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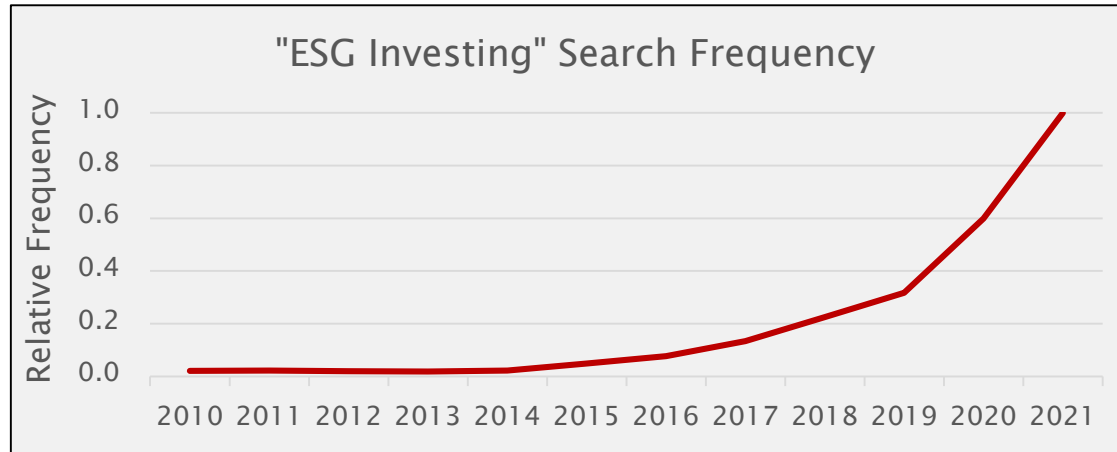
WORLDWIDE PETROLEUM CONSULTANTS

Carbon Capture and Storage
Reliable Investment Evaluations in an
Evolving Industry

EnerCom Dallas
April 6, 2021



Interest in ESG Investing is Trending Up Significantly



Bloomberg.com

Occidental to Strip Carbon From the Air and Use It to Pump Crude

- A new technology could help reduce pollution at the same time it increases the supply of fossil fuels

jpt.spe.org

ExxonMobil Doubles Down on Carbon Capture in \$3-Billion Plan To Lower Emissions

The US oil giant is launching a new business unit that will boost its ability to reduce its own greenhouse gas emissions along with those of other industries.

