The Co-Saline Storage Method
Accelerating Demonstration of Offshore CCS

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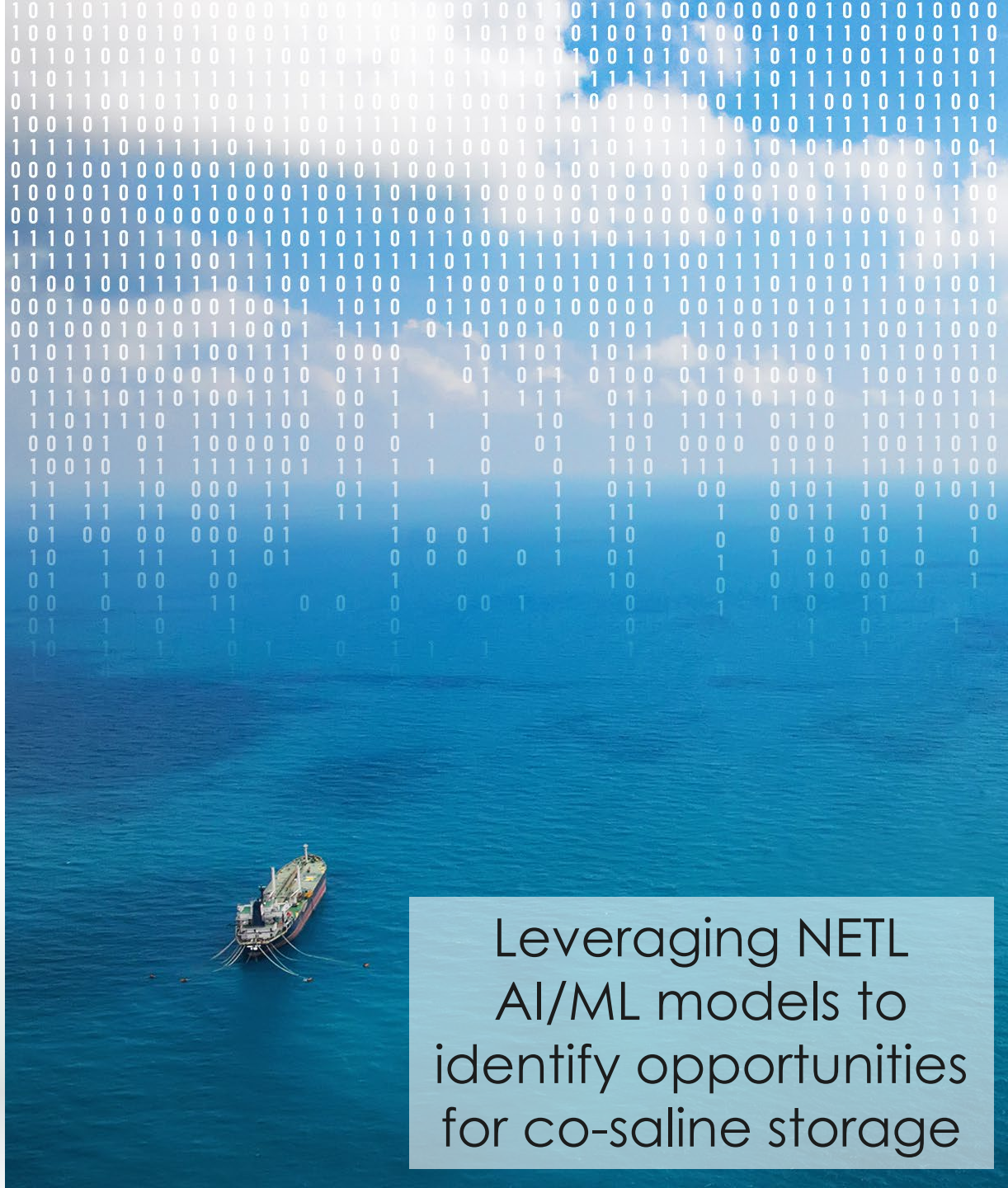
Advanced **Offshore** Research

