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ACCOUNTING FOR CO_2 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

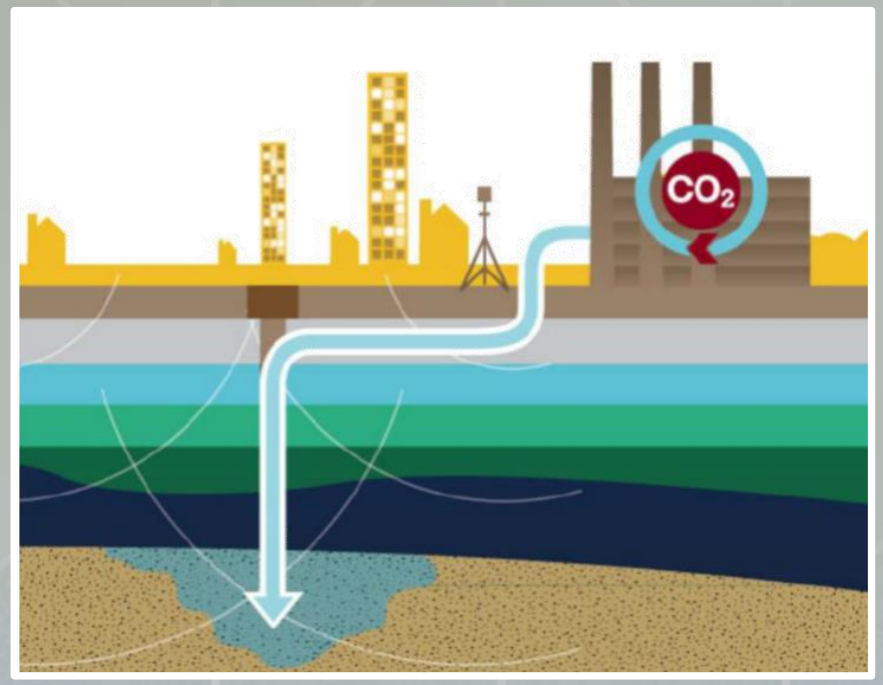
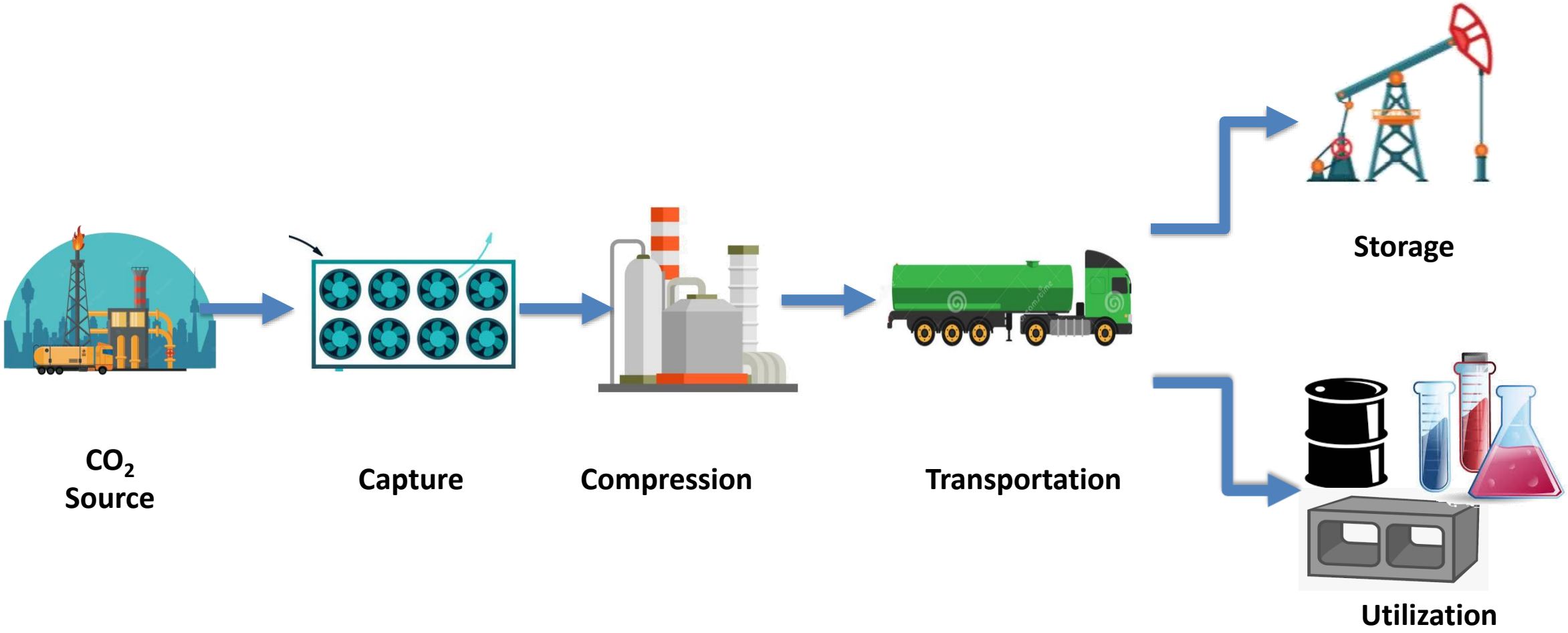


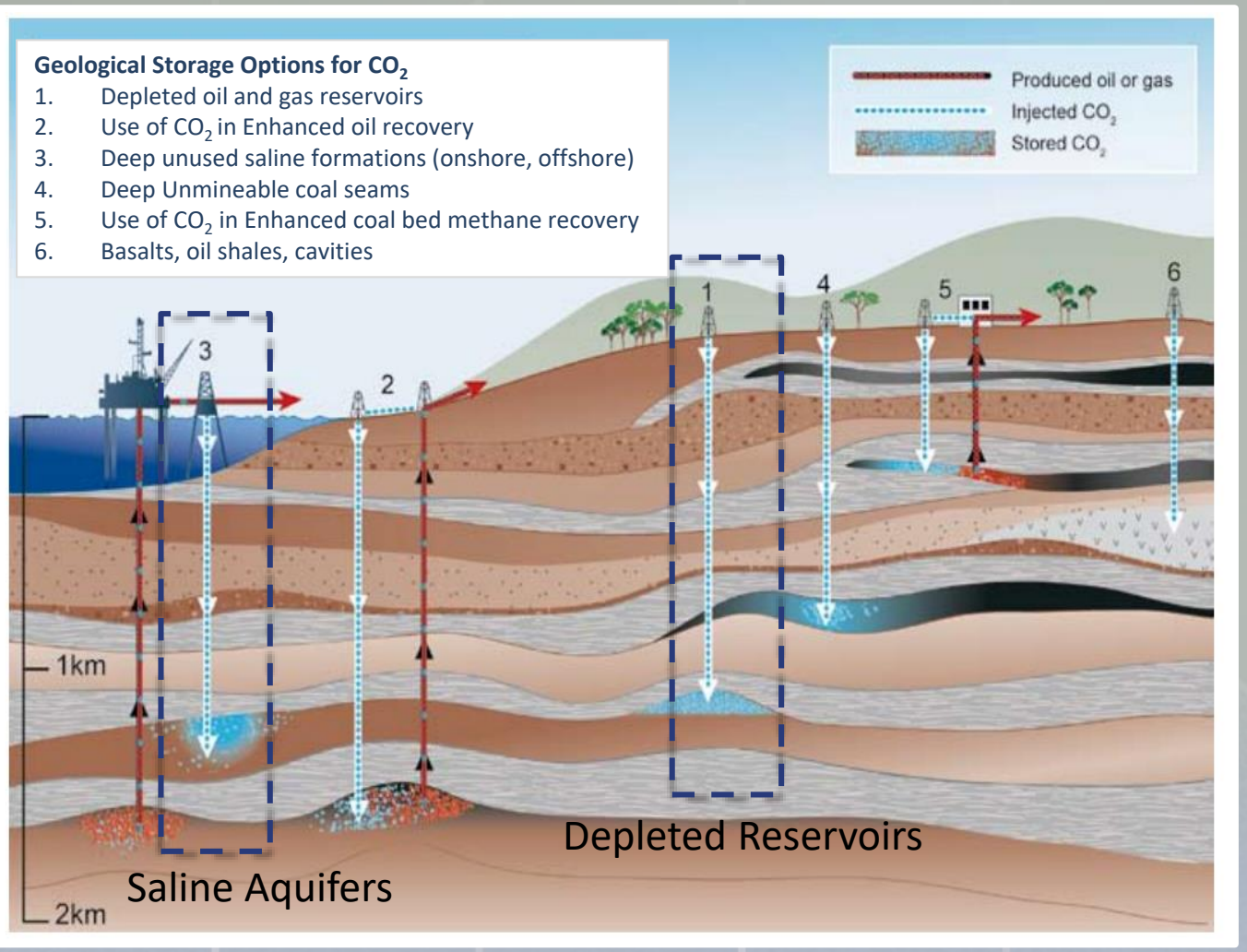
Image from Zero Emission Platform

- Injection of CO_2 into geological formations with the aim of permanently isolating the CO_2 from the atmosphere.
- CO_2 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 CO_2 permanently.

