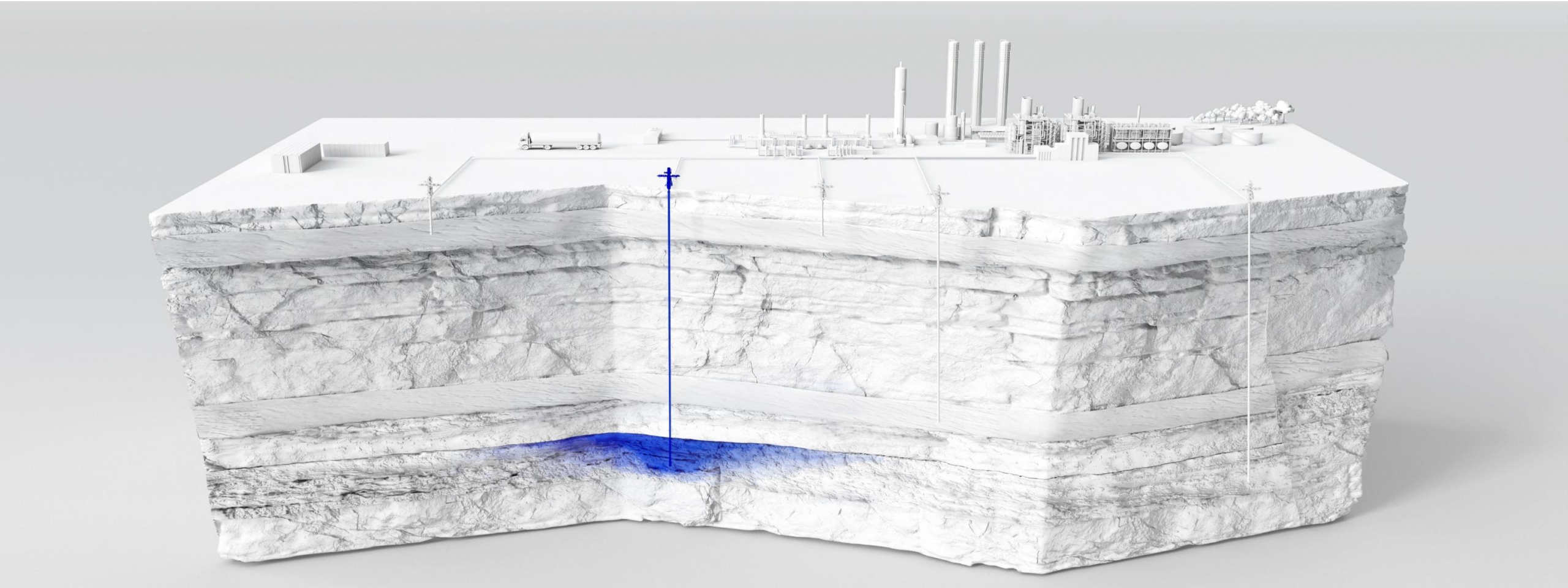
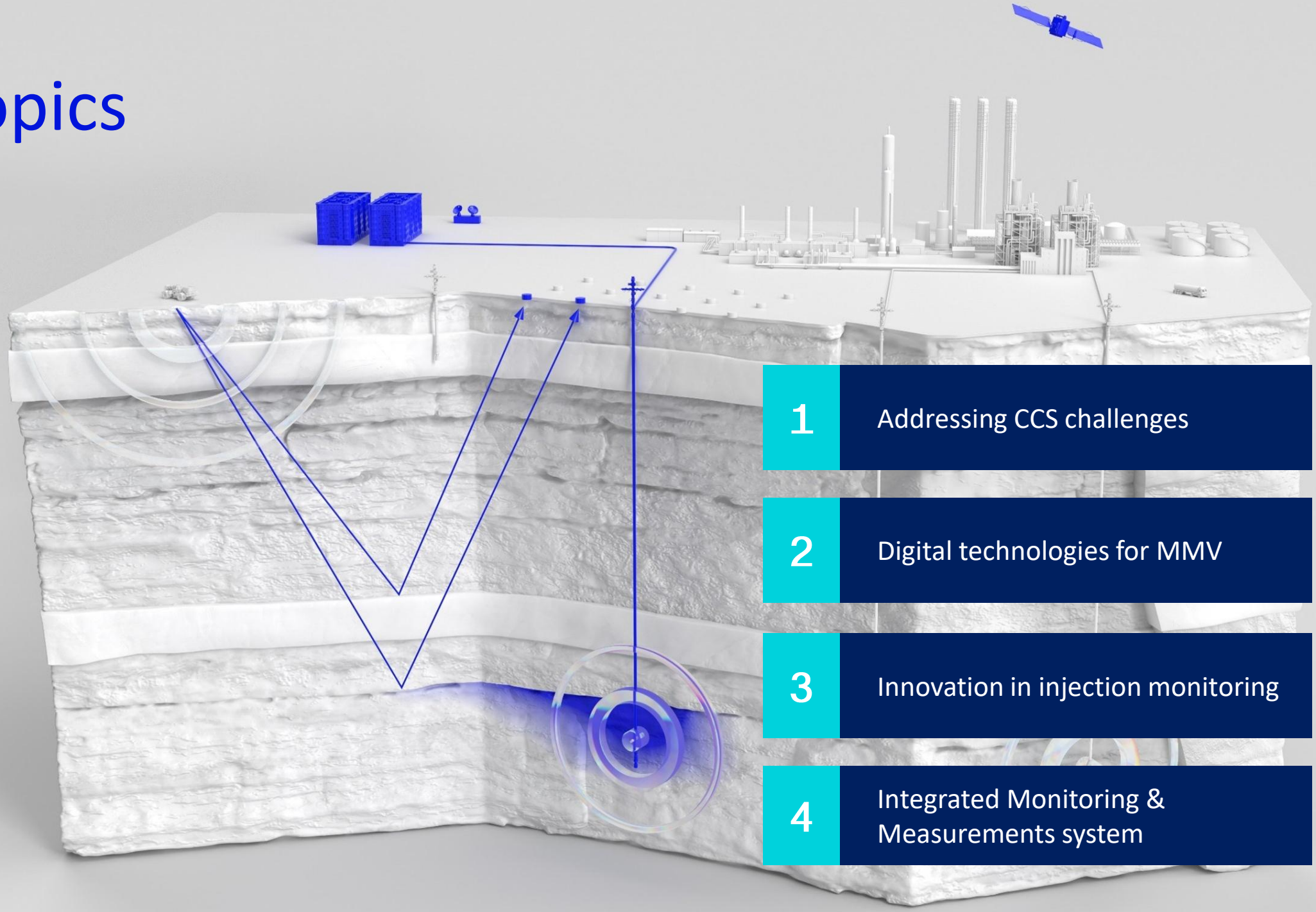
Innovating for Impact

