MARYLENA GARCIA, P.E.



Senior Vice President - Group Coordinator

Marylena has more than 23 years of industry experience and has been with Ryder Scott for more than ten years. As Senior Vice President she conducts reserves evaluations and performance analysis. Her areas of expertise include the evaluation of future income under a variety of fiscal terms and model contracts such as production sharing contacts and agreements, joint venture contracts and agreements, risk sharing and service agreements.

Marylena has a B.S. in Petroleum Engineering from Universidad de Oriente and an M.S. in Petroleum Engineering from Texas A&M University.

Contact Me



Marylena_Garcia@ryderscott.com

www.ryderscott.com

713-750-5468

19TH ANNUAL RYDER SCOTT RESERVES CONFERENCE

ACCOUNTING FOR CO2 USING THE SPE STORAGE RESOURCES MANAGEMENT SYSTEM (SRMS)

Marylena Garcia

PRESENTATION OVERVIEW

- Carbon Capture and Storage Overview
- Motivation for SRMS
- PRMS as a Precursor Document
- SRMS Classification Framework
- Economic Considerations
- Closing Remarks

WHAT IS GEOLOGICAL STORAGE



Image from Zero Emission Platform

- Injection of CO₂ into geological formations with the aim of permanently isolating the CO₂ from the atmosphere.
- CO₂ captured, compressed to fluid state and injected into permeable and porous formations.
- Typically, effective storage sites have:
 - High porosity;
 - High permeability;
 - Extensive cap rock or barrier to contain the CO₂ permanently.

CARBON CAPTURE UTILIZATION AND STORAGE VALUE CHAIN



TYPES OF CARBON STORAGE FOR CO2



- SRMS only addresses CO₂ storage in:
 - Saline Aquifers
 - Depleted oil and gas reservoirs
- CO₂ EOR Storage not yet in the SRMS
- Effective storage sites should have:
 - Capacity
 - Injectivity
 - Containment

SALINE AQUIFERS



- Porous and permeable sedimentary rocks that contain salty, non-potable water (brine).
- Wide geographic distribution.
- 98% of the world's estimated CO₂ storage resources are in the form of saline aquifers with significant theoretical storage capacity.
- Current projects injecting in saline aquifers include:
 - Gorgon CCS (Australia)
 - Quest CCUS (Canada)
 - Sleipner and Snøhvit (Norway)

DEPLETED RESERVOIRS



- Depleted oil and gas reservoirs become storage sites for CO_{2.}
- Portion of the pore volume saturated with unrecoverable oil and/or gas.
- Less than original reservoir pressure.
- Well defined reservoir with existing infrastructure.
- Storage capacity can be inferred based on the recovery of hydrocarbon.

STORAGE RESOURCES MANAGEMENT SYSTEM (SRMS)



PRECURSOR DOCUMENT: PRMS

PRMS

PRMS Published in 2007 Updated in 2018

Petroleum Resources Management System



- To best understand the basis for the SRMS, it is necessary to understand the basis for the PRMS from which it was derived.
- SRMS has a very strong alignment with PRMS.
- PRMS has been time tested and widely adopted in the oil and gas industry and has become the globally accepted standard for hydrocarbon reporting.
- Supported by financiers, security exchanges and regulatory bodies.

MOTIVATION FOR SRMS

Why do we need a common approach for classifying , categorizing and quantifying storage resources?

- A consistent set of definitions and a classification system for CO₂ storage
 - Improve communication to stakeholder: Financiers, corporate and governmental entities
 - Underpin policy decision
 - Economic justification for investment decisions
 - Track the performance of the investment
- Project based system