theguardian.com

BP leads energy companies preparing two major UK carbon capture projects

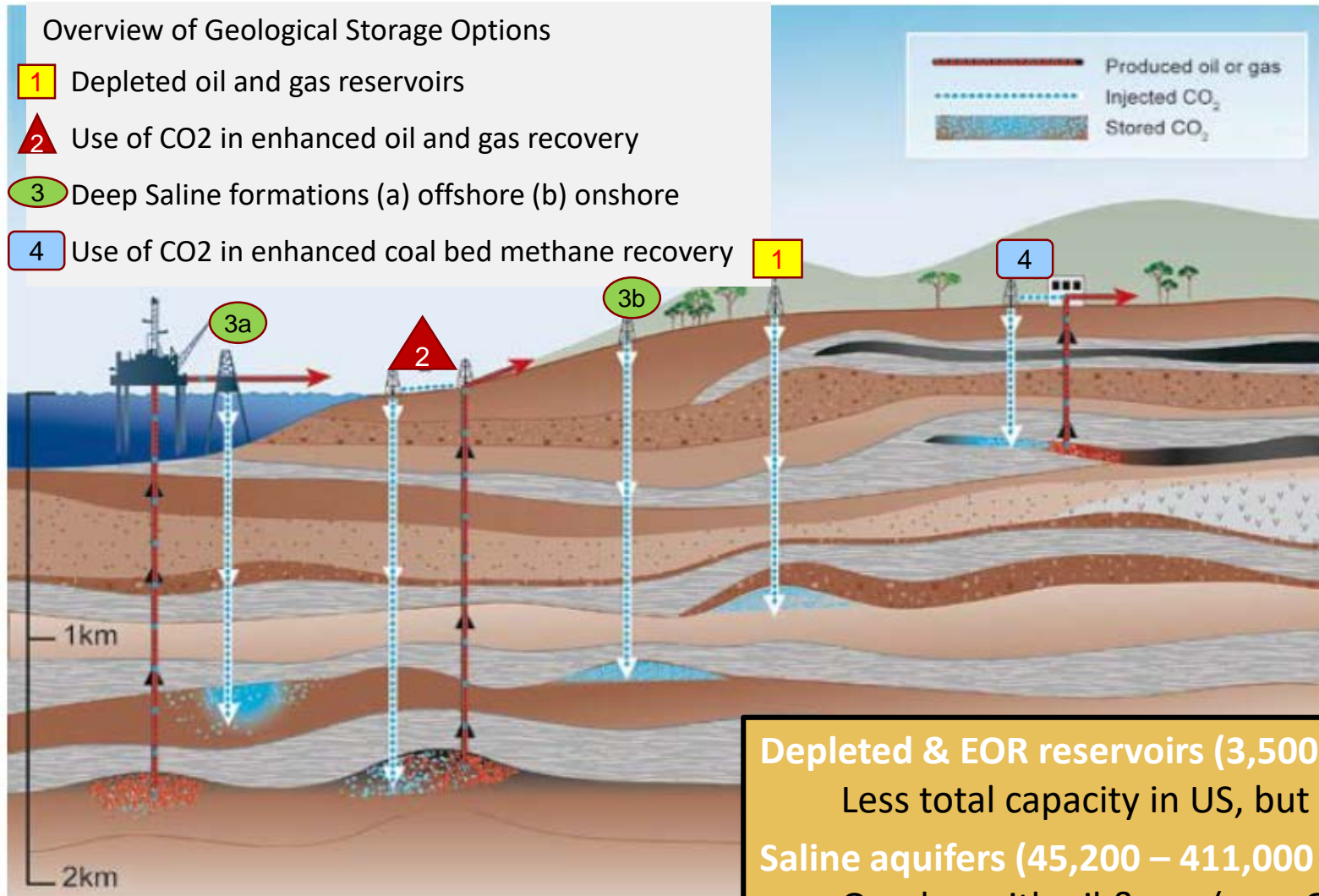
17m tonnes of carbon dioxide to be stored beneath the North Sea every year



Types of Carbon Storage

Overview of Geological Storage Options

- 1 Depleted oil and gas reservoirs
- 2 Use of CO₂ in enhanced oil and gas recovery
- 3 Deep Saline formations (a) offshore (b) onshore
- 4 Use of CO₂ in enhanced coal bed methane recovery



Source: IPCC "Carbon Capture Special Report"