CARBON CAPTURE UTILIZATION AND STORAGE VALUE CHAIN

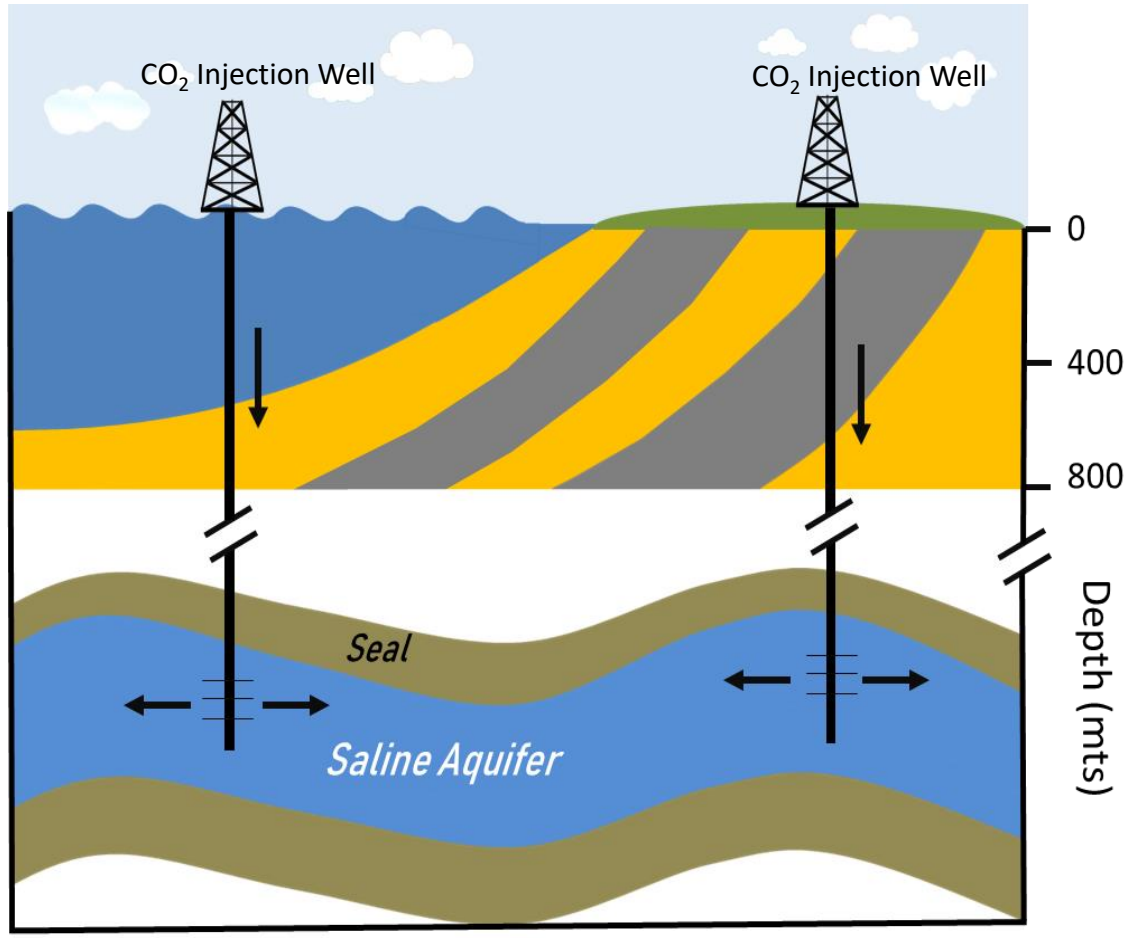


TYPES OF CARBON STORAGE FOR CO_2



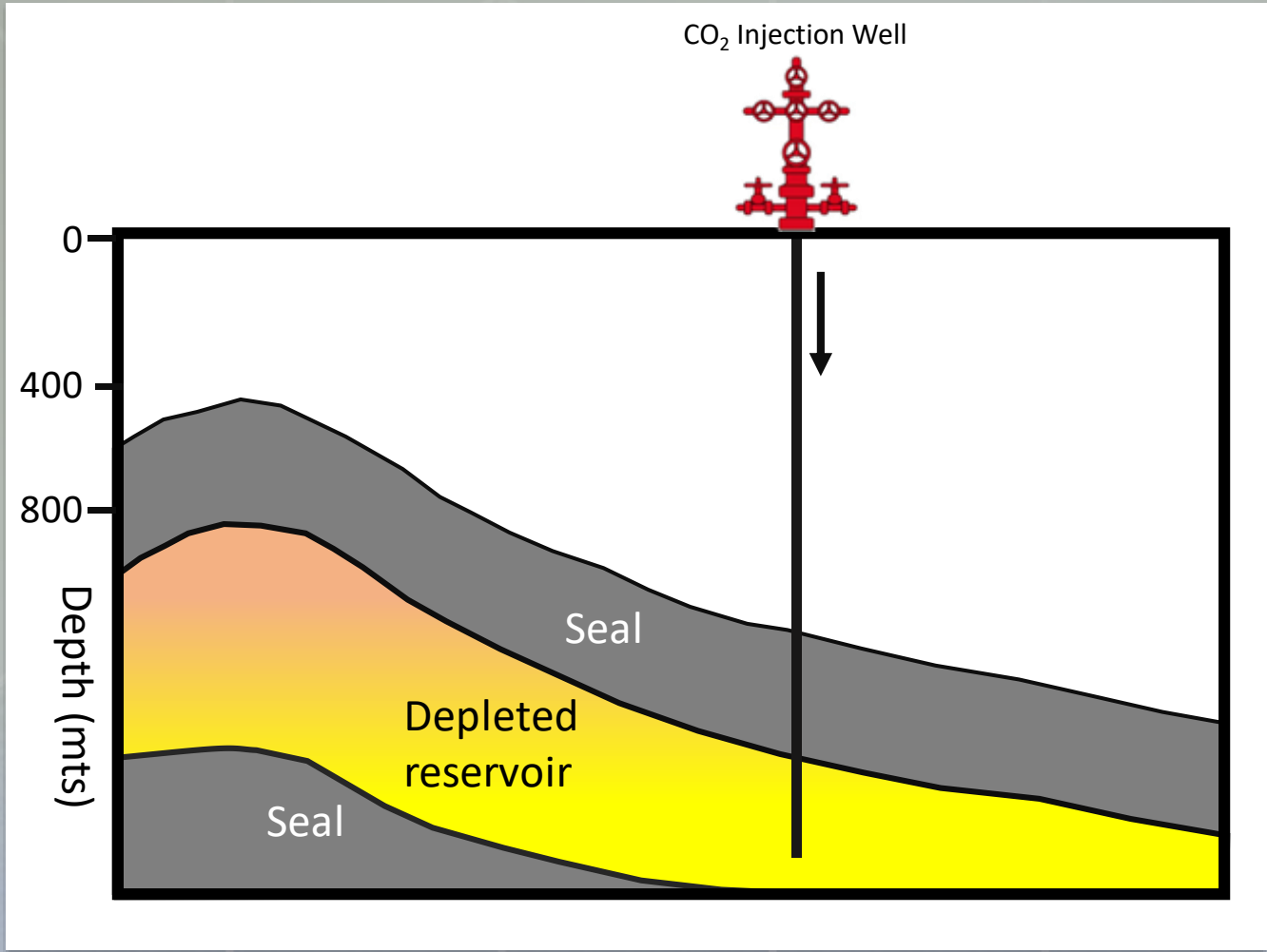
- SRMS only addresses CO_2 storage in:
  - Saline Aquifers
  - Depleted oil and gas reservoirs
- CO_2 - EOR Storage – not yet in the SRMS
- Effective storage sites should have:
  - Capacity
  - Injectivity
  - Containment

SALINE AQUIFERS



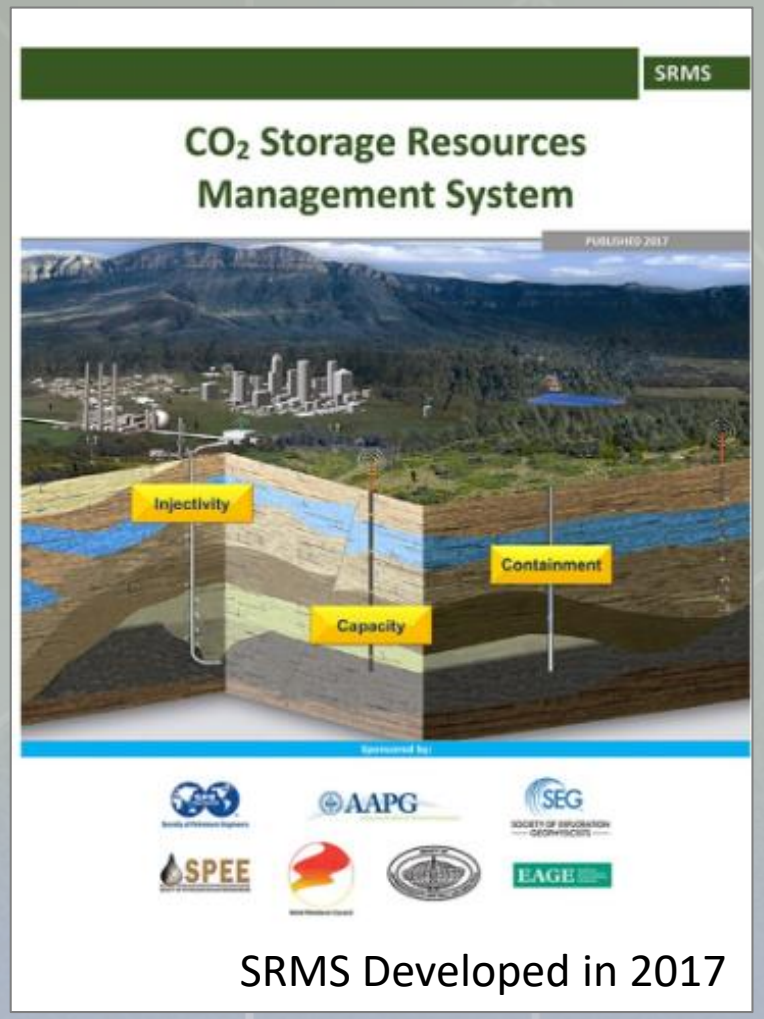
- Porous and permeable sedimentary rocks that contain salty, non-potable water (brine).
- Wide geographic distribution.
- 98% of the world's estimated CO_2 storage resources are in the form of saline aquifers with significant theoretical storage capacity.
- Current projects injecting in saline aquifers include:
  - Gorgon CCS (Australia)
  - Quest CCUS (Canada)
  - Sleipner and Snøhvit (Norway)

DEPLETED RESERVOIRS

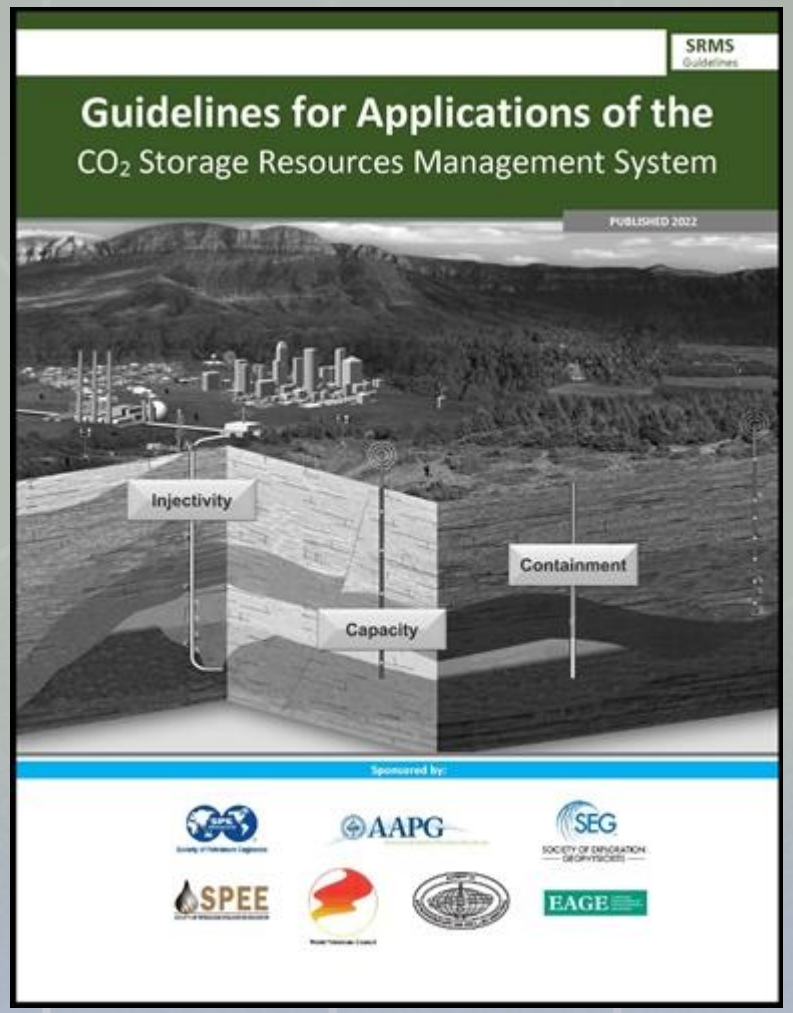


- Depleted oil and gas reservoirs become storage sites for CO_2.
- Portion of the pore volume saturated with unrecoverable oil and/or gas.
- Less than original reservoir pressure.
- Well defined reservoir with existing infrastructure.
- Storage capacity can be inferred based on the recovery of hydrocarbon.