NETL Research · Carbon Storage Program



Leveraging NETL AI/ML models to identify opportunities for co-saline storage

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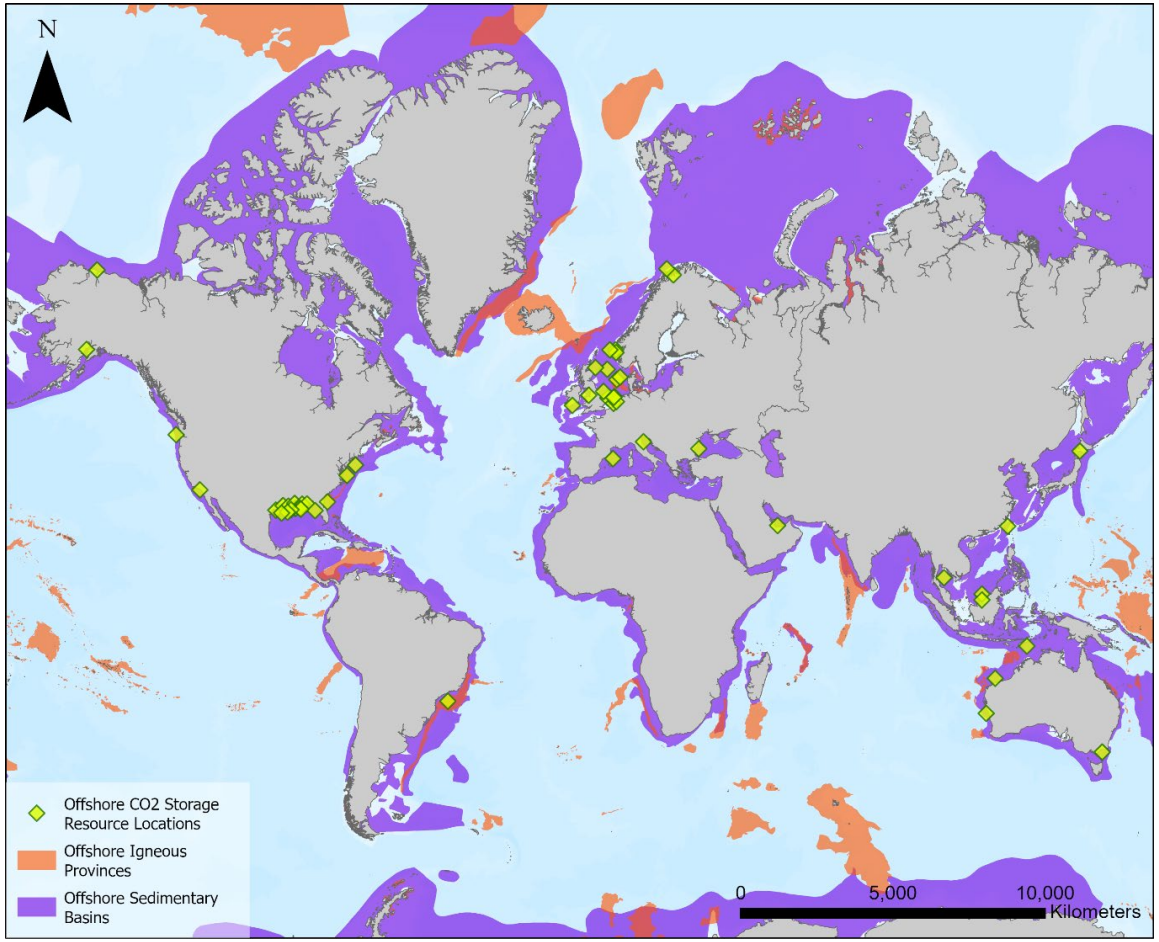
Opportunities for Offshore CCS

…many coincident with O&G operations

- Significant global potential for offshore CCS
- Green dots show existing CCS projects
  - coincide with many existing O&G operations
- Need a systematic method for ensuring *timely* yet safe, reliable implementation