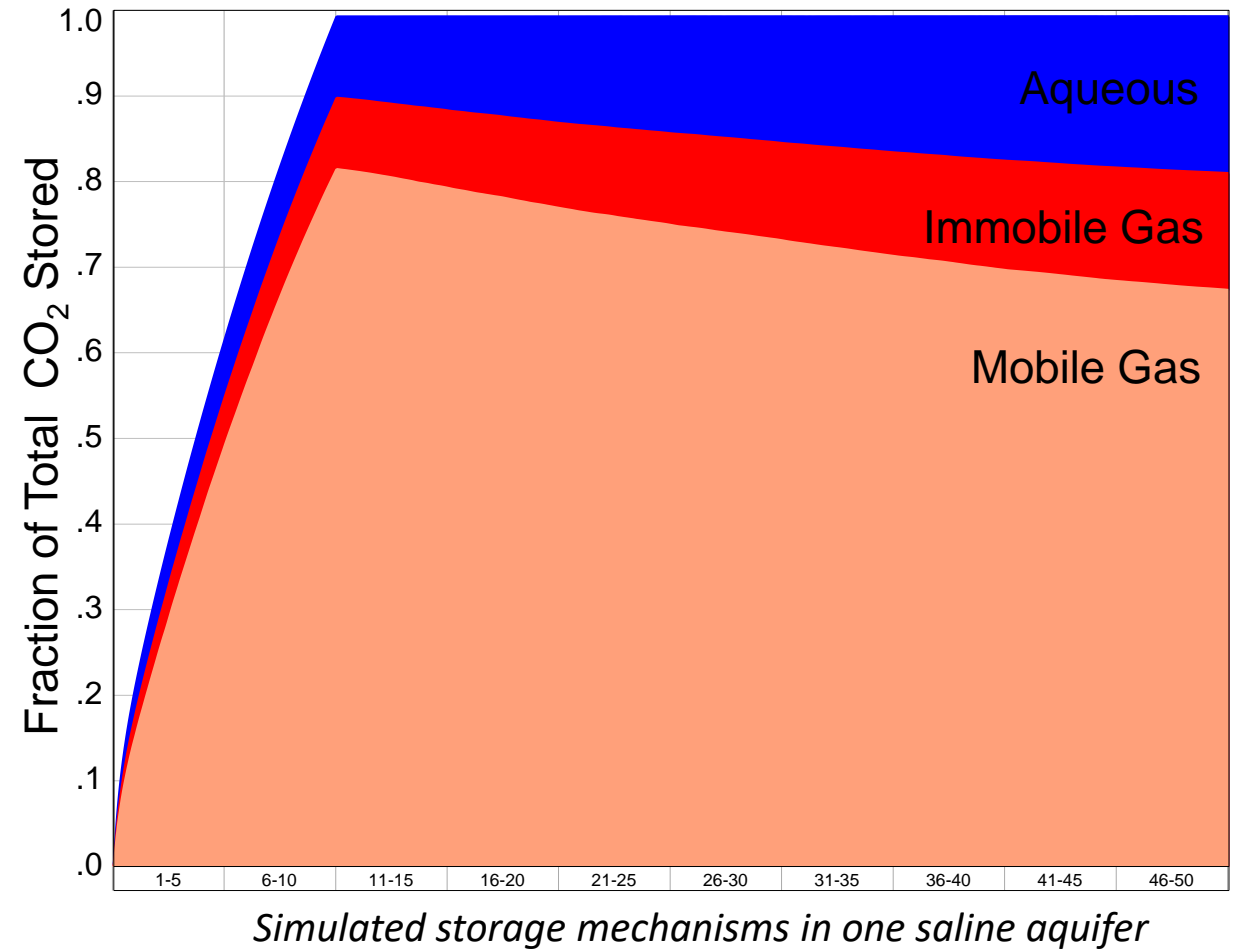
CCS Technical Forecasting

- CCS projects have similar data needs and analysis methods to traditional oil and gas evaluations
 - Require engineering and geoscience to model injection rates, capital requirements
 - Also similar to natural gas storage facilities
 - Uncertainty due to the nature of evaluating subsurface assets
- CO₂ density increases with transition from gas to supercritical fluid
- Relatively few carbon sequestration projects are online as analogs
 - Contrast to E&P projects where analogy and volumetrics are most reliable pre-production
 - Subsurface assessments of these projects rely heavily on simulation modeling
 - Modeling also plays a key role in monitoring requirements (Area of Review)