SRMS RESOURCES CLASSIFICATION FRAMEWORK

	URCES			STORED	Project Maturity Sub-classes		
		CIAL	! ! Lo	CAPA w Best E	CITY	High	On Injection
	RESO	IMER(P1	P 2	Р Р3	3P	Approved for Development
RCES	RAGE	CON	PROVED	PROBABLE	POSSIBLE		Justified for Development
SOU	STOF	SUB-COMMERCIAL	C	CONTINGENT STOR	AGE RESOURCES		Development Pending
E RE	DISCOVERED S		10	C 2	C	3C	Development On Hold
ORAG			C1	C2	C3		Development Unclarified
STC							Development Not Viable
IAI				INACCESSIBLE STORA	AGE RESOURCES		
.OL	ERED EE ES		P	ROSPECTIVE STOR	AGE RESOURCES		Prospect
	NDISCOVE STORAG	DURC	1L P90	J 2l	J 0	3U P10	Lead
		RES					Play
	5			INACCESSIBLE STORA	AGE RESOURCES		

Classification

- Based on project maturity
- Major Classifications
 - Discovered vs Undiscovered
 - Commercial vs Sub-commercial

Categorization

NCREASING CHANCE OF COMMERCIALITY

- Based on certainty in an estimate
- Major Categorizations
 - Low
 - Best Estimate (most likely)
 - High

RANGE OF UNCERTAINTY

FRAMEWORK COMPARISON

PRMS SRMS STORED PRODUCTION CAPACITY RESERVES COMMERCIAL RESOURCE COMMERCIAL Low High 3P 1P 2P 2P 3P 1P (alla) P2 P1 P3 DISCOVERED PIIP PROVED PROBABLE POSSIBLE erciality DURCES TORAGE Proved Possible Probable ACE PETROLEUM INITIALLY-IN-PL INCREASING CHANCE OF COMMERCIALITY SUB-COMMERCIAL CONTINGENT **CONTINGENT STORAGE RESOURCES** STORAGE RES hance of Com COMMERCIAL SCOVERED RESOURCES C1 C2 C3 1C2C3C ਙ SUB **INACCESIBLE STORAGE RESOURCES** UNRECOVERABLE OTA sing PROSPECTIVE UNDISCOVERED PIIP **PROSPECTIVE STORAGE RESOURCES** JNDISCOVERED Increa RESOURCES TOTAL RESOURCES STORAGE 2U 3U 1U Low Best High P50 P10 Estimate Estimate Estimate **INACCESIBLE STORAGE RESOURCES** UNRECOVERABLE Range of Uncertainty

RANGE OF UNCERTAINTY

SUB CLASSES COMPARISON

PRMS





SRMS

Numbers to Count On. Experts to Trust.

SRMS RESOURCES CLASSIFICATION FRAMEWORK



"Chance of Commerciality" is the chance that the project will be developed and reach commercial storage status.

<u>Classification</u> is based on increasing project maturity aligned to development decision points or gates Three main resource classes:

- Capacity
- Contingent Storage Resources
- Prospective Storage Resources

RESOURCES CATEGORIZATION FRAMEWORK



"Range of Uncertainty" reflects a range of storable quantities that are forecasted to be injected and stored.

<u>**Categorization**</u> - Based upon storage resource volume uncertainty range

- Low Case
- Best Case
- High Case

CLASSIFICATION: UNDISCOVERED PROSPECTIVE STORAGE RESOURCES

- Undiscovered storable quantities of pore volume in a geological formation that are estimated, as of a given date, to be accessible by application of future exploration/development projects.
- It can also include uncharacterized parts of discovered geologic formations
- Currently is evaluated for potential storage according to its chance of discovery
- Development program have less detail

		AGE RESOURCES		STORED	Project Maturity Sub-classes
			MERCIAL		On Injection
				CAPACITY	Approved for Development
	RCES		CON		Justified for Development
	SOU	DISCOVERED STOR	IERCIAL		Development Pending
	je re			CONTINGENT	Development On Hold
	DRAG		OMN	RESOURCE	Development Unclarified
5	_ ST(UB-C		Development Not Viable
	ا≥		S	INACCESSIBLE	
	2	ERED	ыс CES	PROSPECTIVE	Prospect
		COVE RAG DRAG		STORAGE	Lead
		NDIS SIGN	a LU	RESOURCES	Play
		5		INACCESSIBLE	
				\longleftrightarrow	
				RANGE OF UNCERTAINTY	

CLASSIFICATION: UNDISCOVERED PROSPECTIVE STORAGE RESOURCES

- There is no well yet or has not been assessed.
- **Play**: Prospective trend of potential prospects, but that requires more data acquisition and/or evaluation to define specific leads or prospects.
- Lead: Currently poorly defined and requires more data acquisition and/or evaluation to be classified as a prospect.
- Prospect: Sufficiently well defined to represent a viable drilling target.