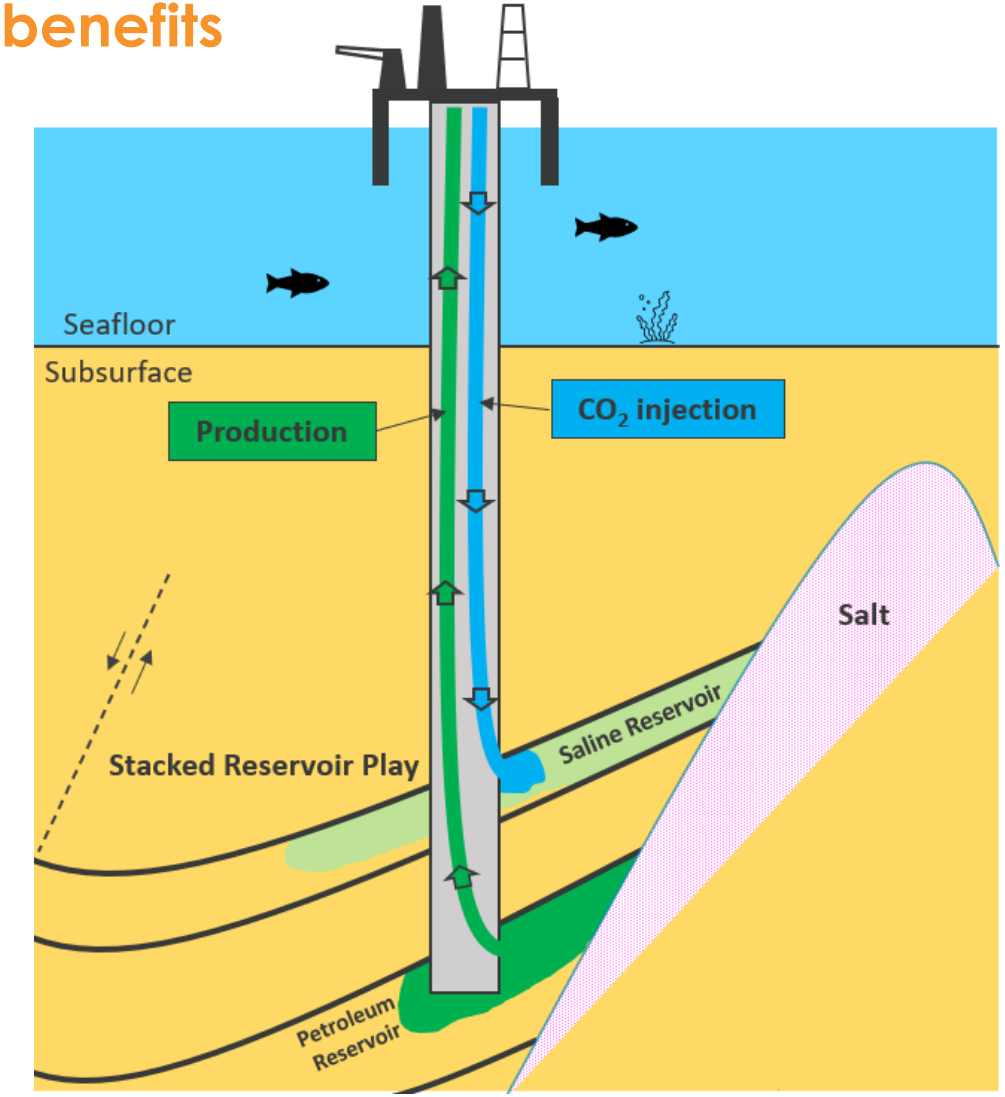


Global map representing offshore geologic carbon storage locations (Choisser et al., 2023).

What is Co-Saline Storage?

A new approach for CS to defray costs, enhance benefits

- Concept of **tapping into saline reservoirs overlying/underlying petroleum reservoirs** to concurrently store CO_2
- **Leveraging existing infrastructure**
- Derive **economic and information benefits** from existing infrastructure, CS offset credits, and extending knowledge/data for these systems



How does Co-Saline Storage differ from Conventional Approaches?