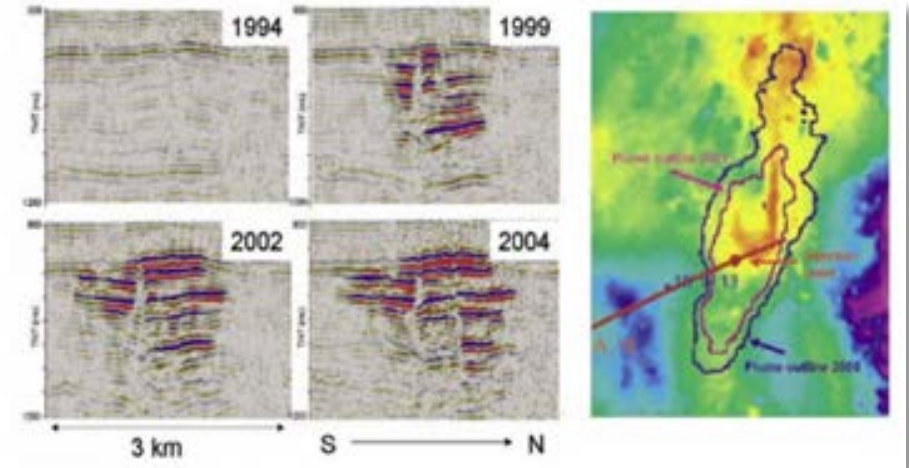
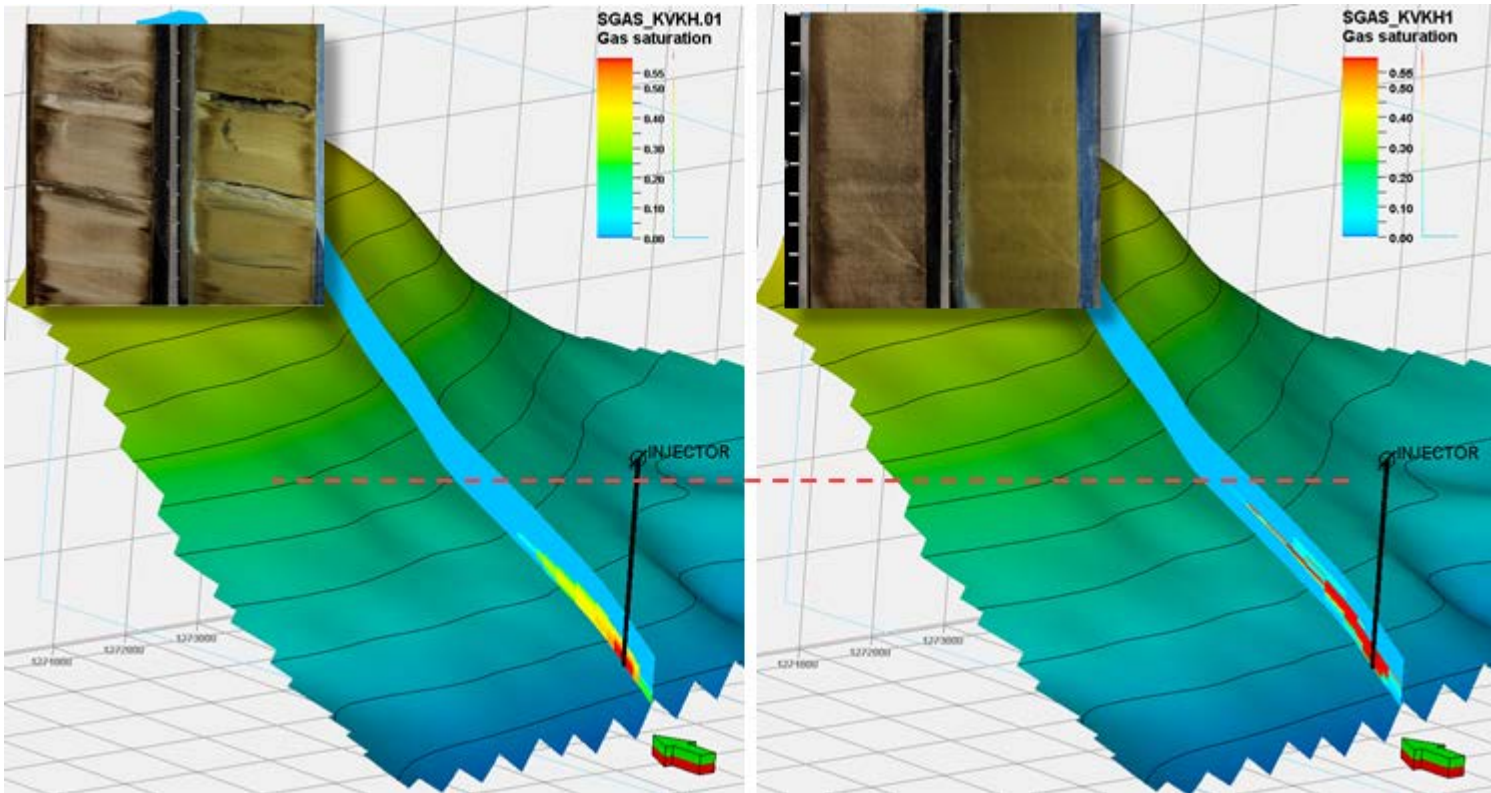
Carbon Capture Simulation

- Simulation models help evaluators understand complex behavior and range of uncertainty
 - Typical rock property uncertainty (perm, rel perm, residual saturation)
 - Transient behavior with large aquifers
- CO₂-water interactions cause behavior not typical in E&P projects
 - Dissolution in water is a component of storage mechanisms
 - Stimulation of reservoir from acidification of brine
 - Precipitation of salts in reservoir due to dehydrated injection stream