Delivering Scalable CCS Technologies

Saad Kisra –Digital CCS & Geothermal Product Manager



Topics

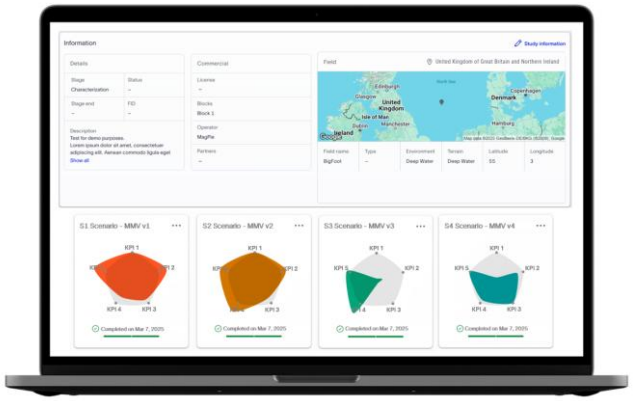


1. Addressing CCS challenges
2. Digital technologies for MMV
3. Innovation in injection monitoring
4. Integrated Monitoring & Measurements system

What is preventing CCS scale-up?

MMV Digital Solutions

Screening → | Selection & Evaluation | Build → | Injection → | Post Injection



MMV Planning

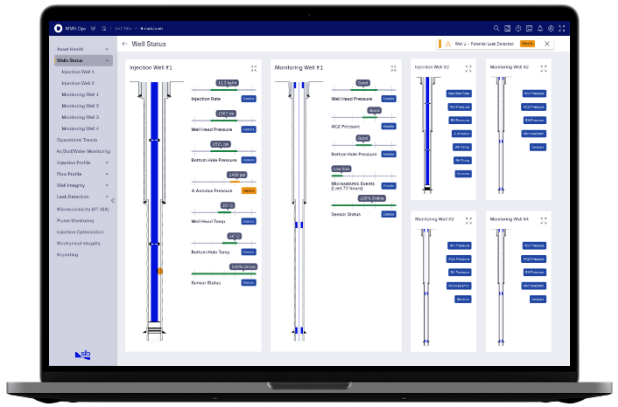
- Risk assessment
- Measurement selection
- MMV plan
- Survey design

Risk based, adaptive, MRV planning platform for Optimized monitoring decisions

Performance Management

- Performance management
- Model Updates from MMV data
- Risks update
- Reporting

Comprehensive, automated, Storage Performance & Risk management system for better Storage Conformance and Predictability



MMV Operations

- Data ingestion & processing
- Surveillance activities
- Safe Operating Windows
- Operation insight
- Reporting

Open, Modular, end to end Surveillance and Reporting Platform for Streamlined CO2 Storage Operations

Adaptive monitoring of the subsurface

"Surface DAS based subsurface monitoring system in land and marine environments: Current status and road ahead"
Tuesday, 9 June 2026. Room 11.
Distributed Acoustic Sensing-1.
Ran Bachrach et al., 15:30 to 15:350.

S-DAS

Surface distributed acoustic sensing

Fiber optics

Adaptive answer products

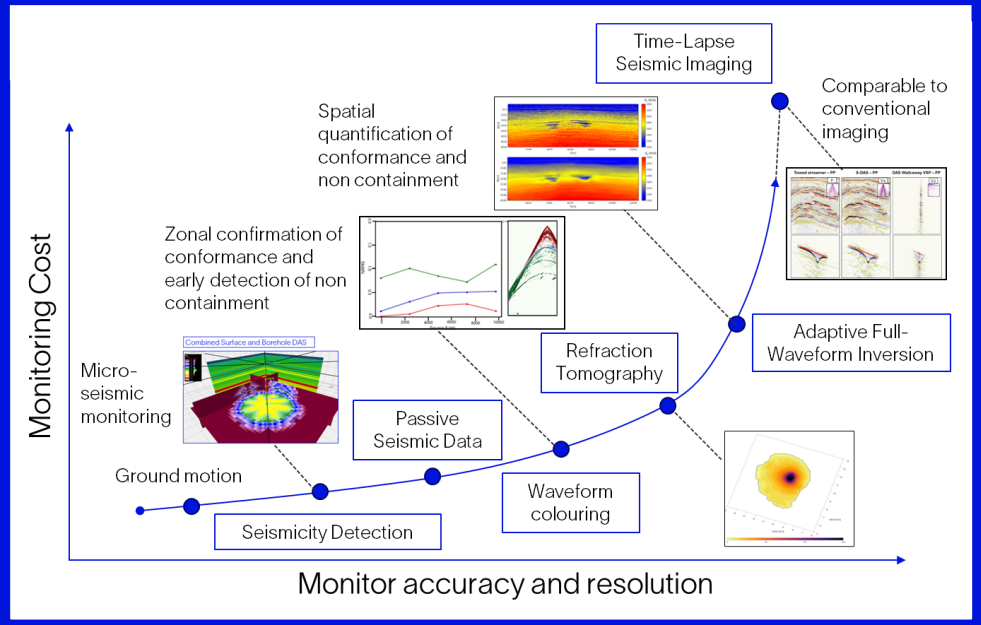
Digital accessibility

Adaptive answer products that utilize fiber optics to provide critical subsurface insight away from the well

Change monitoring concept from full field imaging to scalable and targeted detection schemes

Monitoring effort evolves with the migration of the CO2 plume and changing subsurface risk profile