STORAGE RESOURCES MANAGEMENT SYSTEM (SRMS)



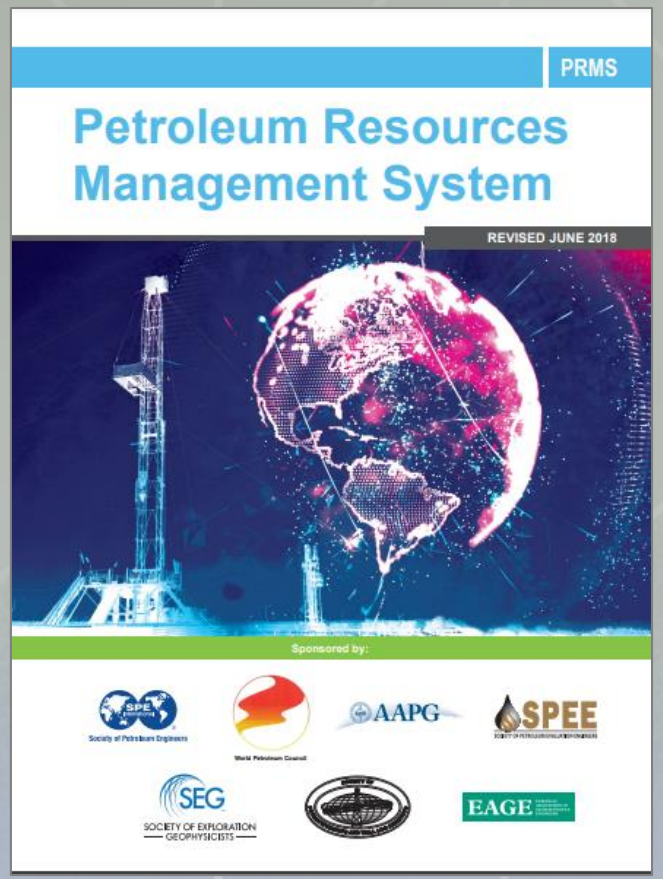
SRMS Developed in 2017



- It provides a framework in which CO_2 storage resources could be quantified, categorized, and classified.
- The SRMS functions in a similar manner to the Petroleum Resource Management System (PRMS).
- It is project based.
- The SRMS provides a measure of comparability and reduce the subjective nature of resources estimations.
- Available at the SPE website (www.spe.org)

PRECURSOR DOCUMENT: PRMS

PRMS Published in 2007
Updated in 2018

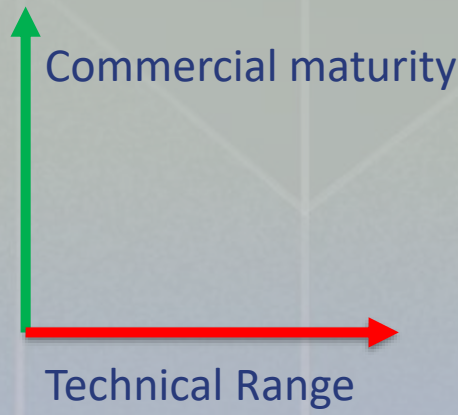


- To best understand the basis for the SRMS, it is necessary to understand the basis for the PRMS from which it was derived.
- SRMS has a very strong alignment with PRMS.
- PRMS has been time tested and widely adopted in the oil and gas industry and has become the globally accepted standard for hydrocarbon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

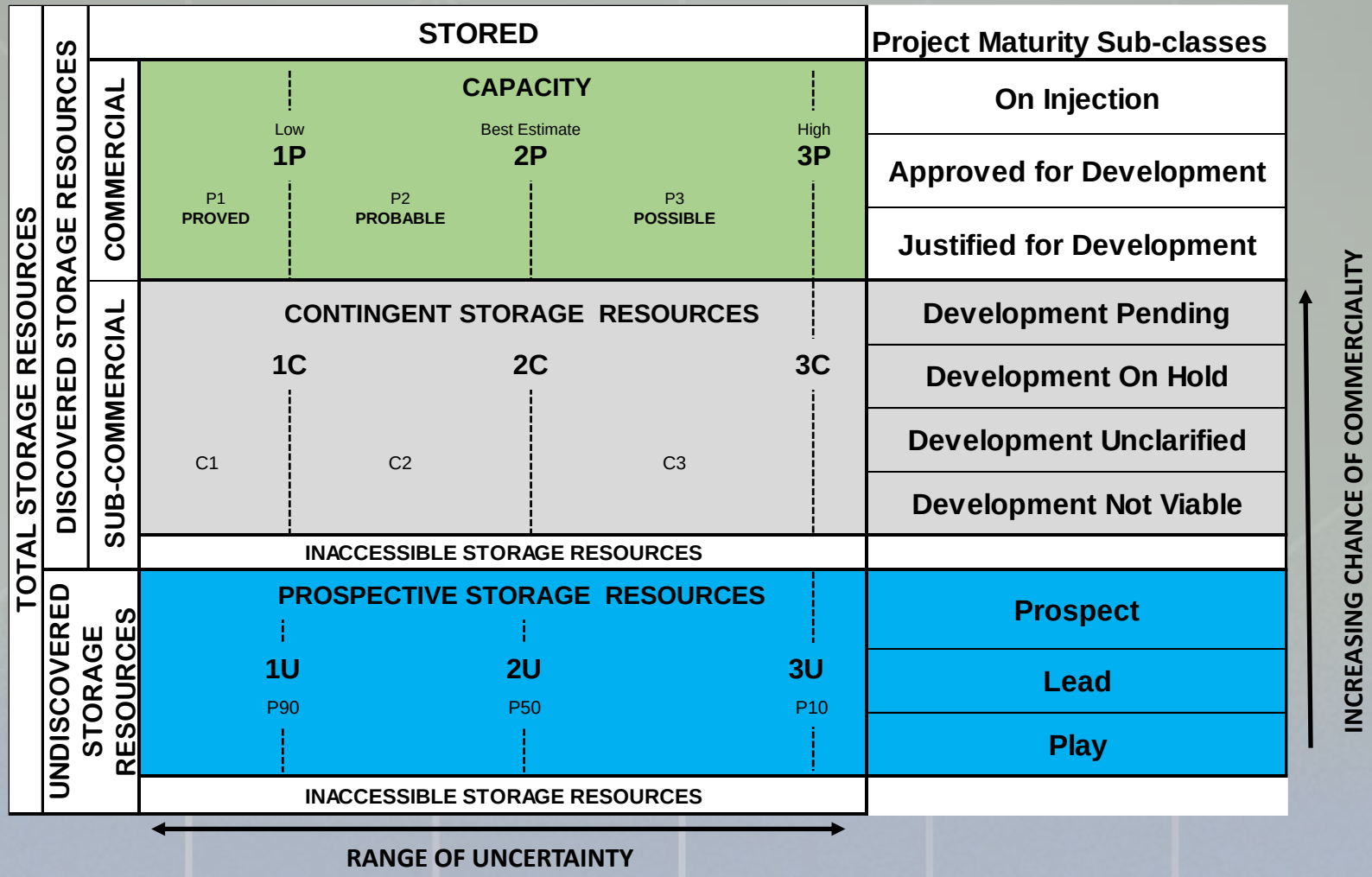
MOTIVATION FOR SRMS

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

- A consistent set of definitions and a classification system for CO_2 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