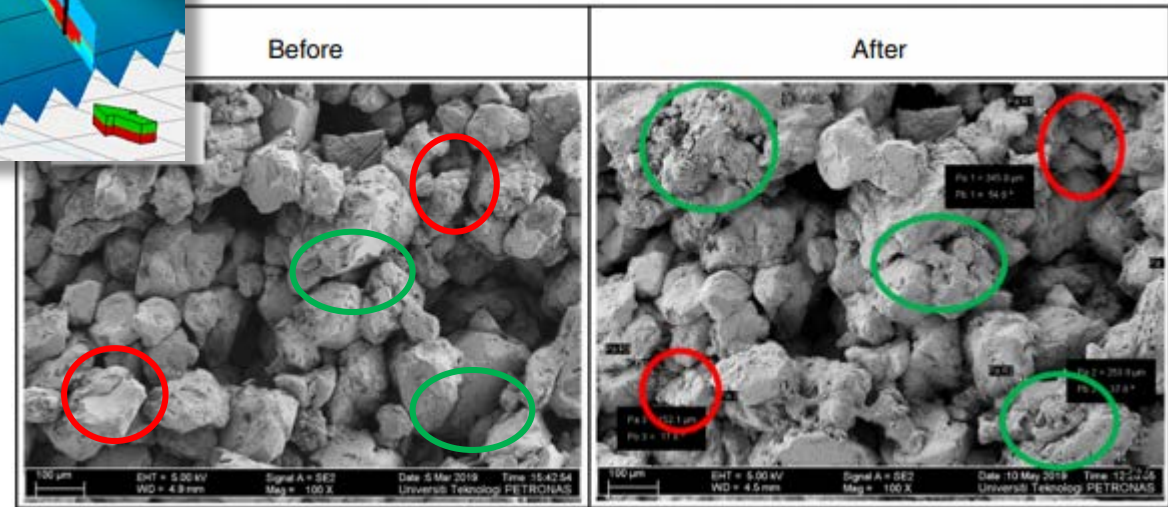




Geologic Considerations



Source: EPA UIC Class VI Well Testing and Monitoring Guidance



Source: Yusof, et al. *Effects of CO₂/Rock/Formation Brine Parameters on CO₂ Injectivity for Sequestration*



Flowstream to Cash Flow: 45Q Tax Credits

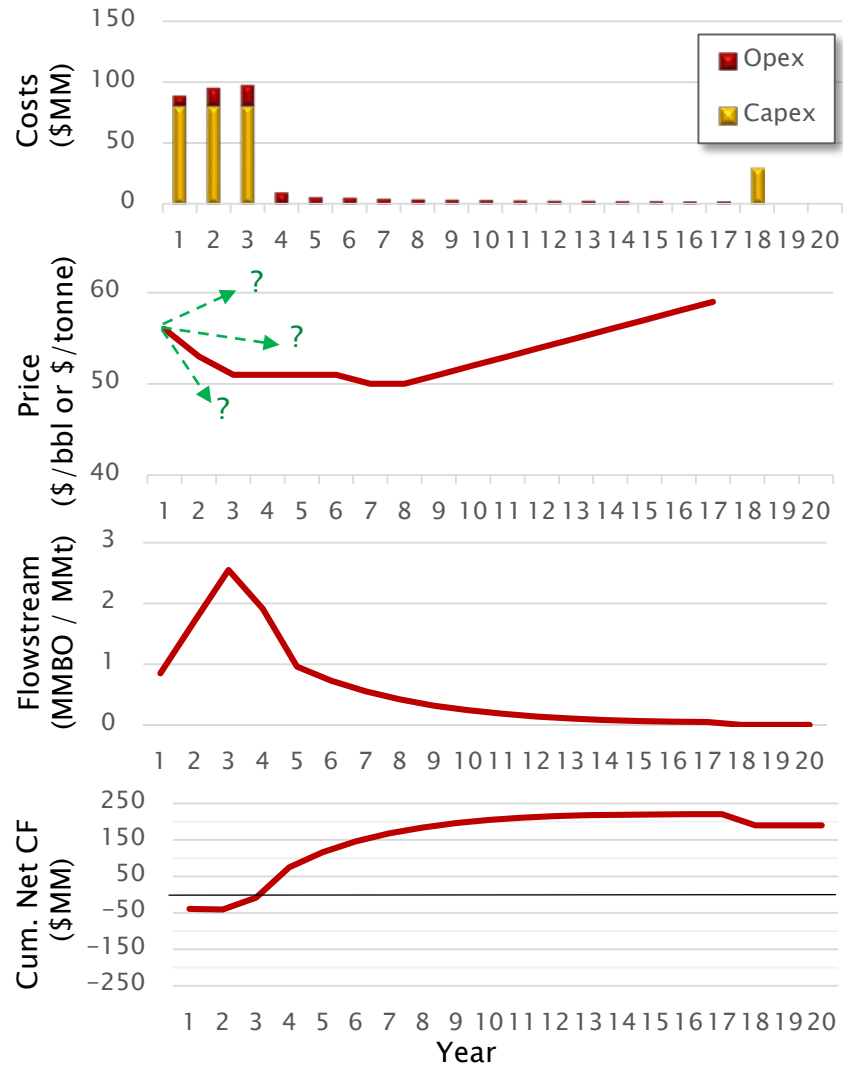
Credit per metric ton **captured and stored (\$50)** or **utilized (\$35)** from a **qualified facility**, lasting **12 years** from the in-service date, which must be under construction **before 2026**