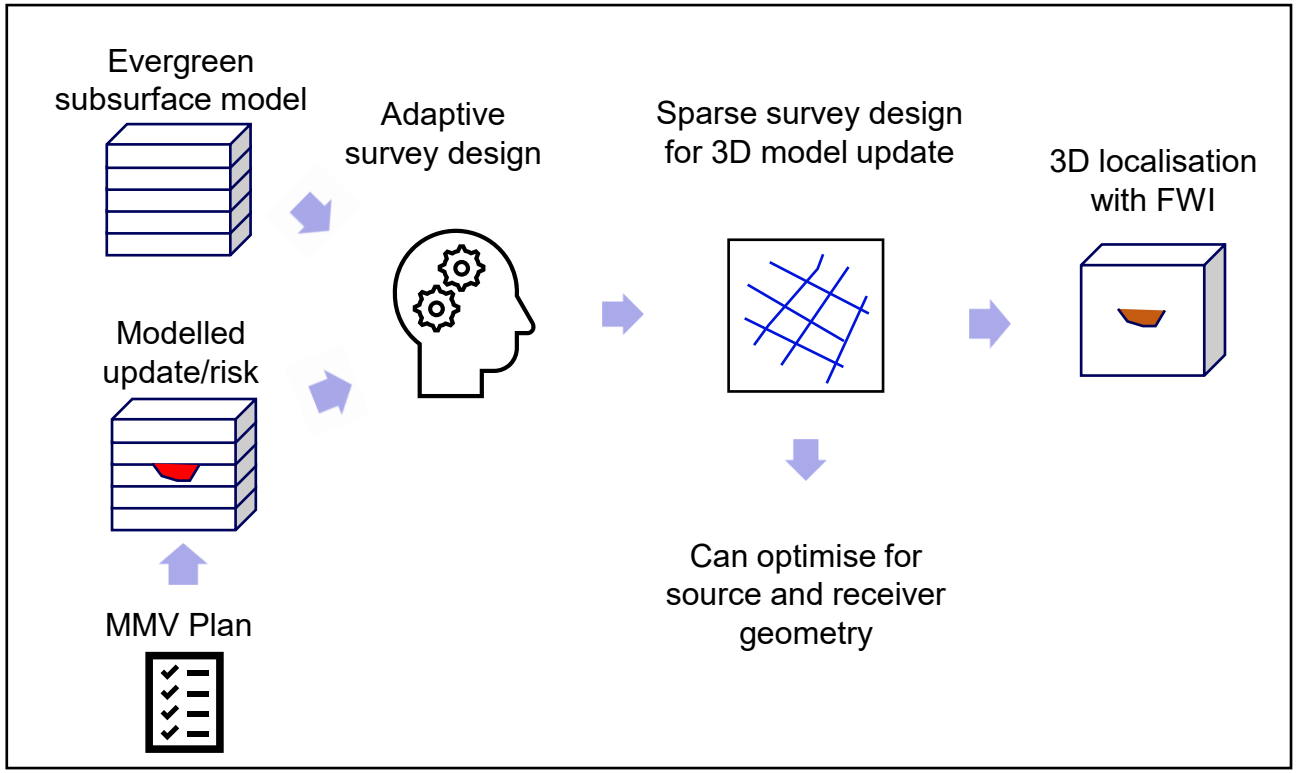
S-DAS answer products that relate to CCS monitoring



Intelligent seismic survey design

"Determining the sparsest acquisition geometry required to meet a known 4D monitoring objective"
(EP24123) Australian Energy Producers Journal, 2025
Mike Branston and David F. Halliday

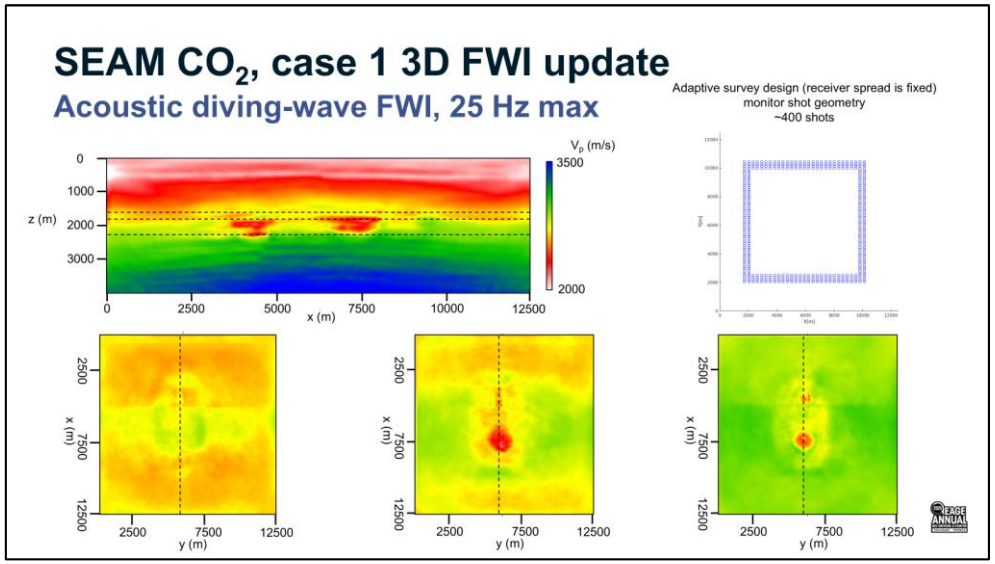
- Automated, FWI-based, perturbation analysis used to tailor the cost of seismic acquisition to match CCS monitoring objectives.
- Part of an adaptive monitoring system that exploits the MMV Plan and an evergreen subsurface model.
- Allows for spatial quantification of the plume extent either for milestone reporting or to recalibrate the subsurface model