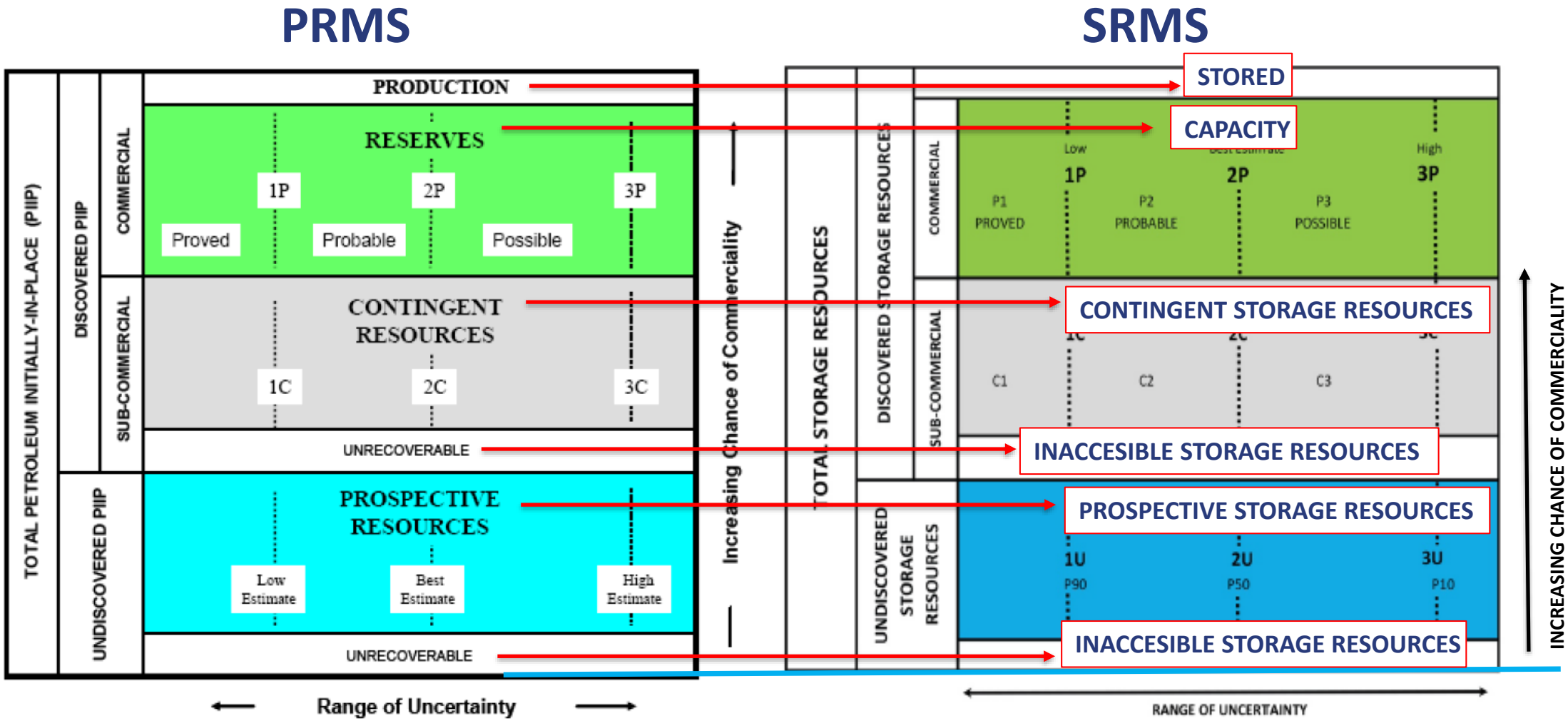
Classification

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

Categorization

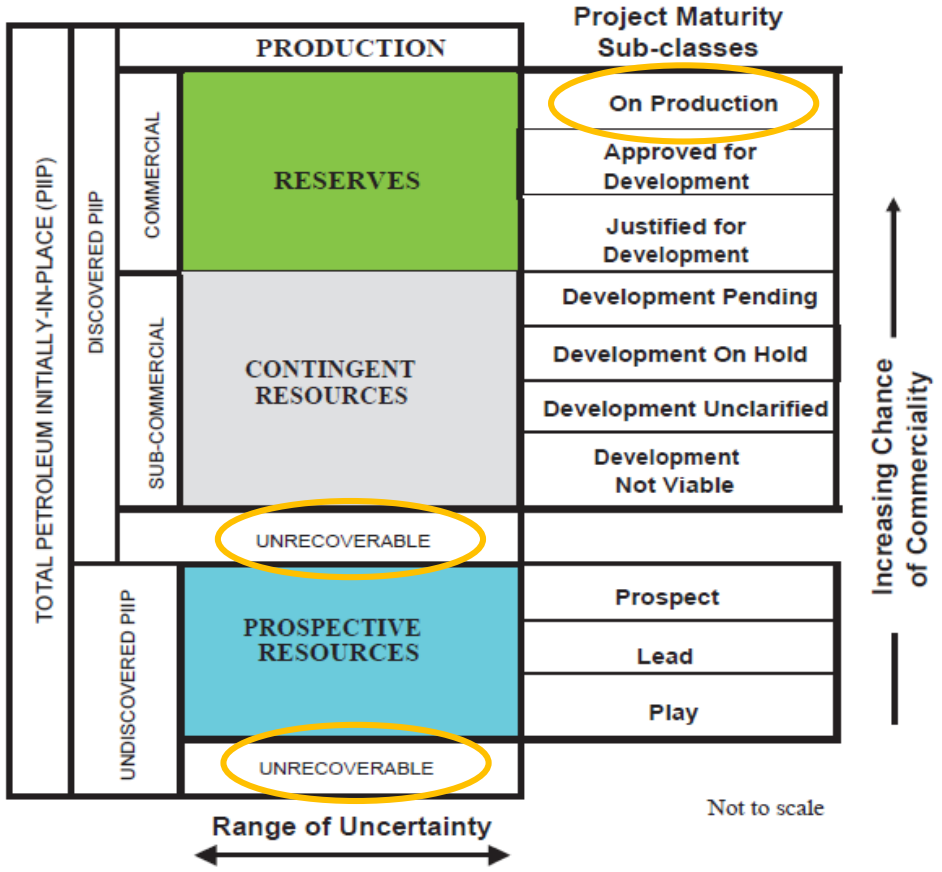
- **Based on certainty in an estimate**
- **Major Categorizations**
  - Low
  - Best Estimate (most likely)
  - High