A comparison…

CO_2-EOR: CO_2 injected into oil reservoir to decrease viscosity and increase flow (output)

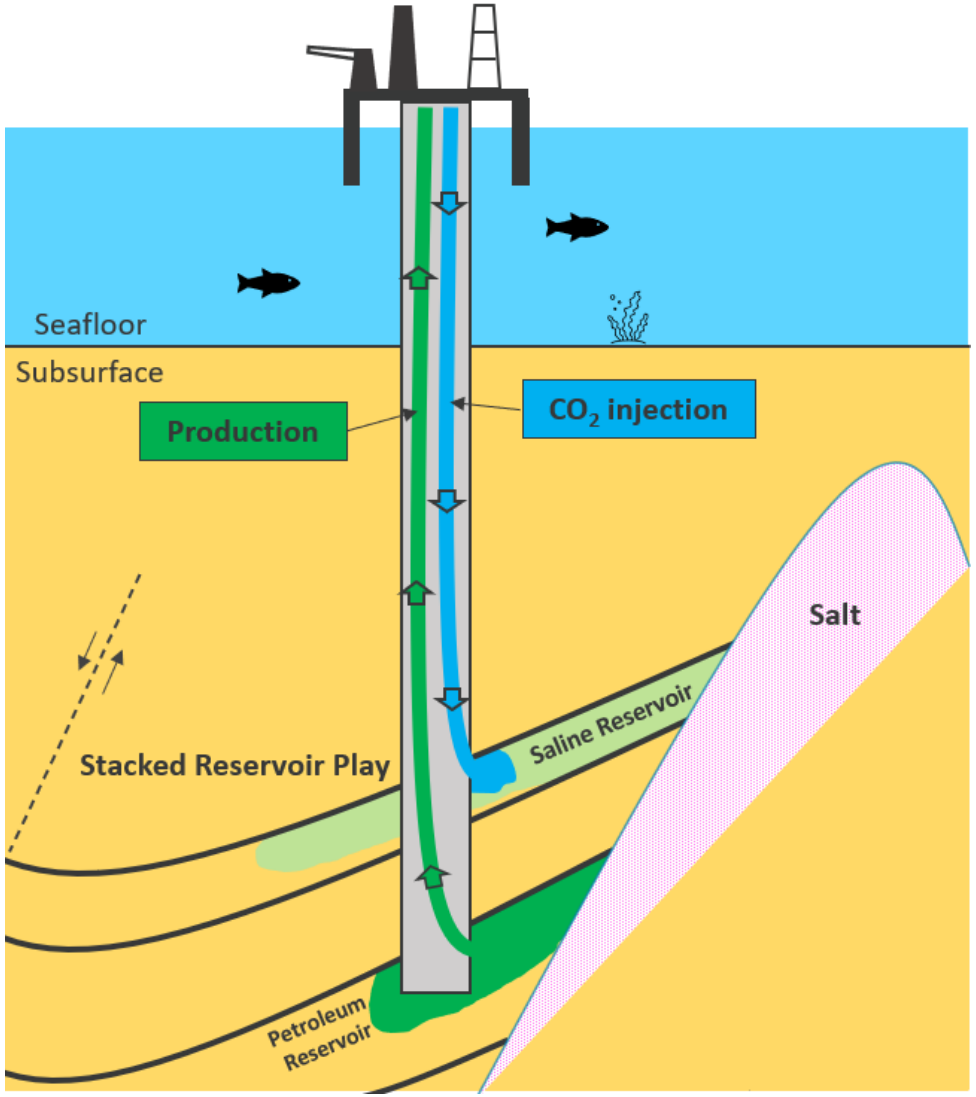
- (+) *Improves petroleum recoverability*
- (-) *Not long-term storage*

Exclusive CO_2 Storage: CO_2 injected into saline reservoir

- (+) *Favorable geologic setting*
- (-) *Requires new infrastructure*
- (-) *Requires dedicated financial investment*