Examples – spatial quantification of conformance

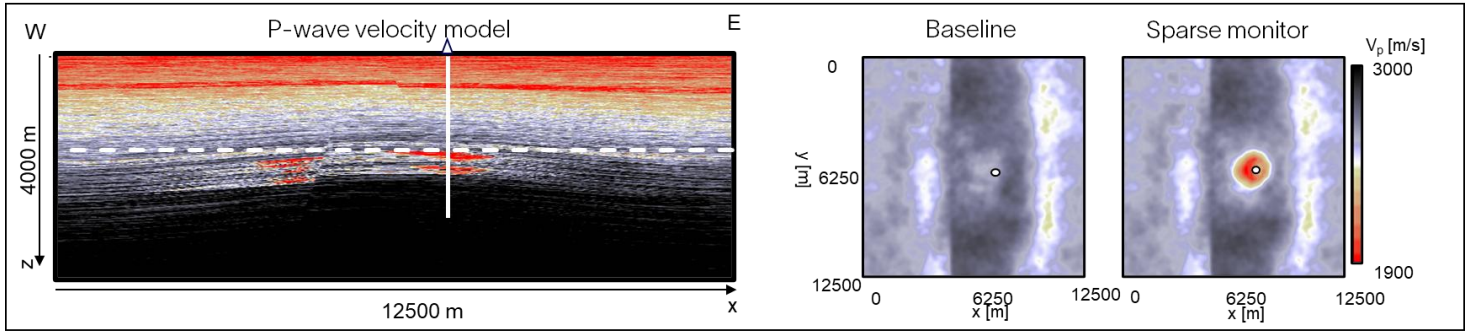
- Provides flexibility to consider many different types of acquisition and sensors
  - Surface / borehole
  - DAS / geophone / hydrophone
- Metric based workflow allows informed decisions
  - Source / receiver geometry
- Significant reduction in source effort
  - 85% reduction in surface seismic source effort
  - 60% reduction in VSP source effort

SEAM CO_2 – Surface Seismic



"Full-waveform adaptive monitoring for CCS" 86th EAGE, 2025
David Halliday, Robin Fletcher, Mike Branston

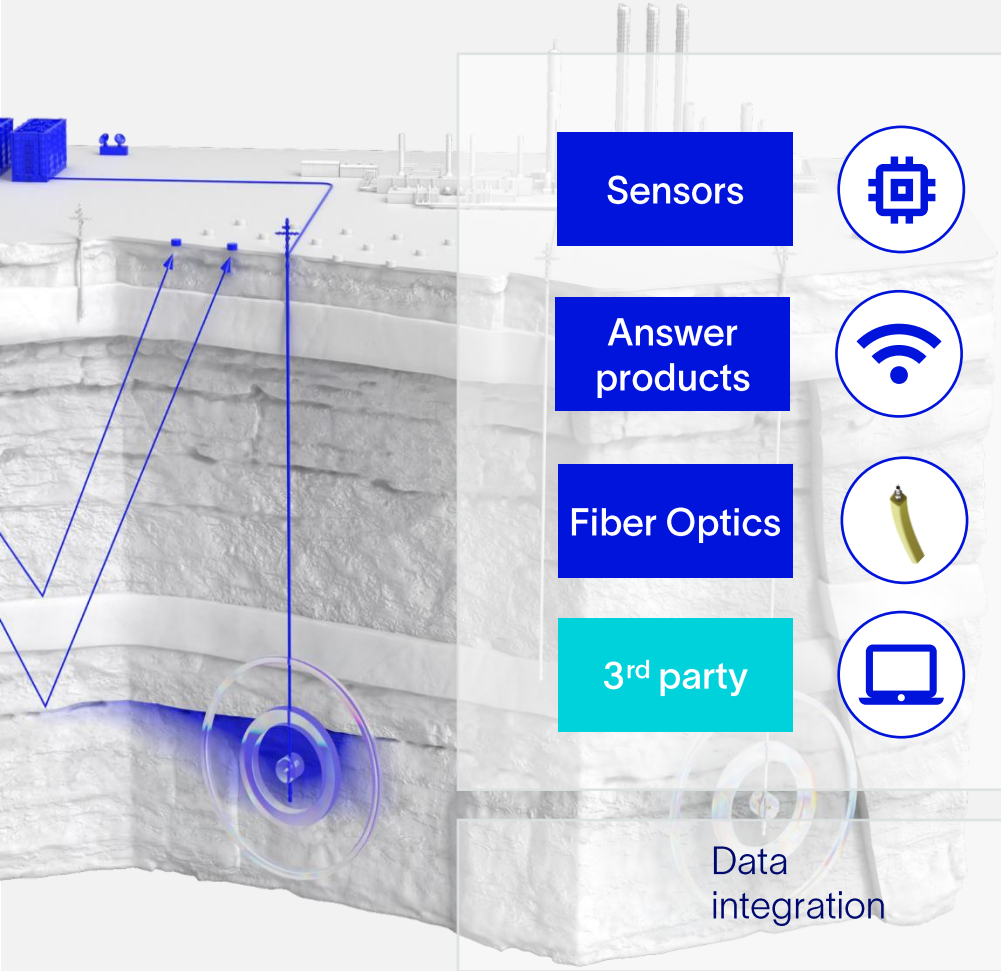
SEAM CO_2 – VSP



"Adaptive survey design applied to VSP data for CCS monitoring"
Tuesday, 9 June 2026 during Poster session 5. Energy Transition - 1. David Halliday et al., 13:30 to 14:30.

Delivering MMV Ecosystem

Measurements | Monitoring | Verification | Reporting

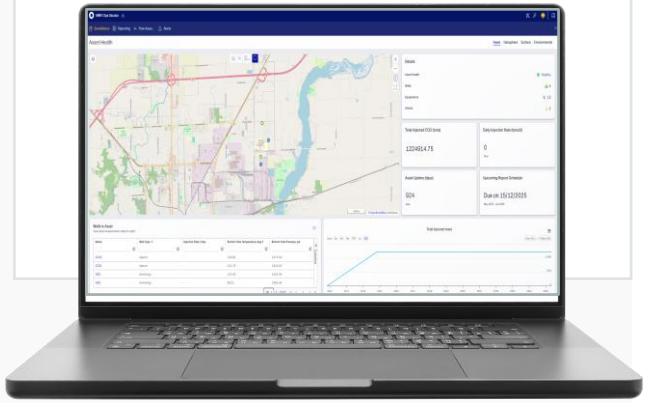


- Sensors
- Answer products
- Fiber Optics
- 3rd party

Carbon Storage Monitoring

→ Asset → Subsurface

→ Wellbore → Environment



- Performance management
- Carbon accounting
- Regulatory Compliance

Data integration

Real time insight

Efficient reporting

Prove permanence & volume

Enables monetization & compliance

Carbon Storage Monitoring (CSM) | Asset View

An integrated solution leads to integrated and informed decisions

Monitor

- **Asset Health at a Glance**

Gives users an immediate view of overall site status, active alerts, uptime, and key operating indicators.