FRAMEWORK COMPARISON

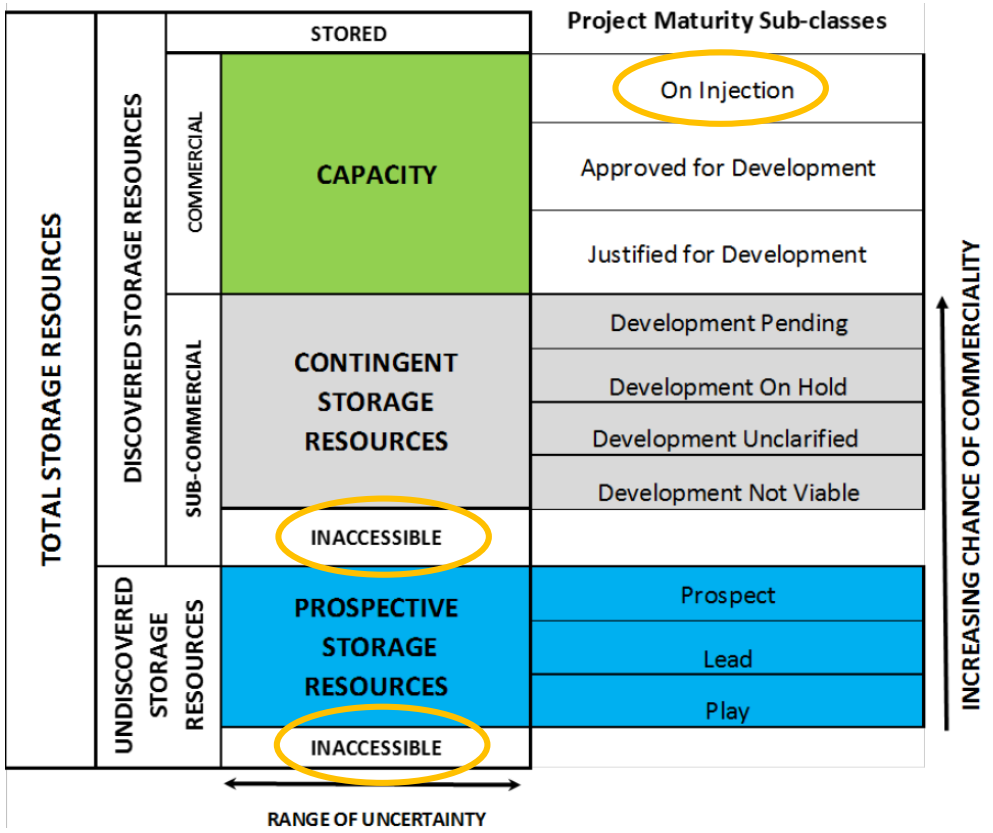


SUB CLASSES COMPARISON

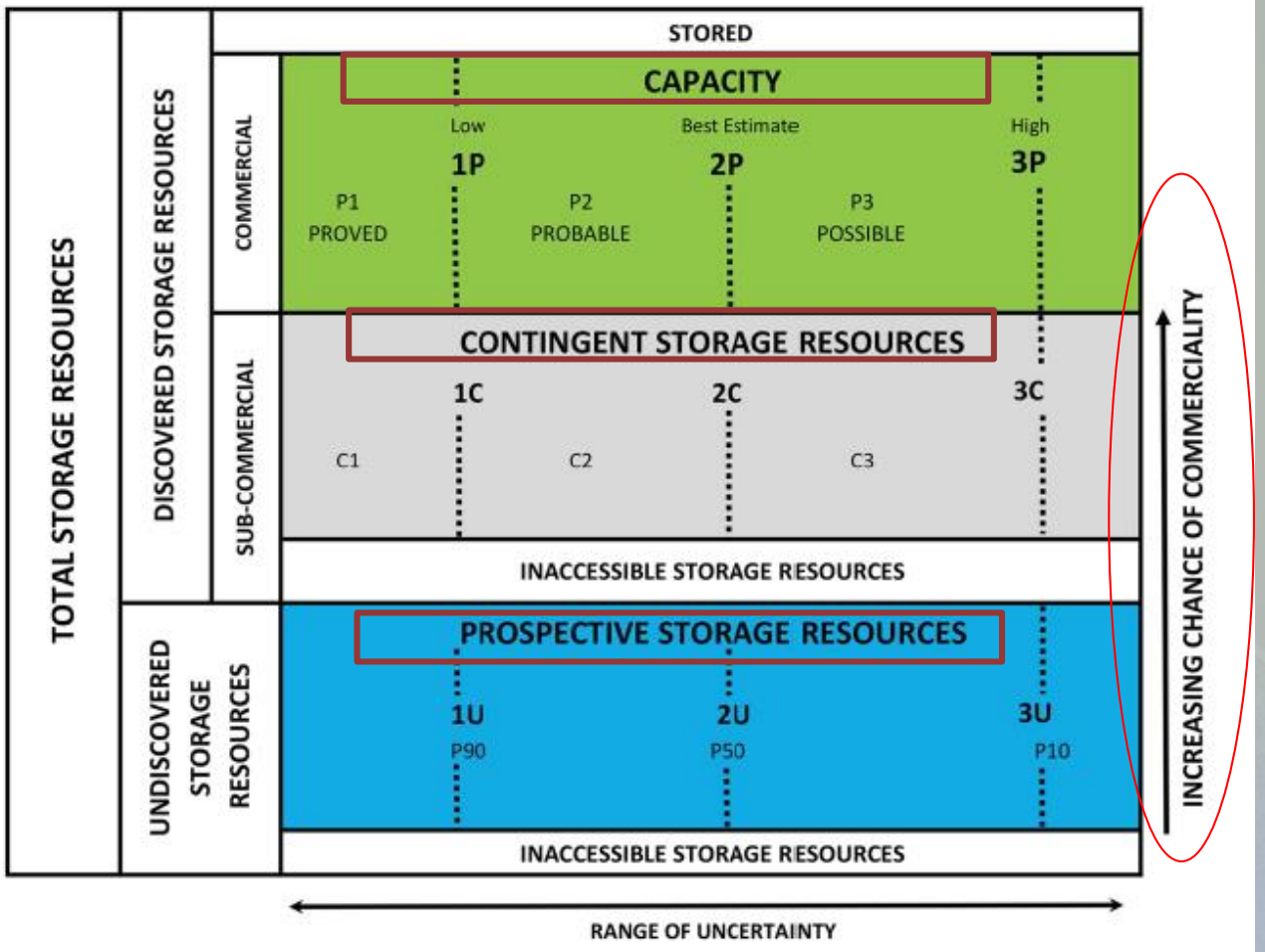
PRMS



SRMS



SRMS RESOURCES CLASSIFICATION FRAMEWORK



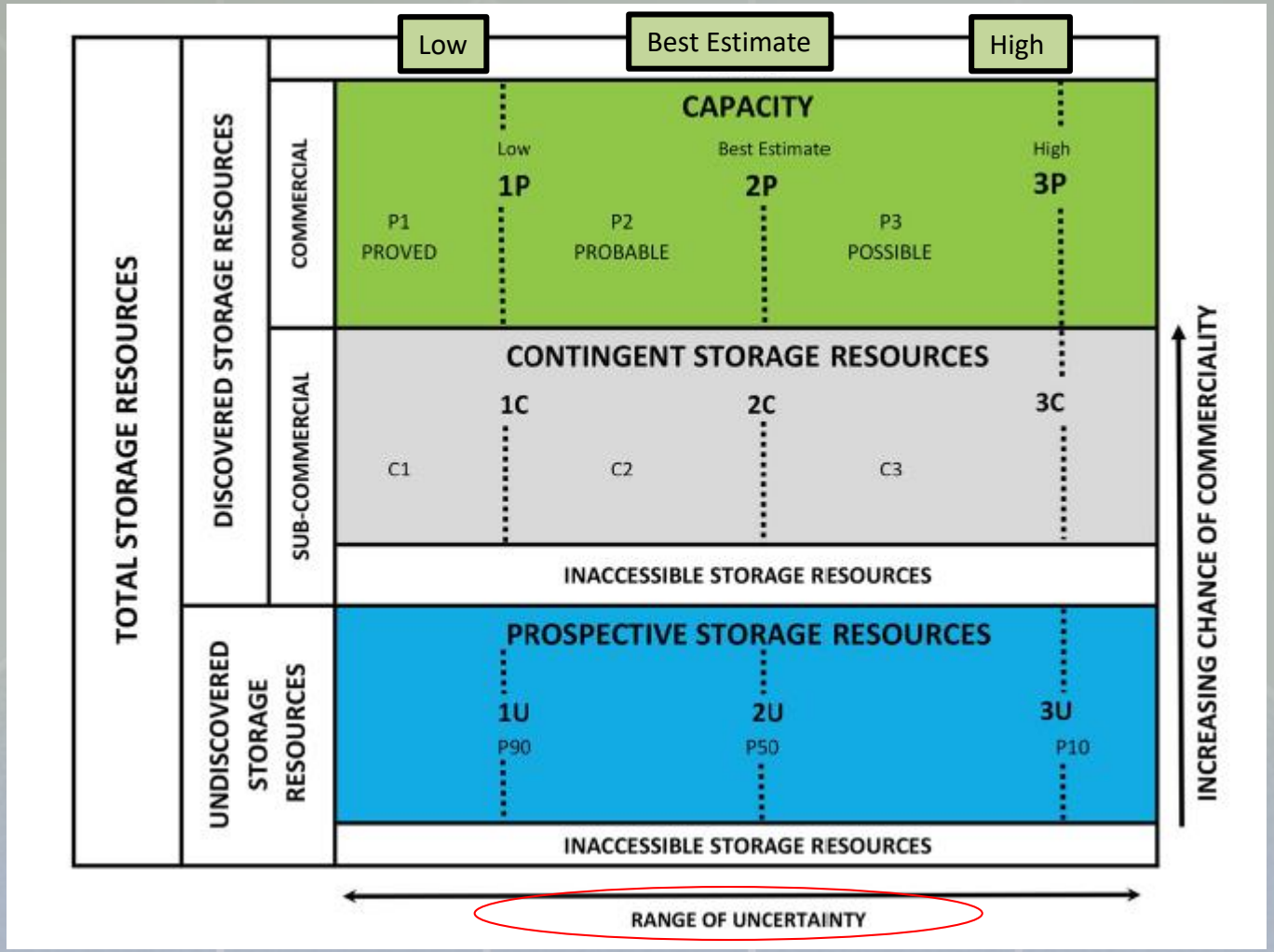
"Chance of Commerciality" is the chance that the project will be developed and reach commercial storage status.

Classification 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



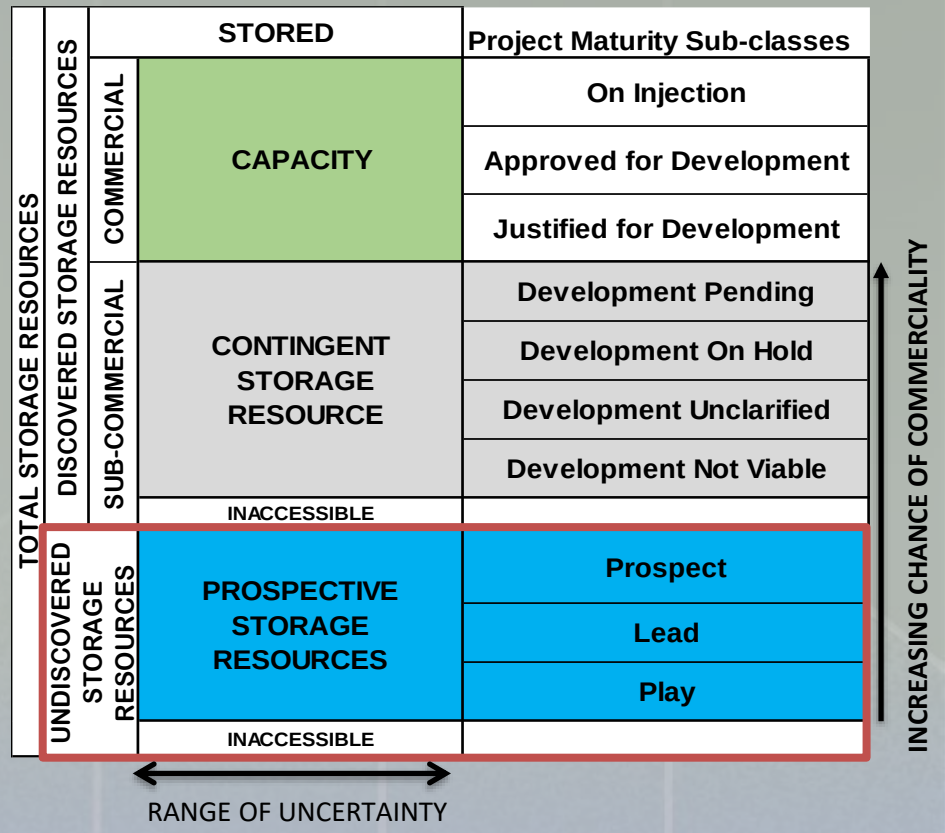
"Range of Uncertainty" reflects a range of storable quantities that are forecasted to be injected and stored.

Categorization - Based upon storage resource volume uncertainty range

- **Low Case**
- **Best Case**
- **High Case**

CLASSIFICATION: UNDISCOVERED
PROSPECTIVE STORAGE RESOURCES

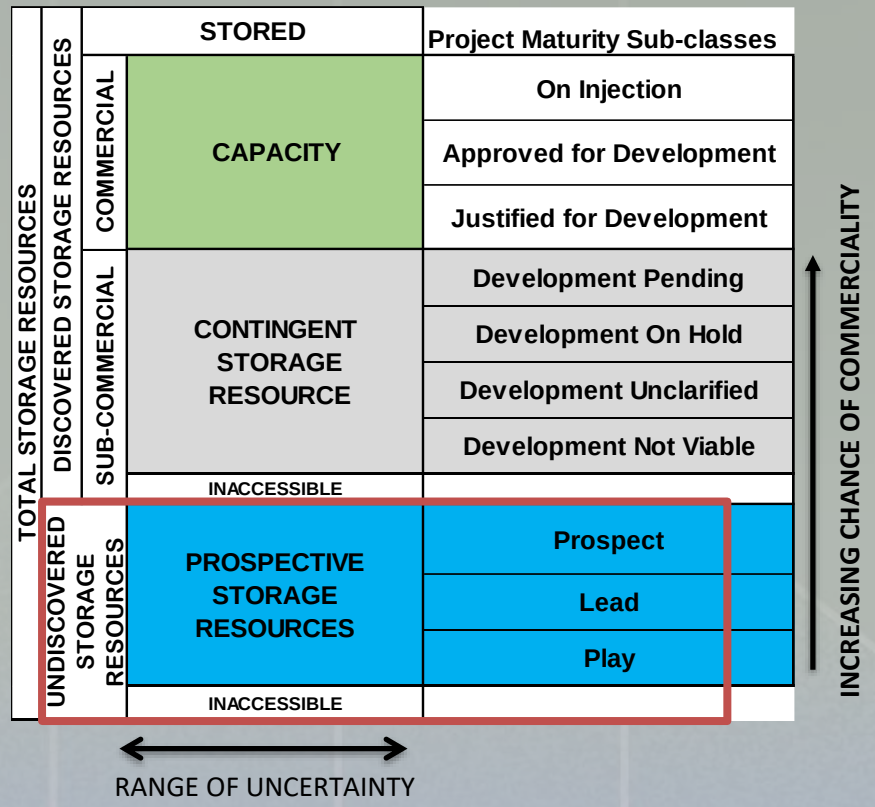
- Undiscovered storable quantities of pore volume in a geological formation that are estimated, as of a given date, to be accessible by application of future exploration/development projects.
- It can also include uncharacterized parts of discovered geologic formations
- Currently is evaluated for potential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



CLASSIFICATION: UNDISCOVERED
PROSPECTIVE STORAGE RESOURCES

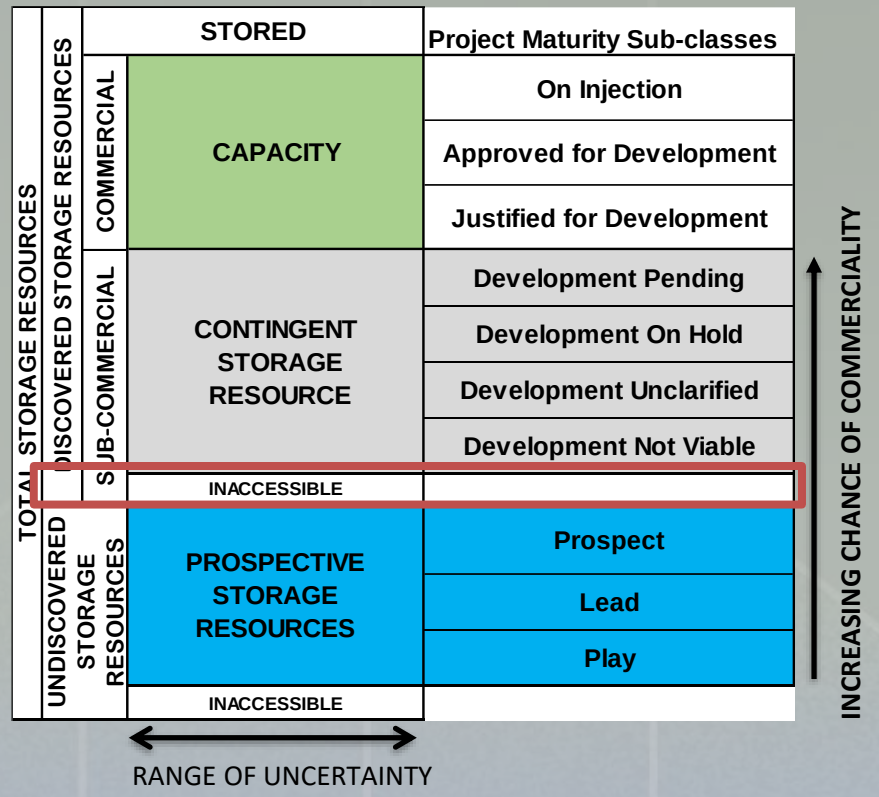
- There is no well yet or has not been assessed.
- **Play**: Prospective trend of potential prospects, but that requires more data acquisition and/or evaluation to define specific leads or prospects.
- **Lead:** Currently poorly defined and requires more data acquisition and/or evaluation to be classified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