Prospective Storage Resources can transition to Contingent Storage Resources with a Discovery.

CAPACITY CONTINGENT STORAGE	On Injection Approved for Development Justified for Development Development Pending Development On Hold
CAPACITY	Approved for Development Justified for Development Development Pending Development On Hold
CONTINGENT STORAGE	Justified for Development Development Pending Development On Hold
CONTINGENT STORAGE	Development Pending Development On Hold
	Development On Hold
STORAGE	
RESOURCE	Development Unclarified
	Development Not Viable
INACCESSIBLE	
PROSPECTIVE	Prospect
	Lead
	Play
	PROSPECTIVE STORAGE RESOURCES

RANGE OF UNCERTAINTY

INACCESSIBLE STORAGE RESOURCES

- The estimated portion of Discovered or Undiscovered Storage Resources, as of a given date that are not usable by future storage development projects
- A portion may be developed for storage in the future if the circumstances change:
 - Current regulatory restrictions,
 - Commercial restrictions,
 - Storage location constraints.
- Or may never be used for storage.

	S		STORED	Project Maturity Sub-classes						
	URCE	SIAL		On Injection						
	RESO	MER	CAPACITY	Approved for Development						
RCES	AGE	COM		Justified for Development						
SOU	JISCOVERED STOR	JB-COMMERCIAL		Development Pending						
E RE			CONTINGENT	Development On Hold						
RAG			NMO:	OMN	OMN	SOMN C		NMO	RESOURCE	Development Unclarified
STC				Development Not Viable						
2		S	INACCESSIBLE							
TO	ERED	ie Ses	PROSPECTIVE	Prospect						
	COVE	DURC	STORAGE RESOURCES	Lead						
	NDIS	RESC		Play						
	D		INACCESSIBLE							
		223	$\leftarrow \rightarrow$	A CONTRACTOR OF THE OWNER OF THE						

RANGE OF UNCERTAINTY

CLASSIFICATION: DISCOVERED, SUB-COMMERCIAL CONTINGENT STORAGE RESOURCES

- Those quantities of Total Storage Resources, as of a given date, to be accessible quantities in known geological formations but the applied project(s) are not yet mature enough for commercial development, as a result of one or more contingencies.
- Contingencies:
 - No viable source of CO_2
 - Project value is insufficient to support development
 - Permitting is still incomplete
 - Technology under development
 - Lack of commitment from management
 - Evaluation of geologic formation is insufficient to clearly asses commerciality



CLASSIFICATION: DISCOVERED, SUB-COMMERCIAL CONTINGENT STORAGE RESOURCES

- A well exists and has been assessed.
- **Development Not Viable:** Discovered storable quantities for which there are no current plans to develop or to acquire additional data at the time as a result of limited storage potential.
- **Development Unclarified:** Discovered storable quantities where project activities are under evaluation and where justification as a commercial development is unknown on the basis of available information.
- Development on Hold: Discovered storable quantities where project activities are on hold and/or where justification as a commercial development may be subject to significant delay.
- Development Pending: Discovered storable quantities where project activities are ongoing to justify commercial development in the foreseeable future.

Contingent Storage Resources can transition to Capacity with a commercial proposal.