- **Map-based Operational Context**

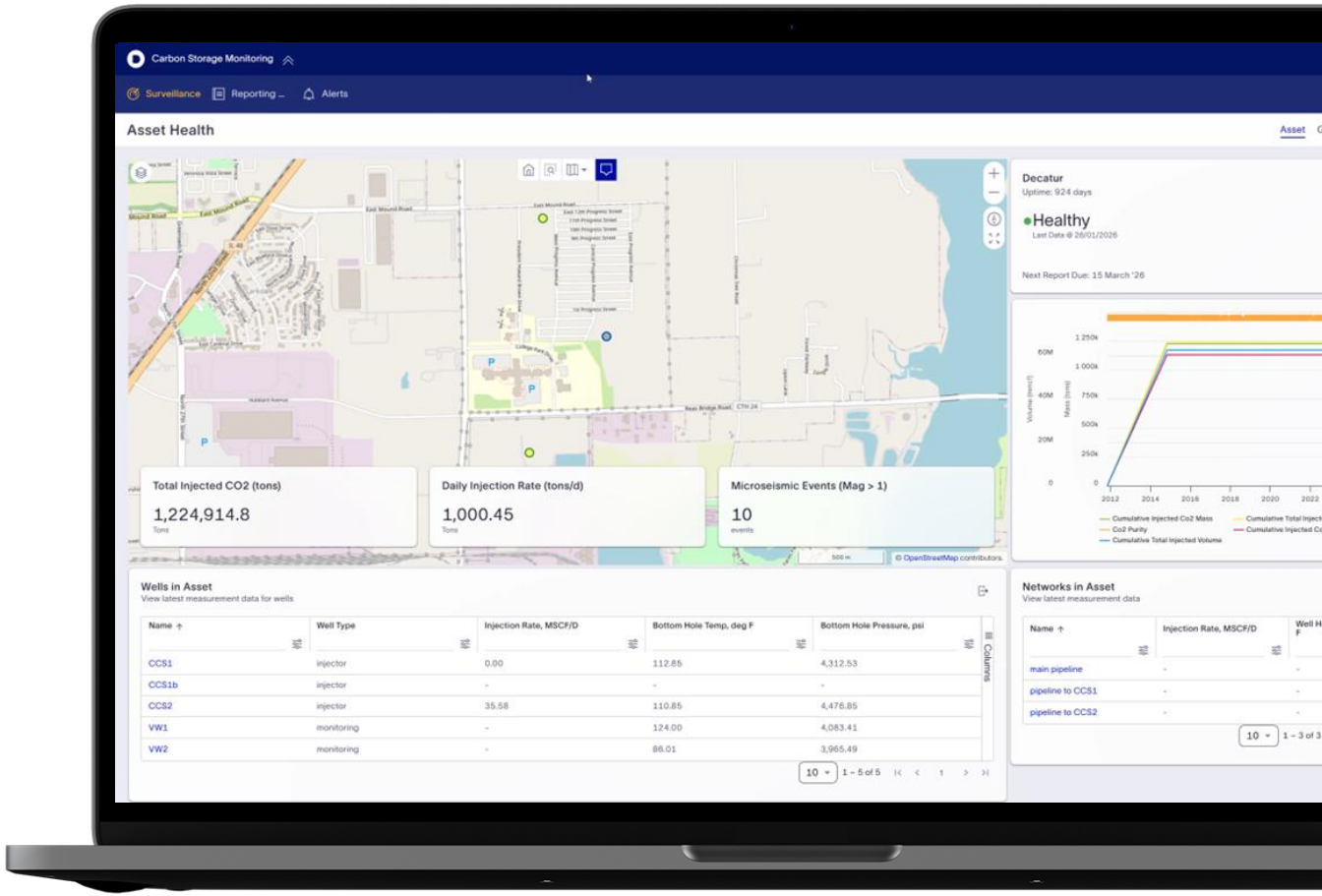
Combines the site map with wells and network assets so teams can quickly see where activity is occurring and where attention is needed.

- **Operations + Surveillance Integration**

Brings together injected mass, daily rate, microseismic activity, bottom-hole conditions, and network status to support faster daily surveillance.

- **Quick Path to Prioritities**

Lets users move rapidly from asset-level awareness to the specific well or network segment that requires investigation.



Carbon Storage Monitoring (CSM) | Integrity View

Early integrity insight reduces risk, response time, and avoidable escalation

Monitor

- **Early Leak Detection**

Uses DTS [Distributed Temperature Sensing] and leak-probability outputs to identify potential well integrity issues before they escalate.

- **Depth-Based Integrity Insight**

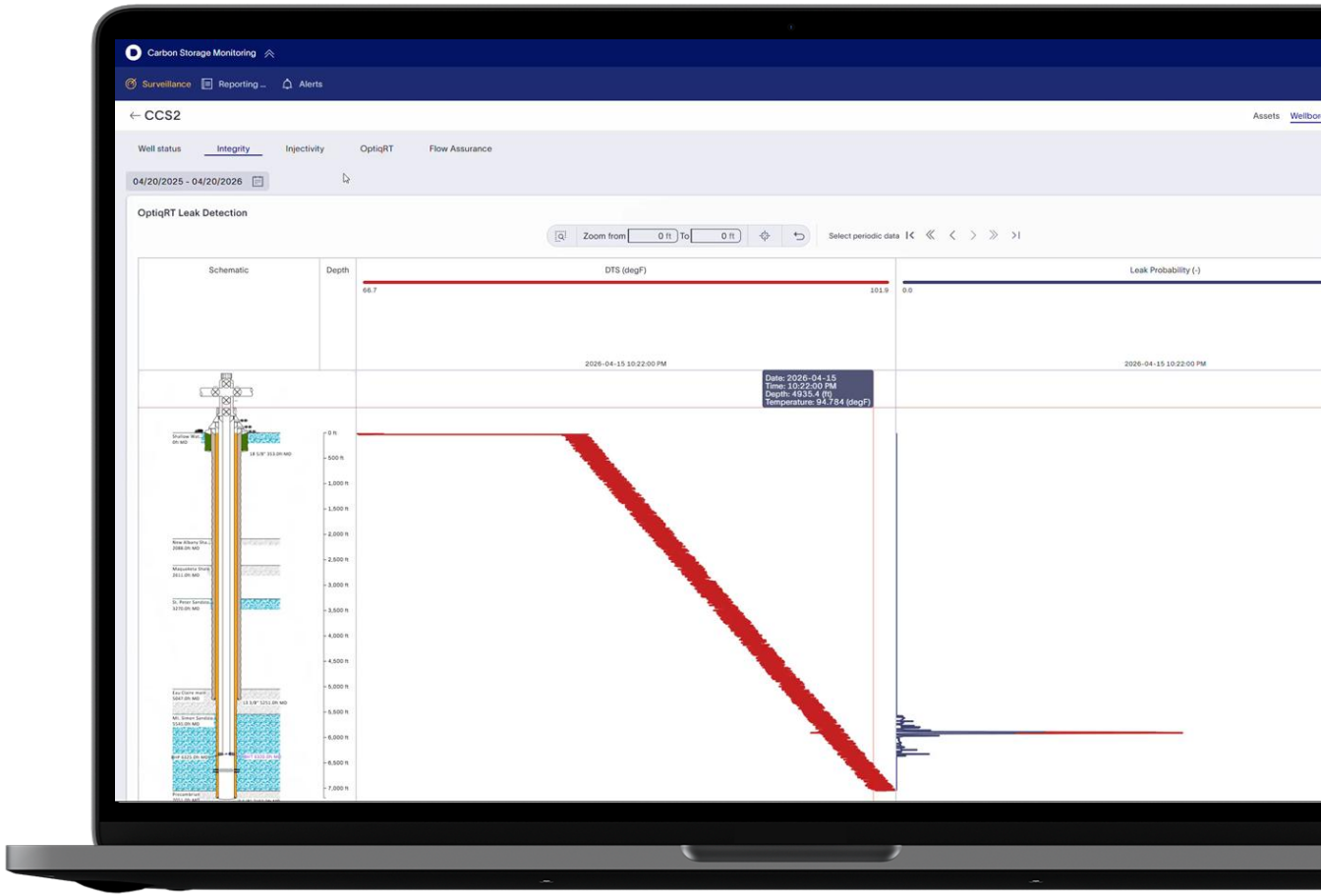
Displays the leak indication against the well schematic and depth scale so users can quickly see where the abnormality is occurring.