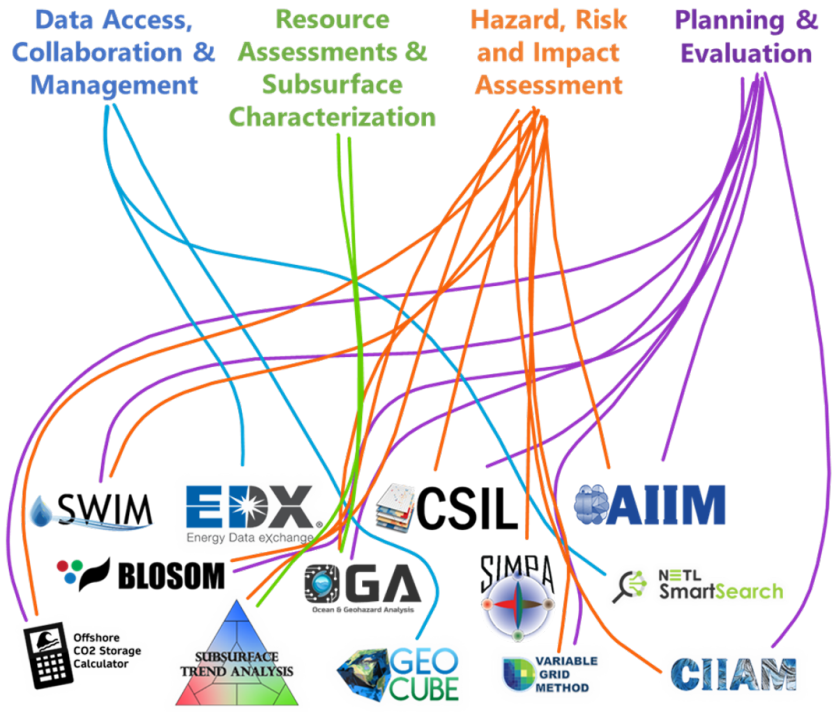
Co-saline CO_2 Storage: CO_2 injected into stacked saline reservoir while producing from HC horizons

- (+) *Utilizes existing infrastructure*
- (+) *Long-term storage*
- (+) *Favorable geologic setting*
- (+) *Offsets costs*
- (+) *Leverages existing data and knowledge*

