

CO₂ Storage MMV and Monitoring Technology

Gaffney Cline Energy Advisory



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What does MMV bring?

NAVIGATING UNCERTAINTIES







PROJECT DE-RISKING

Improved subsurface understanding
Risk safeguard systems design
Regulatory compliant framework
Early alert system

OPEX OPTIMIZATION

Technology application innovation

Passive and autonomous monitoring

Technology cost/benefit analysis

Minimal-intervention monitoring

PROJECT OPTIMIZATION

Data management system

Real-time data analytics

Digital integration platform

Streamlined communication



MMV Plan Development: Project Stage

PRE-INJECTION

INJECTION OPERATIONS

POST-INJECTION

Data Requirements

- CO₂ Candidate Selection
- Reservoir Simulation
- 3D-4D Geomechanics Model
- Legacy Well Integrity Analyses
- Well Completion Plans
- Site Target Disposal Volume
- Time Requirement
- Local Regulatory Governing Docs
- Technology Costs

Baseline MMV Plan

Deliverables are broken down into 3 sub-stages:

- Pre-Feasibility Stage: Conceptual MMV Plan
- Feasibility Stage:
 Quantitative Risk
 Assessment & Monitoring
 KPIs
- 3. <u>Define Stage:</u> Full Baseline Plan

Initial Injection
Stage

- Closely monitor baseline MMV for performance and accepted uncertainty range
- Iteratively adapt plan until performance criteria are met

Long-Term Injection Stage Site Closure Stage

- Performance reviews with real-time and periodic monitoring data
- Ensure CO₂ storage requirements are met as a function of time
- Adapt plan until volume and rate of CO₂ storage meets performance criteria
- MMV plan becomes longterm operational conformance guidebook to interpret ongoing realtime and periodically recorded data
- Enables operator to react to unanticipated migration of CO₂ out of the AoR with mitigation or remediation contingencies



Tested and proven design workflows enable best-in-class technology adoption

SUBSURFACE key technologies

Cementing



PermaSet™ Cement CO2 & H2S Resistant

Wireline



Hi-Resolution Vertilog



Completion



Safety Valve Systems



CO2 Injection Control



Premier™ Removable Packer

Fibre optics



Temperature SureVIEW™ DTS



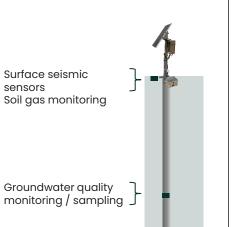
Acoustic SureVIEW™ DAS



Strain SureVIEW™ WIRE



CO₂Watch™



Not to scale



SureSENS™ QPT ELITE

SURFACE key technologies

Panametrics



Tunable Diode Laser Absorption Spectroscopy



Oxygen Measurement Absorption Spectroscopy



Reliable Moisture Measurement

Bently Nevada



System 1 & Orbit 60



AHM Acceleration Sensors Vibration Monitoring



Wireless Triaxial + Temperature Sensor AHM



CO₂WatchTM

Autonomous CO₂ Monitoring Service

- Proactive risk management for CO₂ containment and conformance
- Up to 30% lower OPEX as compared to similar measurements
- Fit-for-purpose data for regulatory reporting
- Effective protection against inaccurate claims of leakage





Featuring:

24/7 CO₂ Maps

CO₂ plume expansion mapping

CO₂ Spots

High-fidelity triggered check points

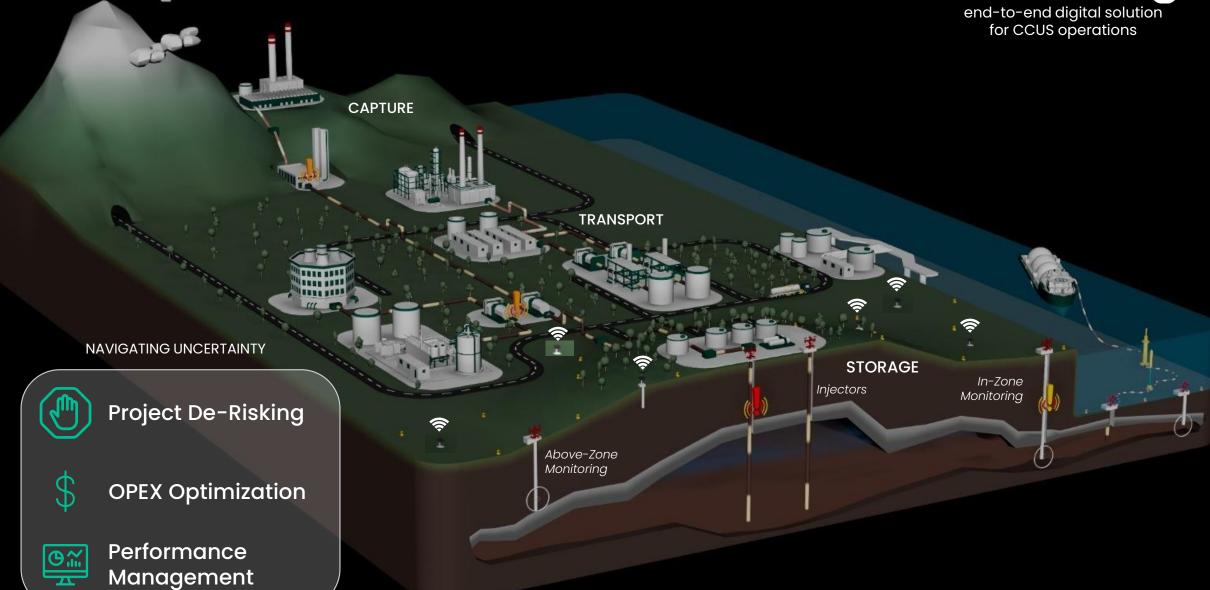
Containment

Integrity Monitoring

Soil & Groundwater

Monitoring options

CarbonEdge®



Carbon Edge[™] How does CO₂Watch™ fit into your MMV Plan? end-to-end digital solution for CCUS operations It's a novel technology for plume mapping and site integrity monitoring in-between seismic surveys CO₂ Capture CO₂ Transport REEL SEEL Injectors In-Zone Monitoring Shallow Subsurface Monitoring Above-Zone Featuring: Monitoring CO₂WatchTM Autonomous CO₂ Monitoring Service CO₂ Storage

Interconnected CO₂WatchTM Station Network