- **Alarm Context for Faster Response**

Brings current leak indications together with alarm history so teams can assess severity and decide whether immediate action is needed.

- **From Detection to Investigation**

Reduces ambiguity by turning fiber data into a focused integrity screen rather than a raw temperature-only view.



Carbon Storage Monitoring (CSM) | Injectivity View

Understanding injection placement improves conformance, performance, and confidence

Monitor

- **See Where CO_2 Is Actually Going**

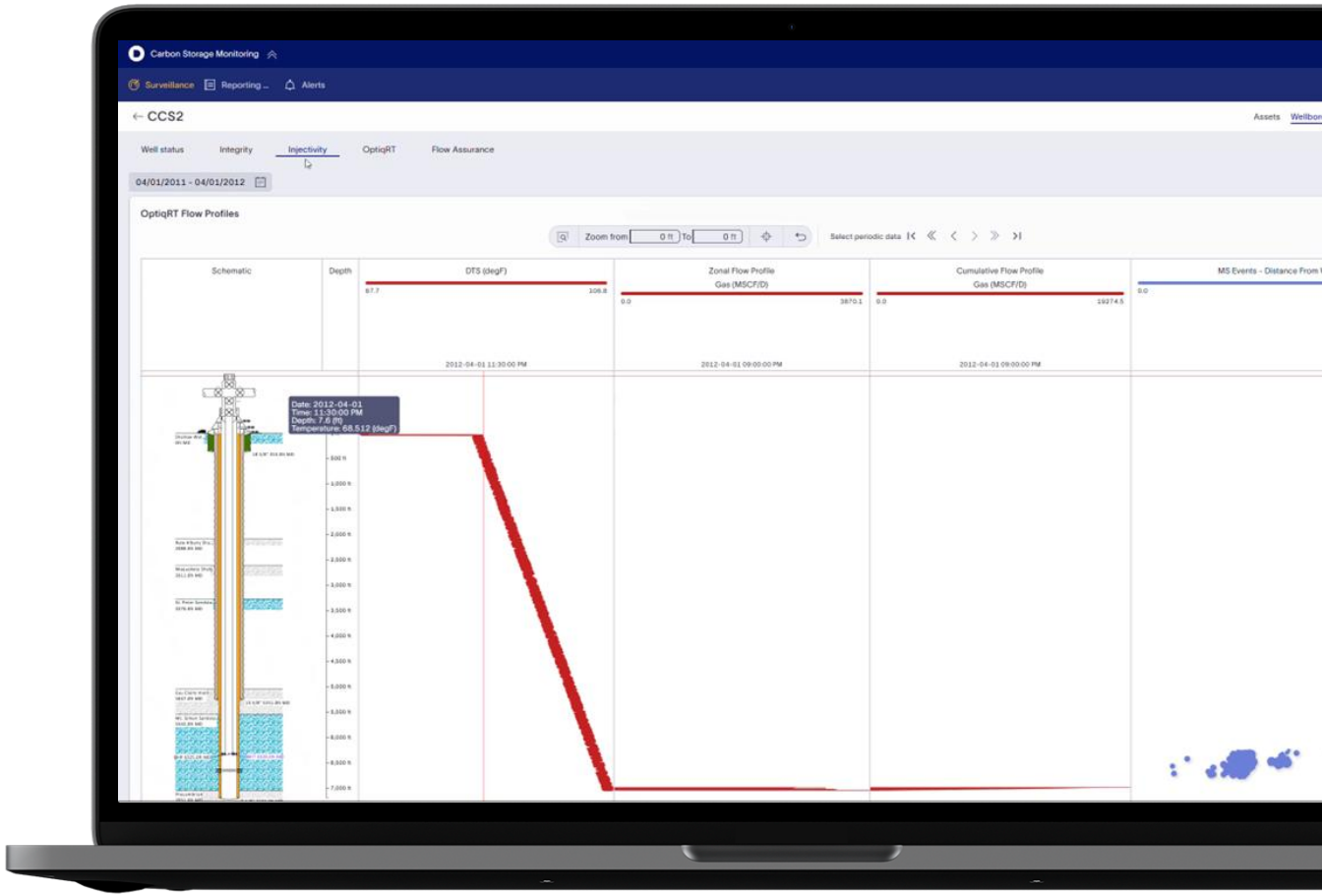
Helps identify uneven placement, dominant intake zones, or underperforming intervals so injection can be managed more effectively.