- Storage wells require a new EPA Class VI permit
 - Only a handful of permitted wells to date
 - Monitoring, post-injection site care requirements
- "Capture Equipment" drives the credit generation
 - Separation, dehydration, compression from processes or direct air capture
 - 1 metric tonne \approx 19 mcf
 - CO₂ worth \$1.85 to \$2.63/mcf – on par with natural gas when stored!
- Tax equity financing raises capital, ensures credits are used
 - Transferrable from capturer to injector/user
 - Partnership structure with reversionary interest
 - Recently announced "American Jobs Plan" may further simplify with direct payments

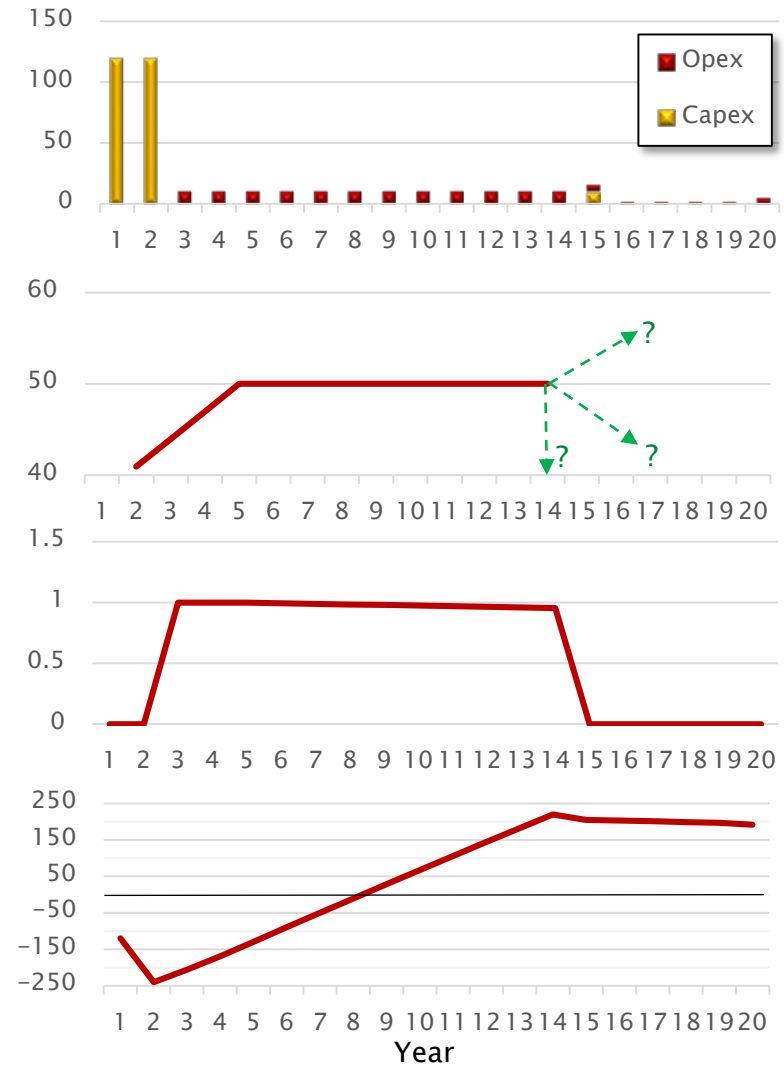


Cash Flow Comparison

E&P Project



45Q CCS Project



SPE Storage Resources Management System

- Most language, logic, and methods follow PRMS
- "Capacity" replaces reserves
- Must be commercial
 - Storage fees
 - Tax credits