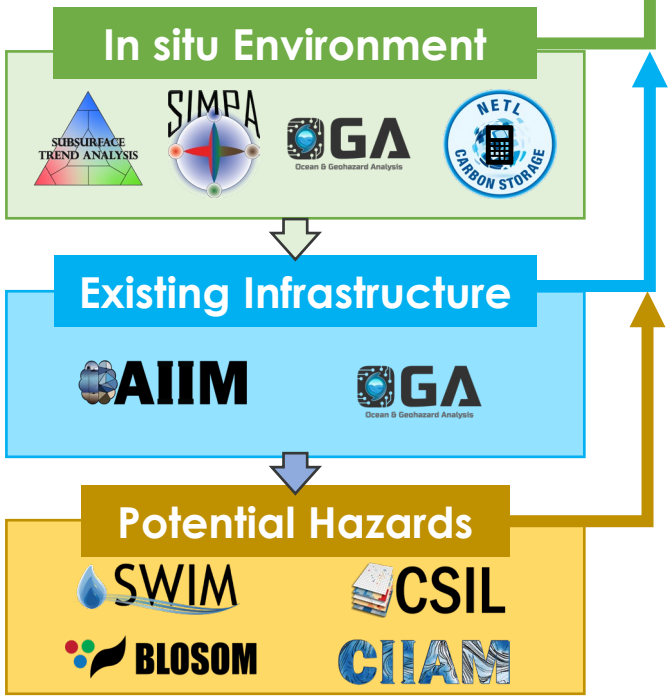


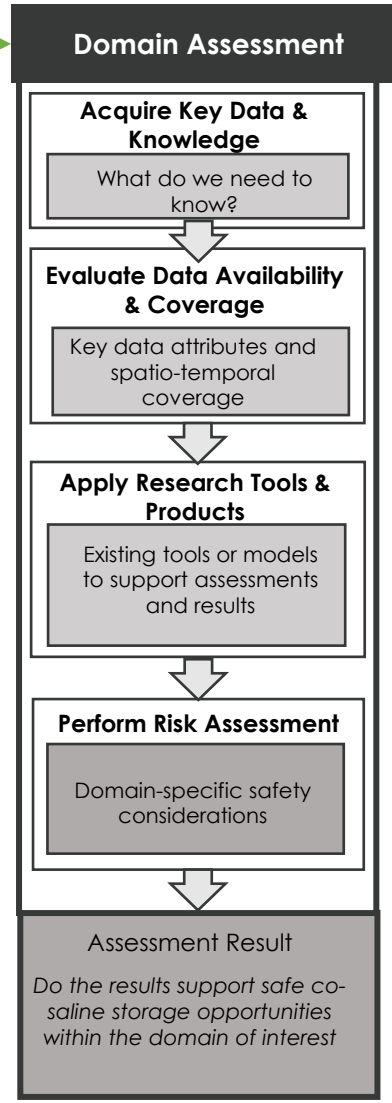
Project Objective

*Apply a **three-part workflow** using NETL's data-driven models and tools for Offshore systems…*



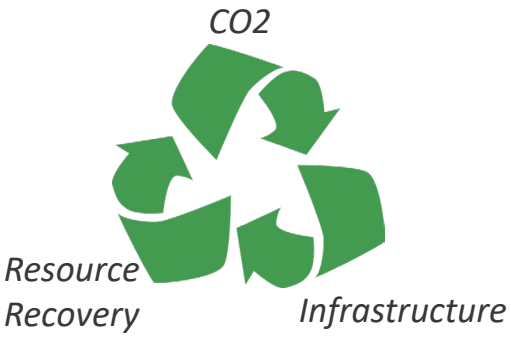
***…to assess storage resources, infrastructure reusability,** and offshore **geohazard risk**…*





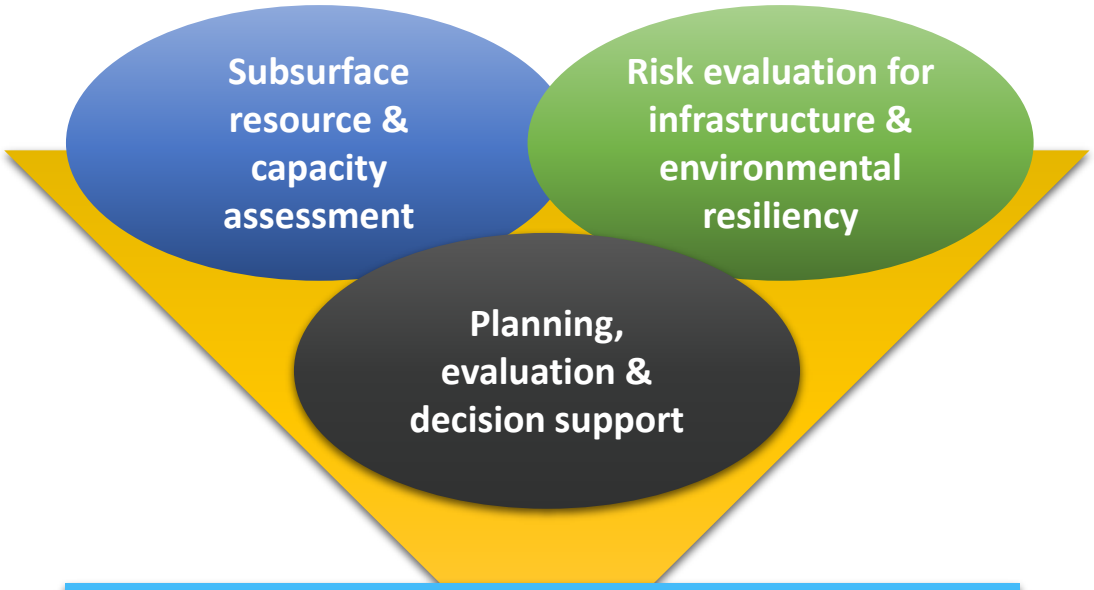
…and provide inputs to demonstrate economic viability

[Strategic Systems Analysis and Engineering | netl.doe.gov]