	S		STORED	Project Maturity Sub-classes
	RESOURCE	COMMERCIAL		On Injection
			CAPACITY	Approved for Development
RCES	AGE I			Justified for Development
SOU	STOR	IAL		Development Pending
E RE	DISCOVERED 8	JB-COMMERC	CONTINGENT STORAGE RESOURCE	Development On Hold
DRAG				Development Unclarified
STC				Development Not Viable
IAL	_	S	INACCESSIBLE	
D	RED	ES ES	PROSPECTIVE	Prospect
	COVE	DURC	ON STORAGE RESOURCES	Lead
	NDIS	SI (Play
	D		INACCESSIBLE	
			\longleftrightarrow	

RANGE OF UNCERTAINTY

NCREASING CHANCE OF COMMERCIALITY

CLASSIFICATION: CAPACITY DISCOVERED, COMMERCIAL STORAGE RESOURCES

- Quantities of Total Storage Resources anticipated to be commercially accessible in the characterized geological formation by application of development projects from a given date forward under defined conditions.
- Commercial Storage Resources must satisfy four criteria:
 - Discovered and characterized (including containment);
 - Possible to inject at the required rates;
 - Development project must be commercial;
 - The storage resource must remain, as of the evaluation date.



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 will be obtained.

Approved for Development

All necessary approvals have been obtained, capital funds have been committed, and implementation of the development project is underway. A project maturity sub-class of reserves.

On Injection

The development project is currently injecting and storing CO₂



Project Maturity Sub-classes

On Injection

Approved for Development

Justified for Development

Development Pending

Development On Hold

Development Unclarified

Development Not Viable

STORED

CAPACITY

CONTINGENT

STORAGE

RESOURCE

INACCESSIBLE

PROSPECTIVE STORAGE

RESOURCES

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RANGE OF UNCERTAINTY

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SUB-COMMERCIAL

CLASSIFICATION CAPACITY STATUS

- Based on the operational status.
- Developed Capacity: Expected quantity that can be stored by leveraging from existing wells and facilities.
 - Developed Injection Capacity is expected to be storable from completion intervals that are <u>open and injecting</u> at the time of the estimate.
 - Developed Non-Injecting Capacity includes <u>shut-in and behind-pipe</u>.
- Undeveloped Capacity: Expected quantity to be storable through future investments.
- Does not apply to Prospective or Contingent Storage Resources.

CLASSIFICATION ECONOMIC STATUS

- Economically Viable Contingent Storage Resources
 - Storable quantities from technically feasible projects that are either currently economic or projected to be economic under reasonably forecast improvements in commercial conditions, but are not committed for development because of one or more contingencies.
- Economically <u>Not Viable</u> Contingent Storage Resources
 - Storable quantities for which development projects are not economic or not expected to be economic, even considering reasonable improvements in condition.

Project Maturity Sub-classes Contingent Storage Resources	Economic Status	
Development Pending	Economically Viable	
Development On Hold		
Development Unclarified	Economically Not Vichle	
Development Not Viable		

SRMS RESOURCES CLASSIFICATION FRAMEWORK



DISCOVERY

- Requires a well.
- A discovery is one geologic formation for which one or several wells have been established through testing, sampling, and/or logging the existence of a significant quantity of potential CO₂ storage for the proposed project.
 - "Significant quantity" implies that there is evidence of a sufficient quantity of Total Storage Resources to justify further evaluation
- For a geologic formation to have storable quantities require:
 - Accessible pore volume (quantity and sustained injectivity)
 - Suited for containment



RANGE OF UNCERTAINTY

COMMERCIALITY

- Requires commitment.
- Reasonable expectation of being developed.
- <u>Project profitability</u> meets company's investment screening and operating criteria.
- <u>Reasonable time frame.</u>
- A reasonable expectation that there will be <u>sustained</u> <u>demand for storage</u>.
- Evidence that the <u>injection facilities</u> are available or can be made available.
- Evidence that legal, regulatory, contractual, environmental and other social and economics will allow implementation of the project.