 - Government subsidies
 - **Coupled with revenue- and CO₂-generating project**
- Independent project evaluations with standard definitions protect capital

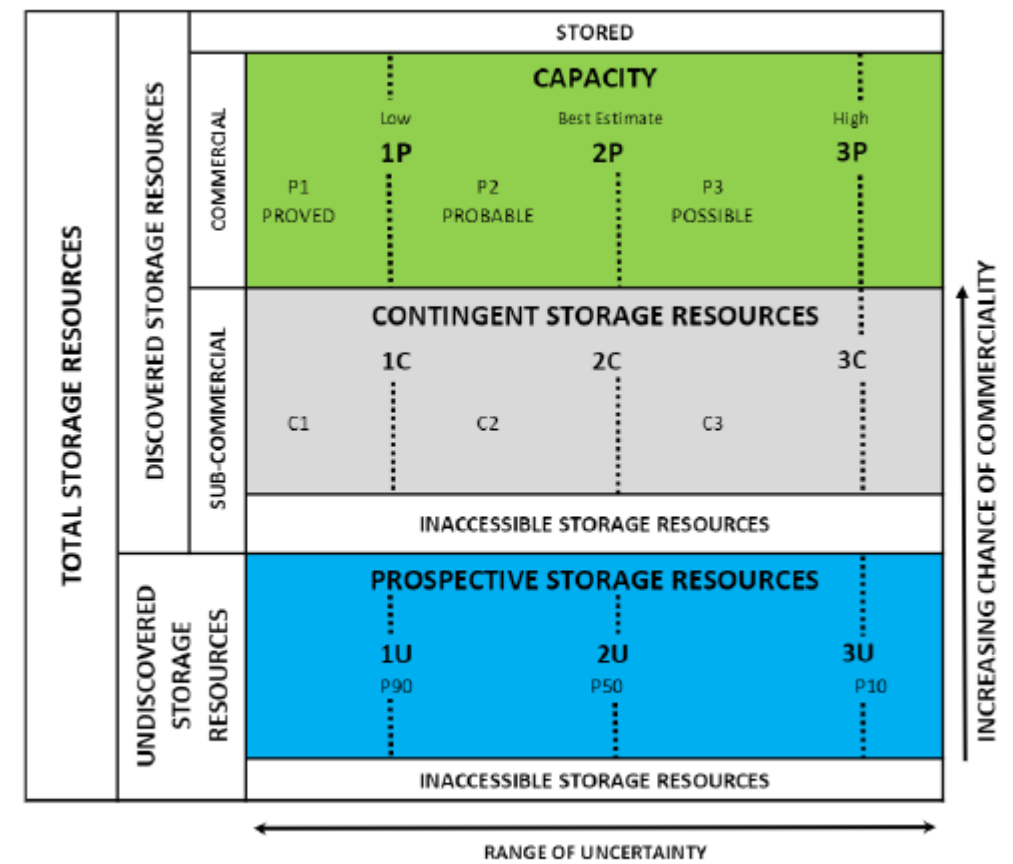


Fig. 1.1 – Resources Classification Framework



Conclusions

- Clear trend of investors pushing to "go green"
 - IPCC pathways generally use *billions of tonnes/yr* of stored CO₂
 - Potential to turn into a large industry from near zero
- Activity in the demonstration/commercial phases, many projects still receiving some form of government support
 - Combination of carbon policies and capture tech still too immature to justify organic, widespread CCS
- Industry needs to be prepared, develop capabilities where it makes sense today
 - Cash flows and project diligence needs are similar to E&P
 - Subsurface uncertainty/risk can be managed

Disclaimer

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APPENDIX