- **Connect Injection to Reservoir Response**

Combines flow profiles with microseismic context to help users assess whether subsurface response is consistent with where CO_2 is entering the formation.

- **Support Earlier Corrective Action**

Turns fiber-derived flow information into a practical surveillance view that helps spot poor placement before it becomes a larger storage or containment concern.

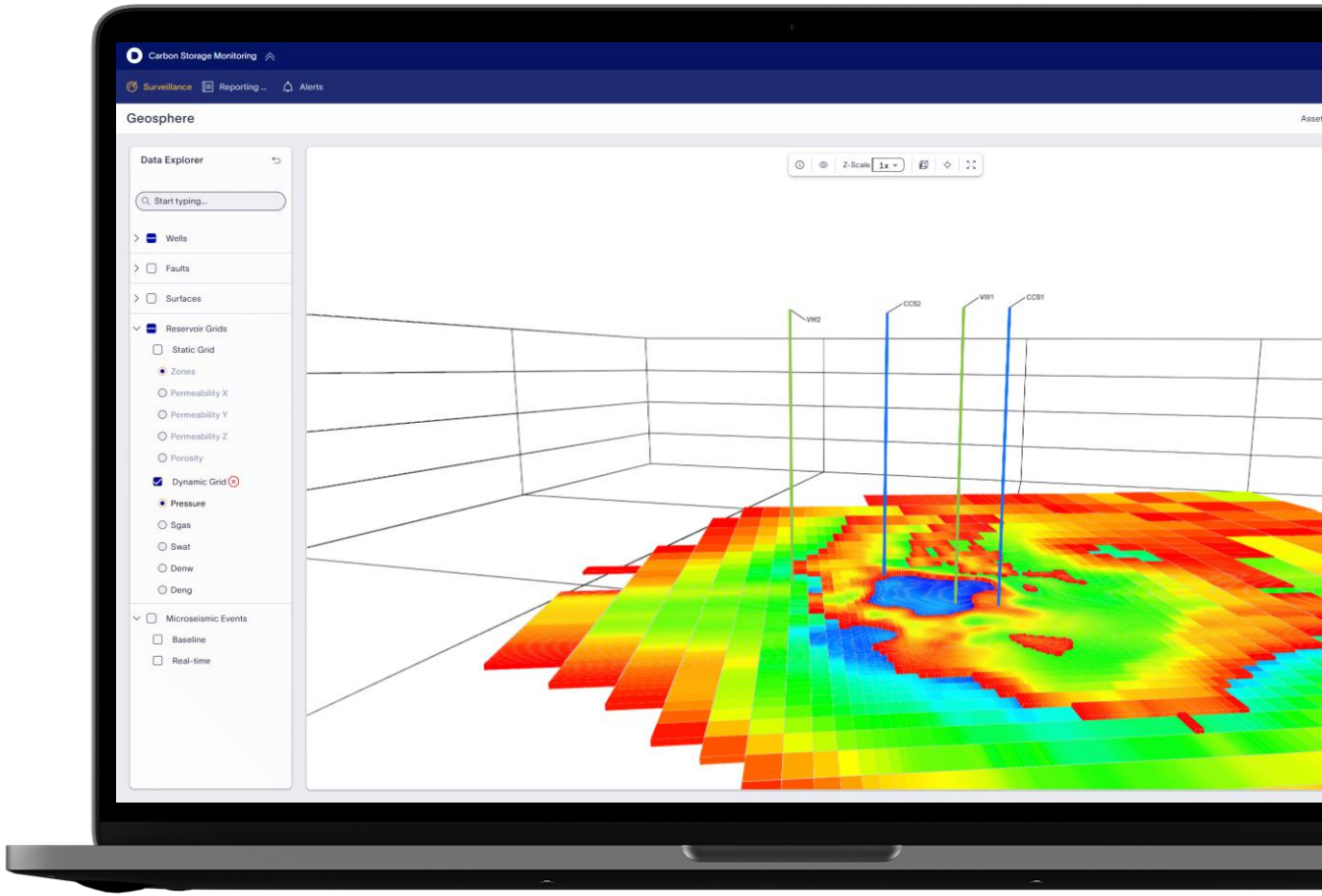


Carbon Storage Monitoring (CSM) | Geosphere (R. Grids)

Subsurface context turns isolated observations into interpretable behavior

Monitor

- **Surfaces**
  Shows wells and key formation surfaces in one 3D view, providing the geological reference frame needed to understand where subsurface activity is occurring.
- **Faults**
  Displays interpreted faults in the same spatial context so users can assess possible structural pathways and relate them to observed subsurface behavior.
- **Reservoir Grids**
  Brings dynamic reservoir model results into the geosphere view, helping teams connect simulated pressure or plume behavior with what is being observed in the field.
- **Microseismic Events**
  Places real-time seismic events in geological context so users can quickly see whether activity is occurring where expected or where attention is needed.