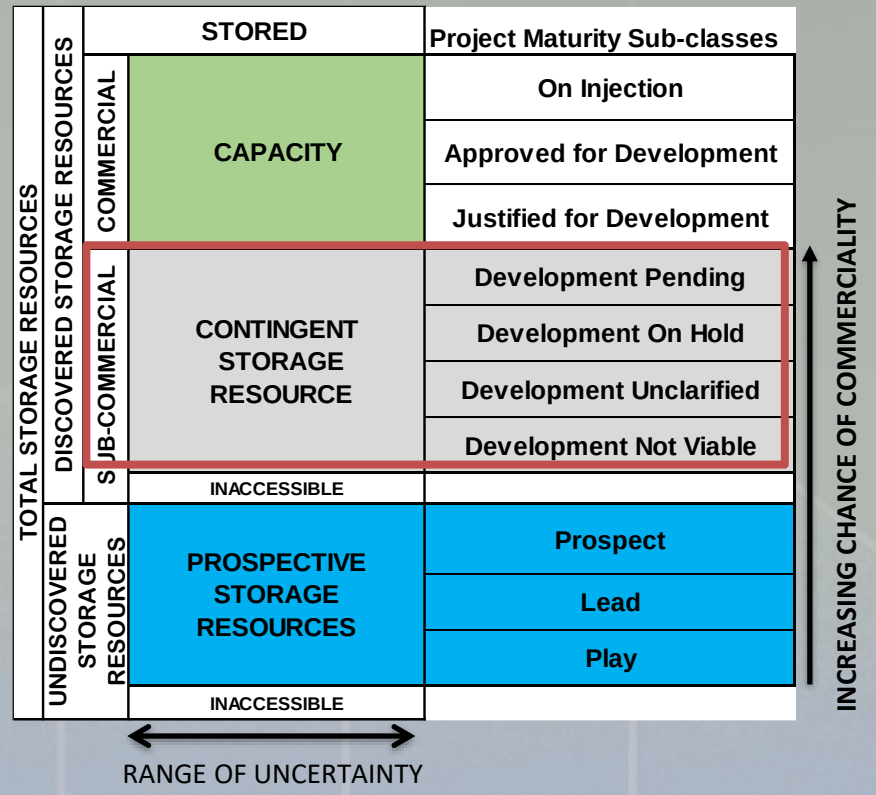
INACCESSIBLE STORAGE RESOURCES

- 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.



CLASSIFICATION: DISCOVERED, SUB-COMMERCIAL
CONTINGENT STORAGE RESOURCES

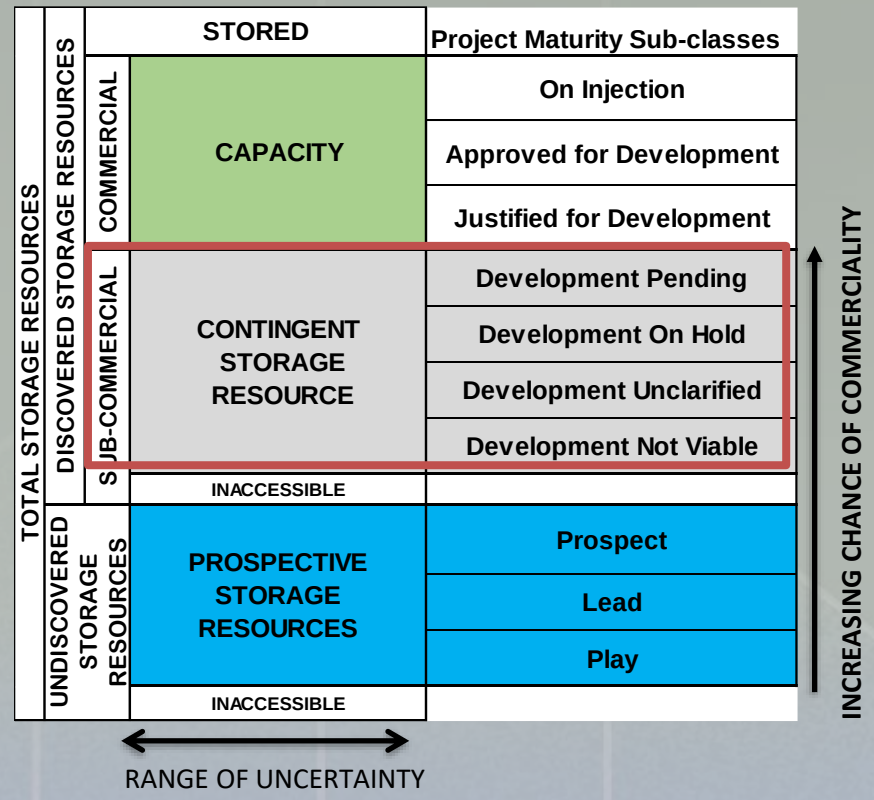
- Those quantities of Total Storage Resources, as of a given date, to be accessible quantities in known geological formations but the applied project(s) are not yet mature enough for commercial development, as a result of one or more contingencies.
- Contingencies:
  - No viable source of CO_2
  - Project 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

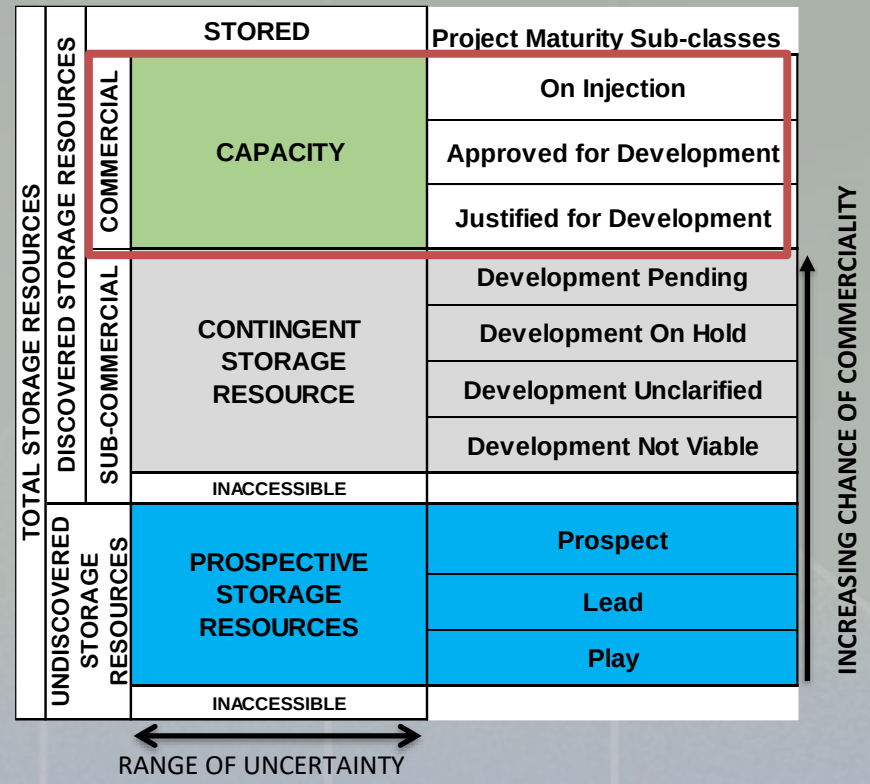
- **A well exists and has been assessed.**
- **Development Not Viable:** Discovered storable quantities for which there are no current plans to develop or to acquire additional data at the time as a result of limited storage potential.
- **Development Unclarified:** Discovered storable quantities where 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.



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.



CLASSIFICATION: CAPACITY
DISCOVERED, COMMERCIAL STORAGE RESOURCES

- **Justified for Development**

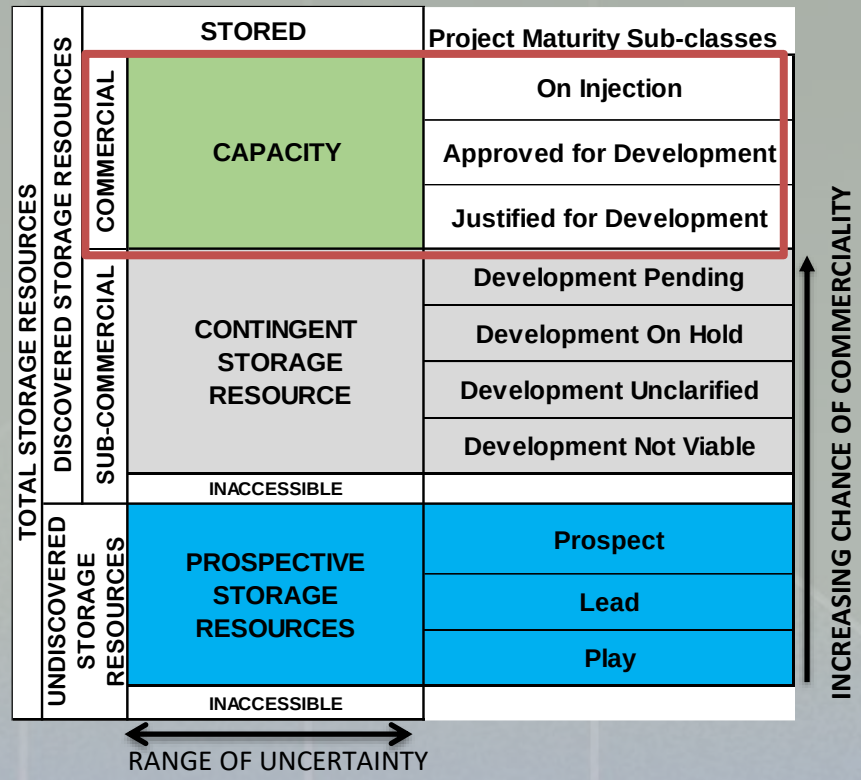
  Implementation of the development project is justified on the basis of reasonable forecast commercial conditions at the time of reporting, and there are reasonable expectations that all necessary approvals will be obtained.

- **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 CO_2.