CATEGORIZATION OF STORABLE QUANTITIES

- Based on range of uncertainty and independent of project maturity.
- May be represented by deterministic scenarios or by a probabilistic distribution:
 - Low Estimate
 - 1P/1C/1U
 - High Probability
 - P90
 - Best Estimate
 - 2P/2C/2U
 - Most Likely
 - P50
 - High Estimate
 - 3P/3C/3U
 - Low Probability
 - P10



CATEGORIZATION OF STORABLE QUANTITIES PROVED, PROBABLE, AND POSSIBLE

Proved (P1) – Proved Capacity (P90)

Quantity of storage that, by analysis of geoscience and engineering data, can be estimated with reasonable certainty to be commercially used for storage.

• Probable (P2) – Probable Capacity (P50)

The additional storable quantities, which analysis of geoscience and engineering data indicate are less likely to be used for storage than Proved Capacity, but more certain to be stored than Possible Capacity.

Possible (P3) – Possible Capacity (P10)

The additional storable quantities, which analysis of geoscience and engineering data suggest are less likely to be used for storage than Probable Capacity.

FLOW DIAGRAM GUIDE TO ASSIGNING SRMS SUB-CLASSES





REASING CHANCE OF COMMERCIAL

Oil and Gas Climate Initiative – CO₂ Storage Catalog Cycle 3 Report

STORAGE RESOURCES ARE PROJECT BASED



Storage Resources are estimated on a project basis (like PRMS)

- Geologic Formation The storable quantities and the fluid and rock properties that affect CO₂ storage, including sustained injectability and containment.
- The Property Contractual rights and obligations, including the fiscal terms defining entitlement and share of investments, expenses, and revenues.
- **Project** Each project applied to the storable quantities of a specific geologic formation generates unique injection and cash-flow schedules.

STORAGE RESOURCES ARE PROJECT BASED

Project:

- Represents the link between a potential storable quantity and the decision making process for budget allocation.
- SRMS encourages consideration all feasible development project at various stages of design and implementation.
 - Typical Projects include wells, CO₂ transportation, subsurface injection, etc
 - May combine notional and real projects
- Projects not initially economically viable remain in the resource portfolio as potential future investment.

INCREMENTAL PROJECTS

- Design to increase stored CO₂, storage efficiency and/or accelerate injection by making changes to existing projects.
- Evaluated at project level.
- Classified according to the same criteria as the initial project.
- Categorized on certainty of storage:
 - Capacity
 - Contingent Storage Resources



Project 1: Injection Well

Project 2: Injection well Drilling project (Funds committed)
Project 3: Injection Capacity Upgrade (Contingent)

ECONOMIC VS. COMMERCIAL

Commercial

"When a project is commercial, this implies that the essential social, environmental, and economic conditions are met, including political, legal, regulatory, and contractual conditions"

"... storage project is expected to be developed and placed on injection within a reasonable timeframe" (Five years)

Economic Criteria

"In relation to Storage Capacity and Resources, economic refers to the situation in which the income from an operation exceeds the expenses involved in, or attributable to, that operation"

ECONOMIC LIMIT

- Defined as the injection rate below which the net operating cash flows from a project ... are negative at a point in time that defines the project's economic life.
 - May be an individual well, lease, entire storage site, or related project (e.g., an industrial plant, power generation, or a hydrocarbonproducing project).



CLOSING REMARKS

- SRMS provides a consistent set of definitions and a classification system for international usage that can be integrated into business and asset management models.
- The SRMS CO₂ storage resources can be quantified, categorized, and classified based on project maturity and geological and reservoir uncertainty.
- SRMS has a very strong alignment with PRMS.
- It will enable effective comparisons between different projects.
- Industry-wide system that can be used for project management and reporting internally and also where external disclosure is required.

CARBON CAPTURE UTILIZATION AND STORAGE



Marylena_Garcia@ryderscott.com

Office Phone: +1-713-750-5486



1100 Louisiana, Suite 4600 Houston, Texas 77002

www.ryderscott.com

Risk Assessment Feasibility Studies Economic Due Diligence United Nations Classification Framework Utilization and Sequestration Authenticate Greenhouse Gas Assertions Surface and Sub-Surface Integration

Numbers to Count On. Experts to Trust.