Carbon Storage Monitoring (CSM) | Microseismicity

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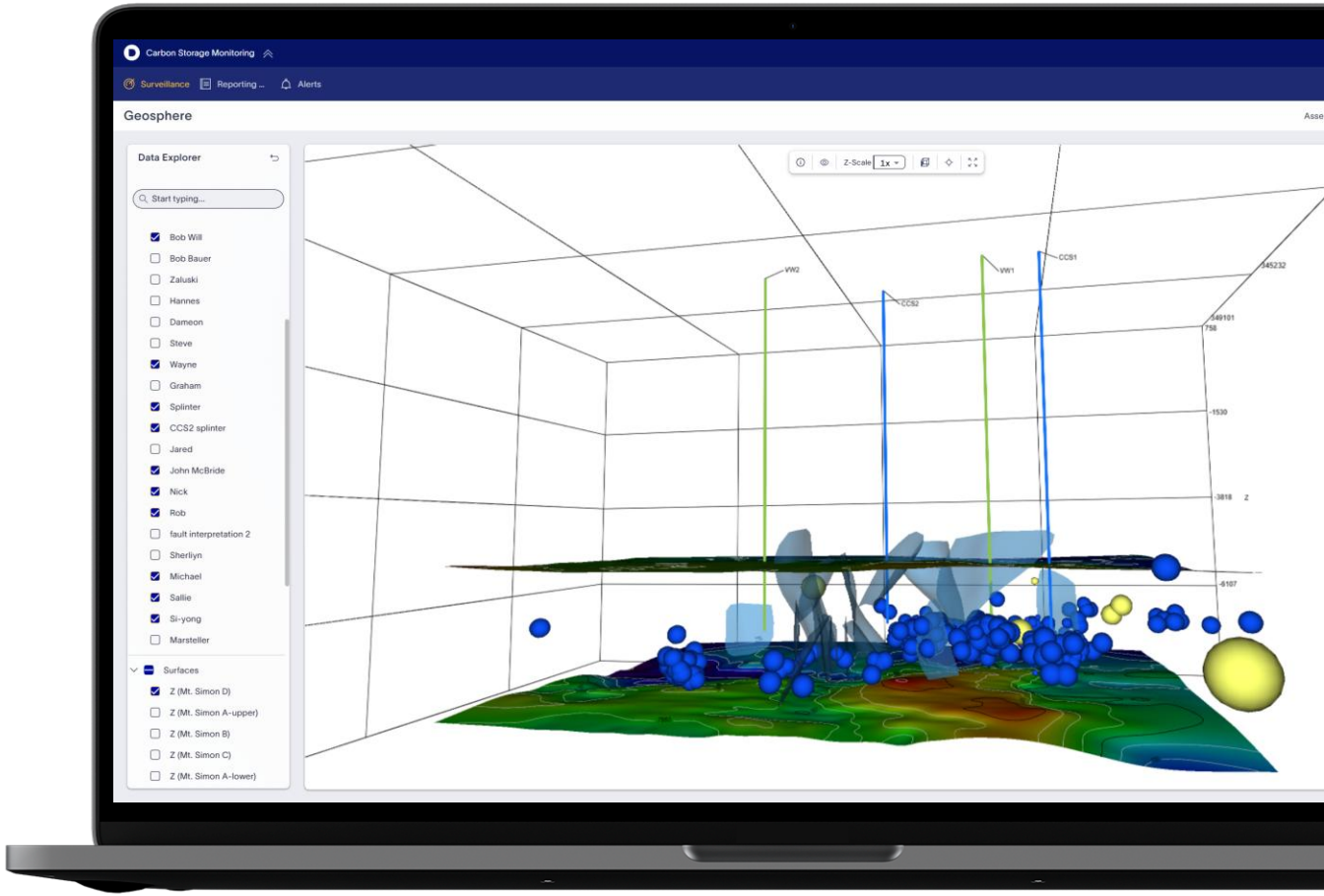
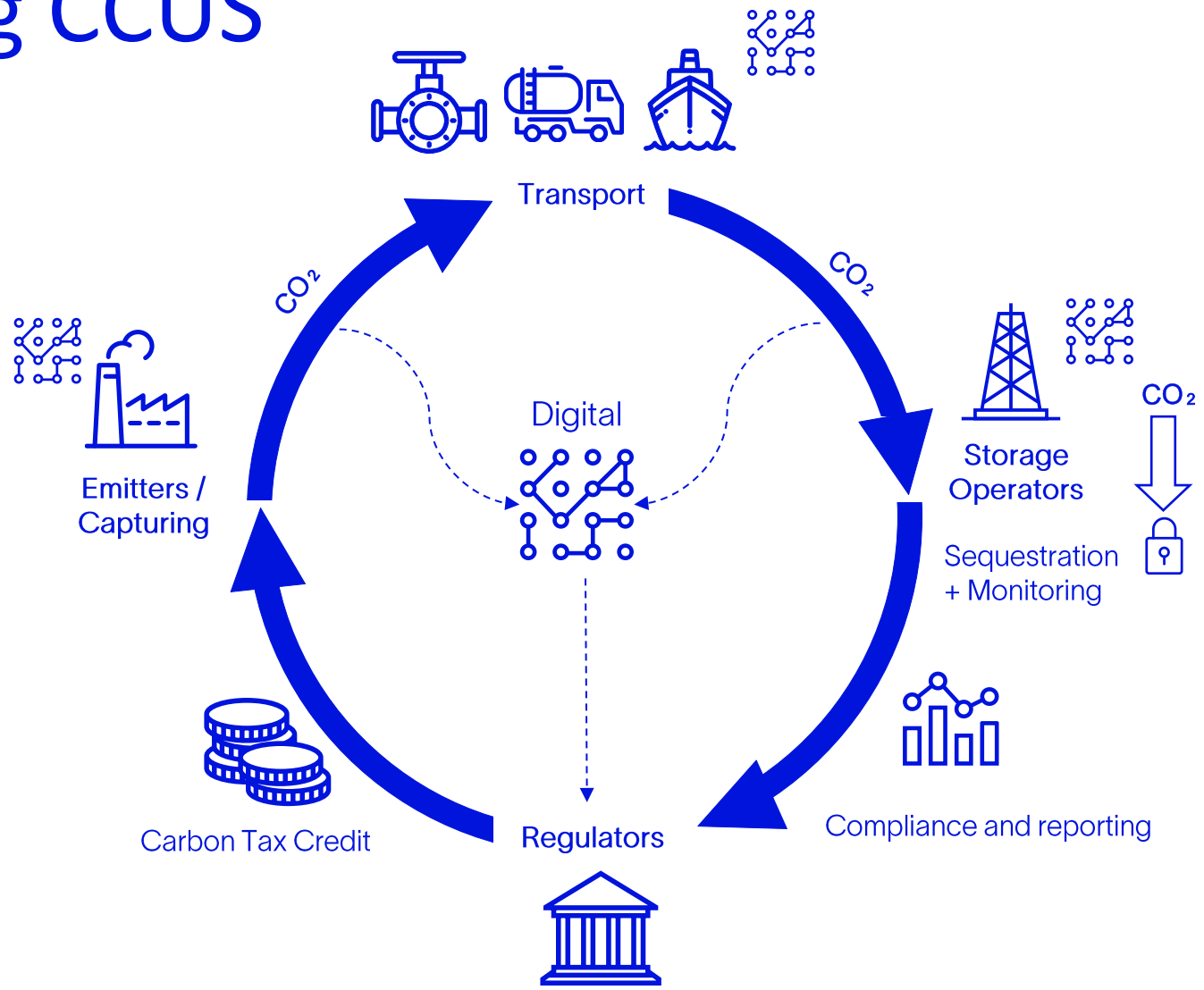


Digital Technologies Accelerating CCUS



Thank you