CLASSIFICATION
CAPACITY STATUS

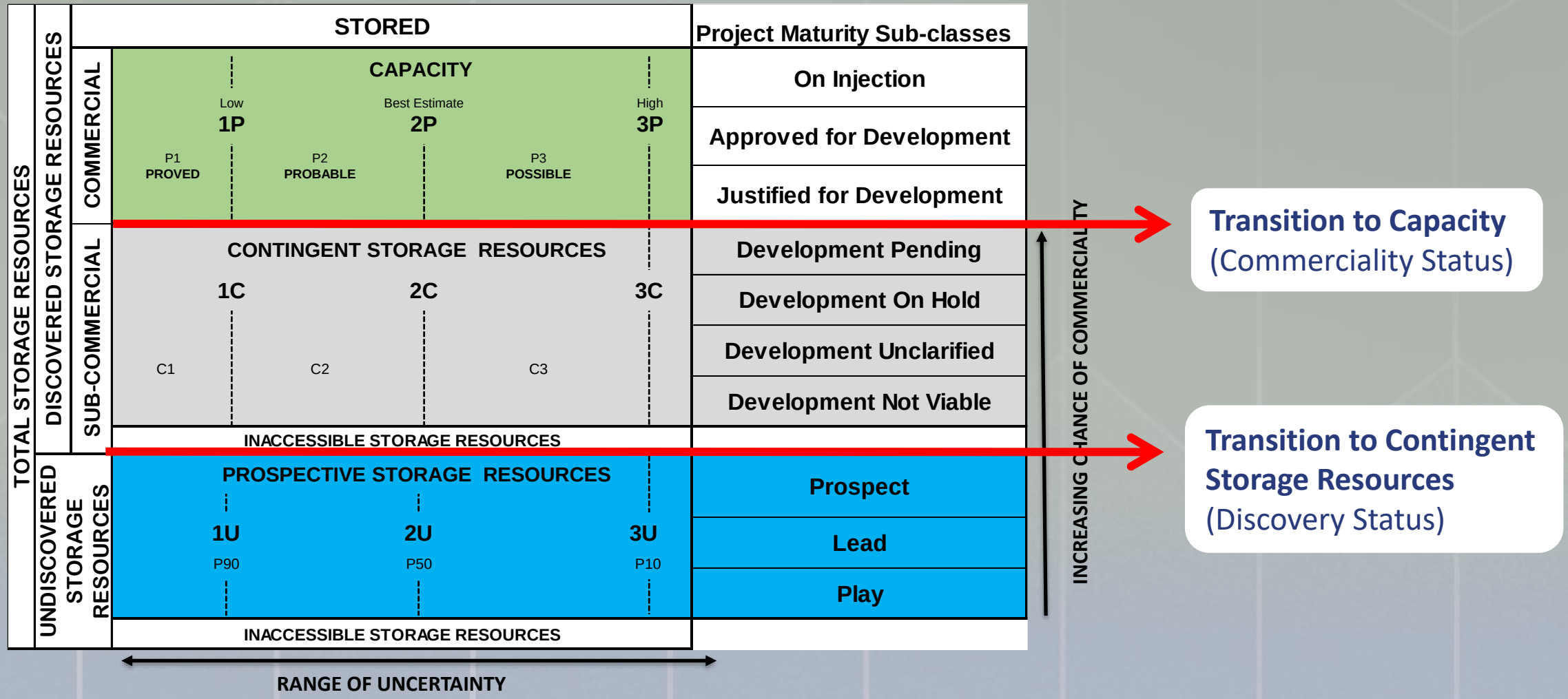
- **Based on the operational status.**
- **Developed Capacity:** Expected quantity that can be stored by leveraging from existing wells and facilities.
  - **Developed Injection Capacity is expected to be storable from completion intervals that are open and injecting at the time of the estimate.**
  - **Developed Non-Injecting Capacity includes shut-in and behind-pipe.**
- **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 Not Viable Contingent Storage Resources**
  - Storable quantities for which development projects are not economic or not expected to be economic, even considering reasonable improvements in condition.

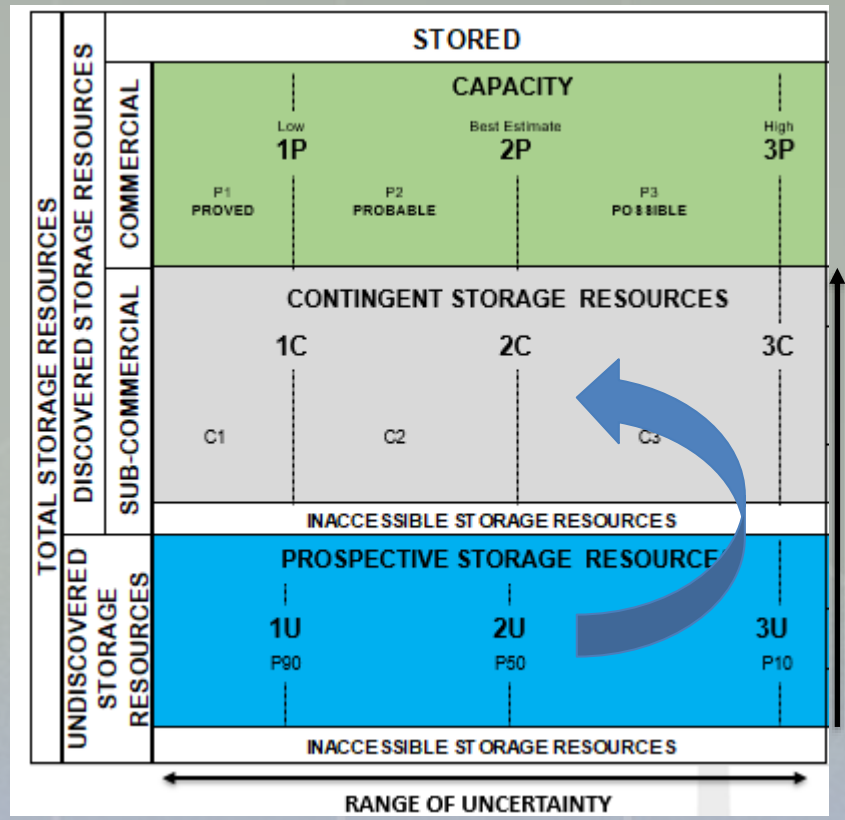
Project Maturity Sub-classes Contingent Storage Resources	Economic Status
Development Pending	Economically Viable
Development On Hold	
Development Unclarified	Economically Not Viable
Development Not Viable	

SRMS RESOURCES CLASSIFICATION FRAMEWORK



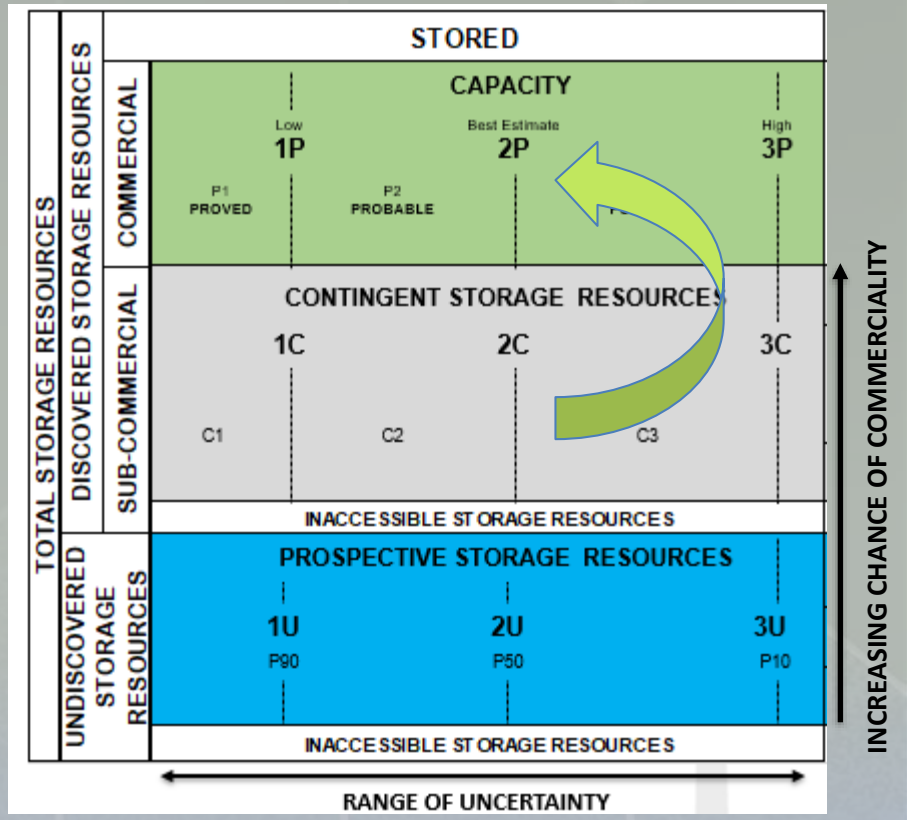
DISCOVERY

- 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 CO_2 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



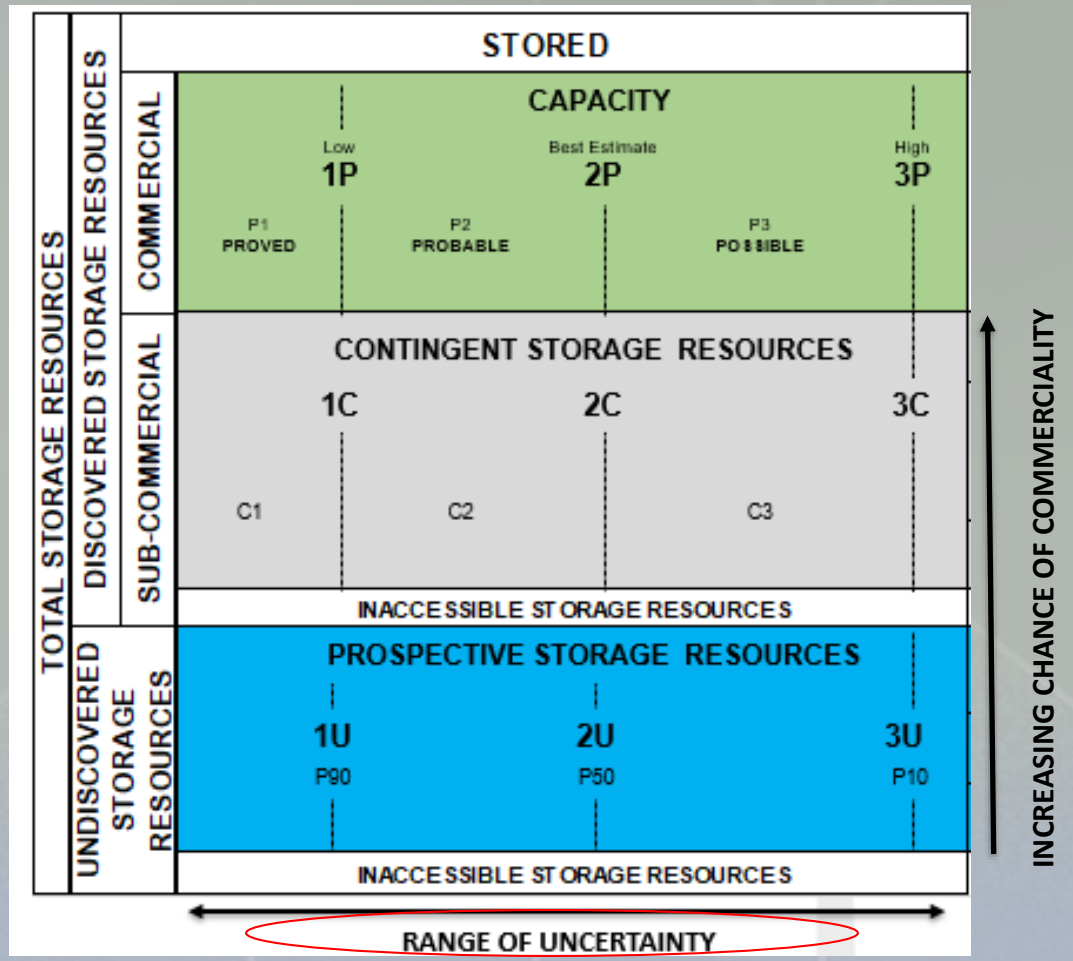
COMMERCIALITY

- Requires commitment.
- Reasonable expectation of being developed.
- Project profitability meets company's investment screening and operating criteria.
- Reasonable time frame.
- A reasonable expectation that there will be sustained demand for storage.
- Evidence that the injection facilities 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.

