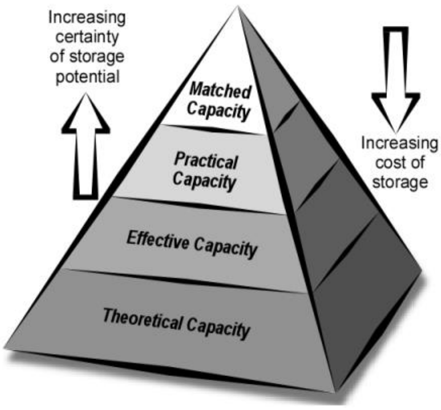

Fig 2 Techno-Economic Resource-Reserve pyramid for CO_2 storage capacity showing the relationship between Theoretical, Effective, Practical and Matched capacities. (Carbon Sequestration Leadership Forum; “Estimation of CO2 storage capacity in geological media-Phase II report. Prepared by the Task Force on CO_2 Storage Capacity Estimation for the Technical Group of the Carbon Sequestration Leadership Forum”; 2007)

SPE Management System

The SPE have had previous success in developing classification standards having developed the Petroleum Resources Management System (PRMS) which has been accepted by many organizations and is now in common use internationally. The SPE have therefore established the CO_2 storage management resource system drawing upon experience from the PRMS. The UNFC-2009 system can be used in conjunction with the PRMS, bringing together the two classification systems using a ‘bridging document’[3]. By working with the UNECE, the SPE will apply the same approach to the SRMS to maintain consistency between the two systems and ultimately work towards providing a bridging document similar to that of the PRMS.

Given this has been successfully achieved within the oil and gas industry with the SPE-PRMS system, by following the same methodology it is hoped the SRMS system will develop the same international success.

The “SPE-SRMS” report contents are as follows:

[3] 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.

Basic Principles and Definitions

By developing a set of principles and definitions the SPE system hopes to make the comparison between projects and discussions surrounding storage capacity easier. The system considers the project's economic feasibility, productive life and related cash flows.

The definitions are more specific than those stated in the UNECE documents. The categories within the classification system are: capacity, contingent storage resources, prospective storage resources and inaccessible storage resources.

The definitions given for these categories are along the same lines as the principles used for the CSLF pyramid where capacity definitions are based on increasing certainty of storage potential. The SPE definitions are specifically based on how commercially available resources are. The SPE document makes no reference to theoretical, effective, practical or matched capacity (as used by the CSLF) and they are not included in the glossary of terms for resource evaluations.

The SPE document describes the classification system as 'project based' and is driven by classifying the project based on its chance of commerciality. The primary data sources used to calculate storage resource are considered to be geological formation attributes, injection and cash flow schedules and the ownership/contract terms of the licensed property area.

Classification and Categorization Guidelines

These guidelines describe how to determine the discovery status, commerciality, and risk associated with the project and further describes the classification sub-categories. The range of uncertainty is also discussed, defining the probabilities required to describe a project as a low, best or high certainty estimate.

Evaluation and Reporting Guidelines

To ensure consistency between projects the system also includes guidelines on how to evaluate and report the storage resource findings. The report covers how to conduct cash-flow evaluations, injection measurements and resource entitlement.

Estimating Storable Quantities

Once a project has been classified based on its project maturity, different analytical procedures can be applied to estimate the associated storable quantities and assign an uncertainty category.

For estimating storable quantities the analytical procedures come under three main categories: analogues, volumetric estimates and material balance. Each method will provide a range of storable quantities and storage efficiencies which reflects the underlying uncertainties. Generally, the more analytical procedures used, the greater the confidence in the estimate.

Analogue methods are regularly used within the petroleum industry using comparable data from the same geological formation e.g. on permeability and porosity. Given there is limited experience in the CO_2 storage industry analogue data will be more difficult to come across. The report highlights that this method will therefore become increasingly important as the industry matures.

Volumetric estimates are also discussed in the report highlighting key uncertainties and limitations. For this analysis the general principle is that the porosity and permeability of a gross rock volume are considered (with other attributes) but dynamic factors, such as how the plume will move long-term, are not included in the assessment.

Mass balance analytical methods can also be conducted but will have high uncertainties in complex situations e.g. where there is natural water flow. Injection performance analysis is also briefly discussed in the report.

The difference between deterministic and probabilistic approaches being applied to these analytical procedures is also included in the report and suggests that conducting both methods and making a comparison can ensure the results are reasonable. It also highlights that aggregating resource classes is not suggested due to the significant differences in criteria associated with each classification.

Conclusions

In summary, the draft SPE-SRMS report provides a detailed description of each storage resource classification and guidelines based on a petroleum resource evaluation approach. It has taken into consideration definitions used with a variety of approaches developed by the CCS community over the past decade. The SRMS approach includes commercial considerations as well as different estimation methods.

	Injection Application of UNFC-2009	**SPE SRMS**
Purpose	To be able to apply UNFC-2009 to Injection Projects	To provide a consistent approach to estimate storable quantities, evaluate projects and present results.
Main focus	Classifying projects	Classifying projects
Classification Classes	Commercial Injection Potentially Commercial Non-commercial Screening Projects	Stored Capacity Contingent Storage Prospective Inaccessible
Categories	E,F ang G (then from 1-4 based on class)	P,C or U (then from 1-3 based on uncertainty)
Specifications (i.e. guidelines and definitions given within the document)	Generic (e.g. use of numerical codes, bridging documents, economic assumptions)	Specific and focused on project scale (e.g. how to report resource estimations, injection measurements, cash-flow evaluations.

Table 1 Summary highlighting UNFC-2009 and SPE-SRMS differences.

Further References

Given the industry focused nature of the Society of Petroleum Engineer's publications, the SRMS document is best suited to those with prior knowledge of the petroleum based PRMS system. For non-technical readers a summary on the PRMS may give some clarification on the storage classification system and its intended uses. The SPE summary of the PRMS for non-technical users can be accessed via the SPE website:

http://www.spe.org/industry/docs/PRMS_guide_non_tech.pdf

An example of the 'bridging document' between the PRMS and UNFC-2009 (which will be conducted for the SRMS also) can be found on the UNECE website:

http://www.unece.org/fileadmin/DAM/energy/se/pdfs/UNFC/pub/UNFC2009_Spec_ES42.pdf (the bridging document can be found on page 37).

To clarify, these documents are not for the purpose of geological storage but their methodology and style will be the basis for the SPE-SRMS and are therefore a good reference to develop further understanding.

Lydia Rycroft
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