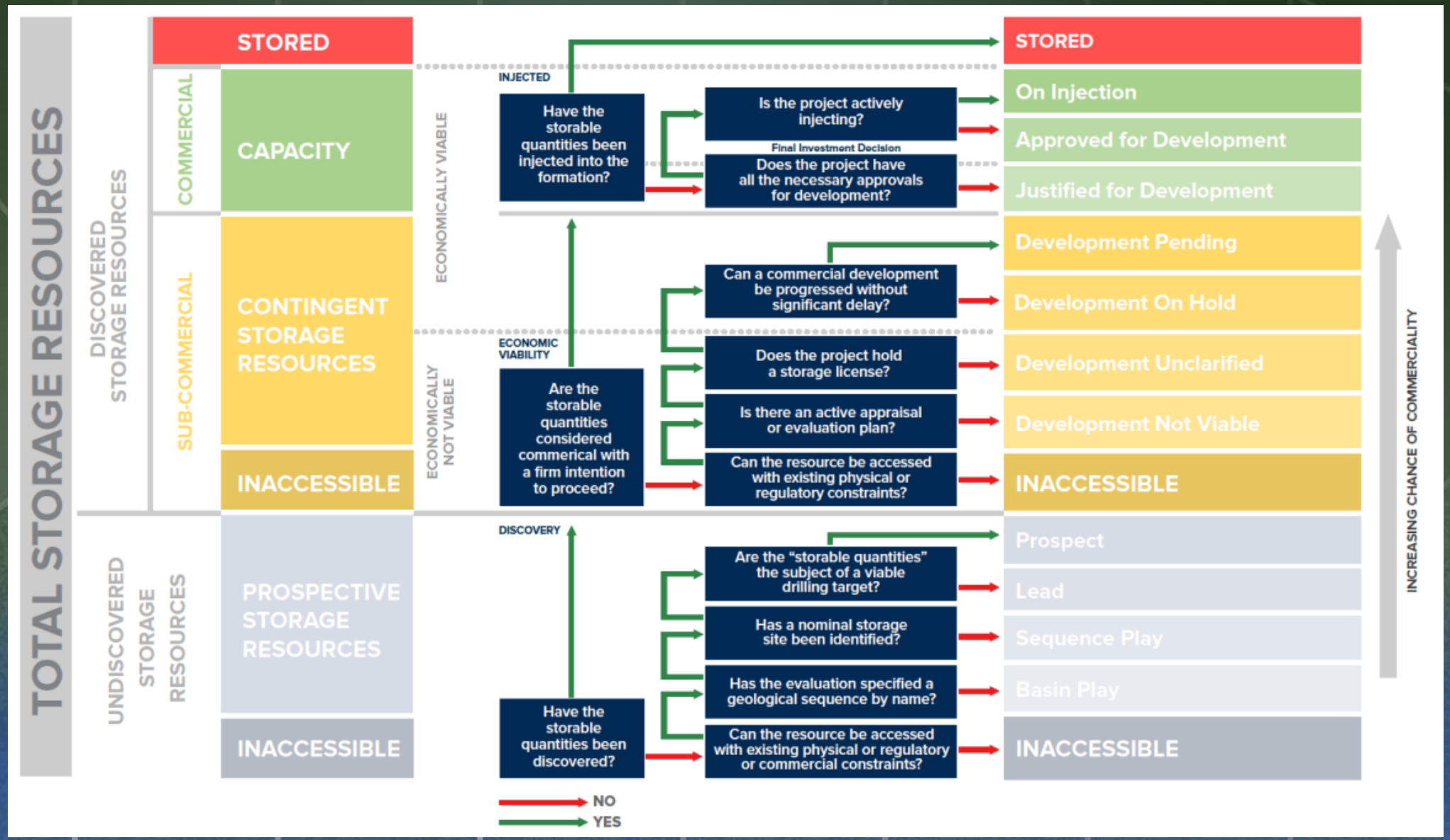
- **Probable (P2) – Probable Capacity (P50)**

  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)**

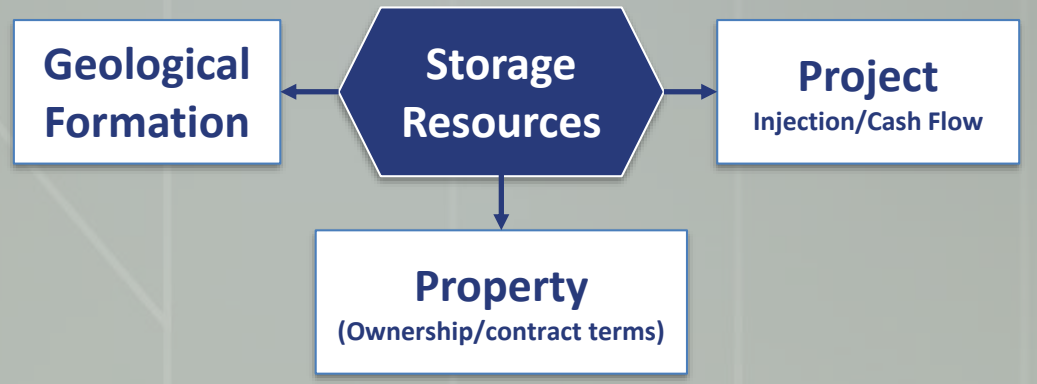
  The additional storable quantities, which analysis of geoscience and engineering data suggest are less likely to be used for storage than Probable Capacity.

FLOW DIAGRAM GUIDE TO ASSIGNING SRMS SUB-CLASSES



Oil and Gas Climate Initiative – CO_2 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 CO_2 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.

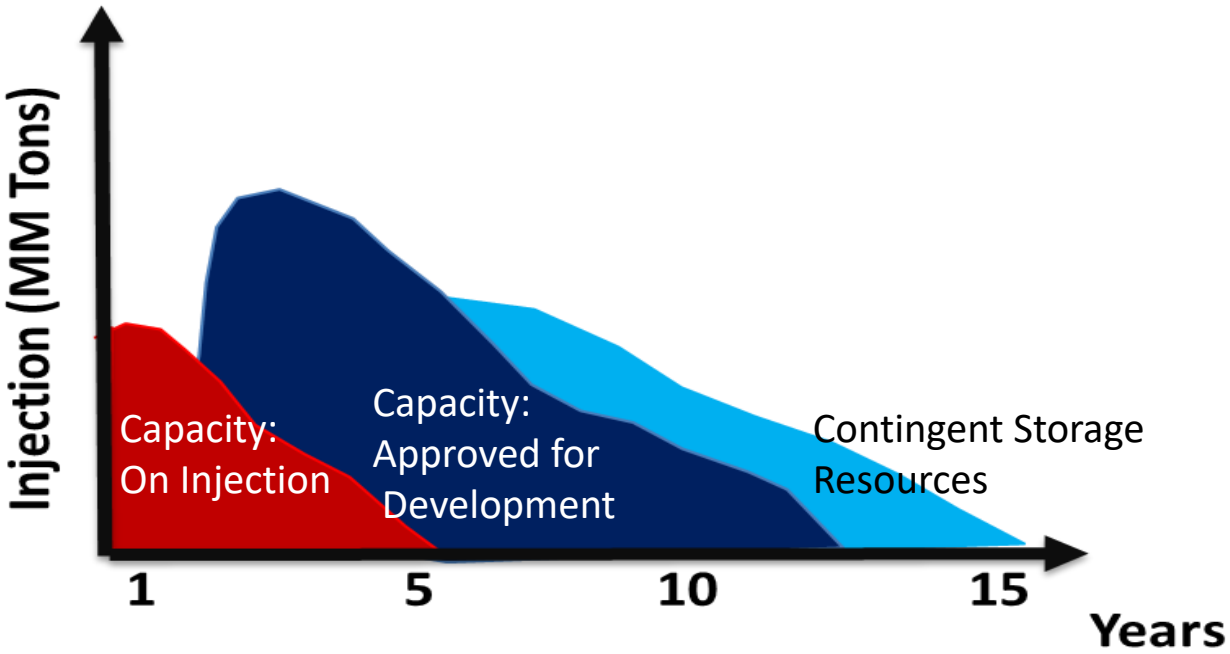
STORAGE RESOURCES ARE PROJECT BASED

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, CO_2 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 CO_2, 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"

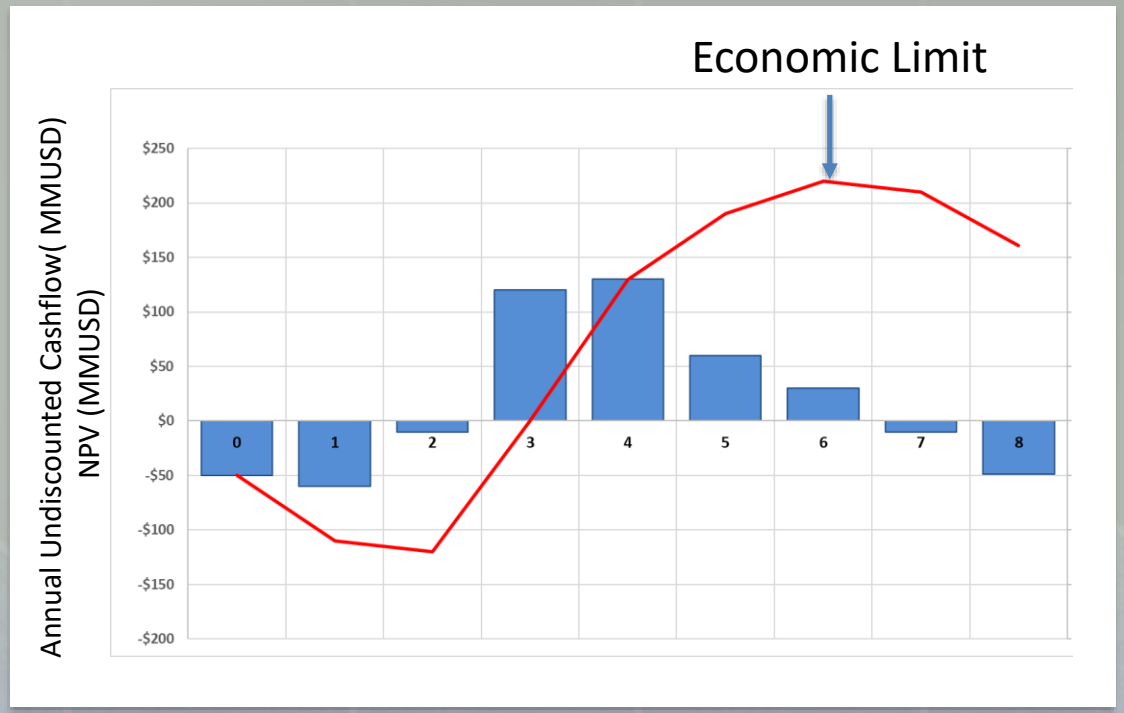
"… storage project is expected to be developed and placed on injection within a reasonable timeframe" (Five years)

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 hydrocarbon-producing 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 CO_2 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

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