Building Solutions on a Solid Foundation

Leverage 10+ years of data, tools, and models from NETL's Offshore R&D



*Identify candidates for **safe** reuse and resource resiliency*

Current Offshore Tools

Data and tools can be used **individually or synergistically**, and are **configurable** to meet applications for multiple uses & stakeholders

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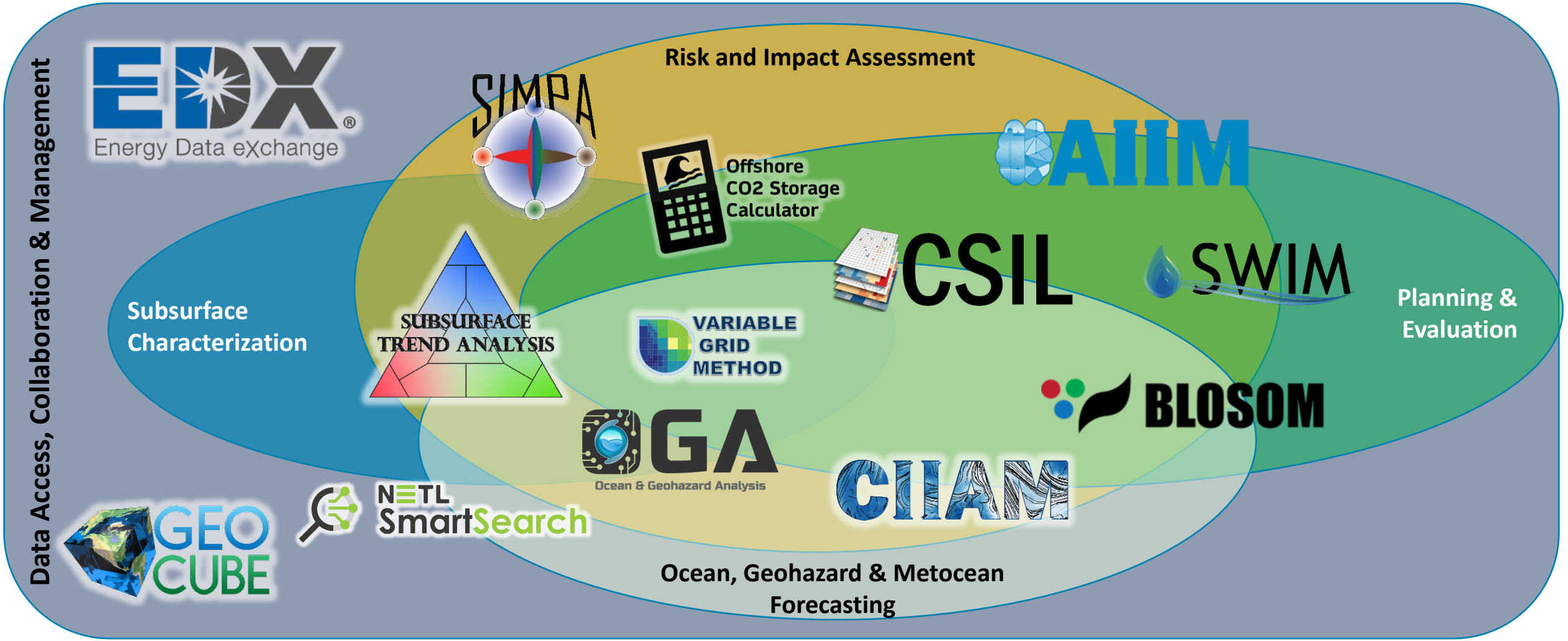
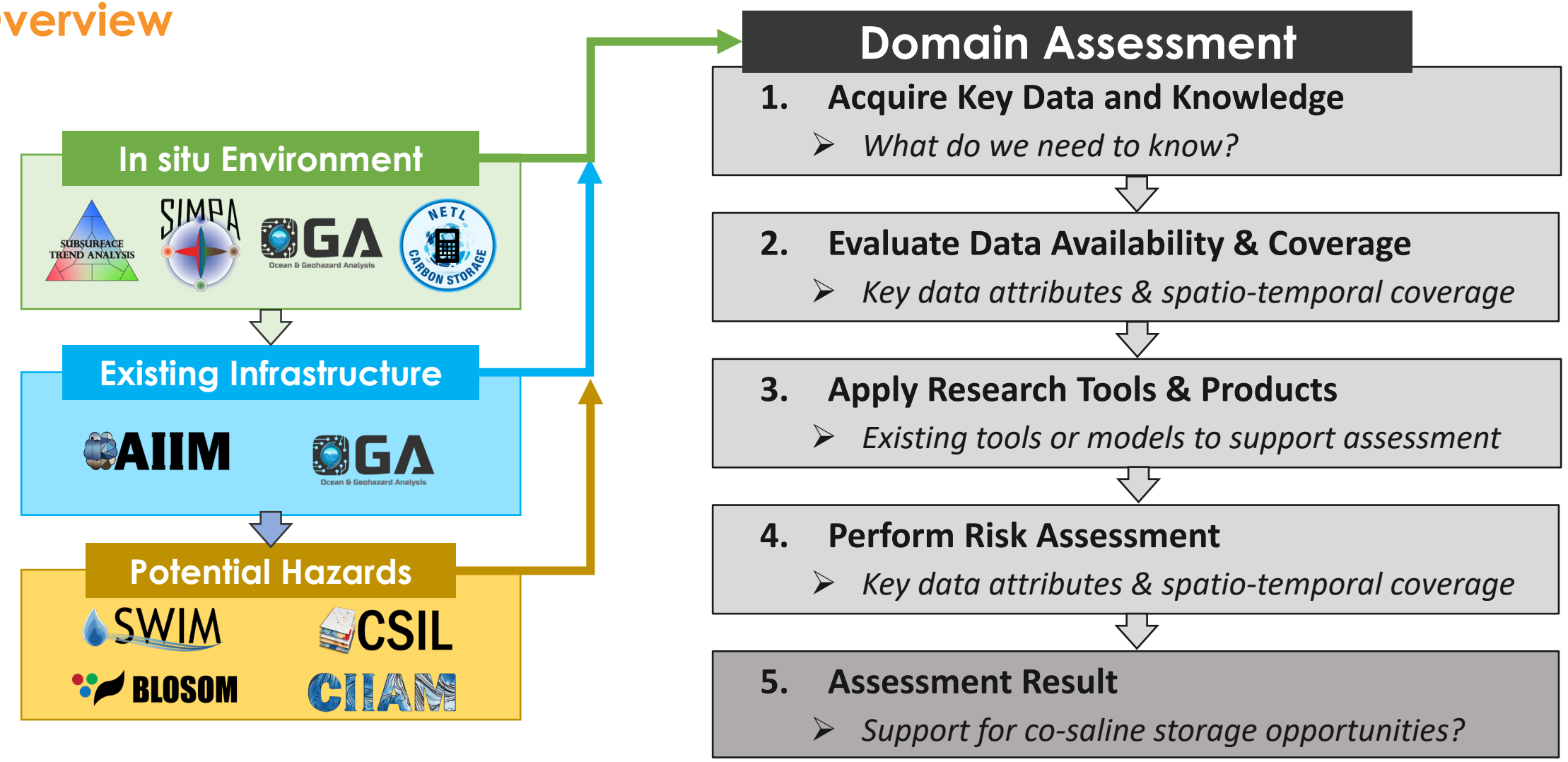


Support **collaboration**, **real-time or near-real time** analytics, and **multiple spatio-temporal scales**

Co-Saline Assessment Workflow To Date…

Overview



Co-Saline Storage Feasibility Assessment

1. In situ Environment

Acquire Key Data & Knowledge

Reservoir	Production history
Cap rock	MetOcean
Trap type	Wellbores

Evaluate Data Availability & Coverage

Seismic	Geomechanics
Well Logs	Depth
Cores	Historic fluid injection rates
Well tests	

Apply Research Tools & Products

Reservoir properties

Prospective storage resource estimates

SUBSURFACE TREND ANALYSIS

SIMPA

GA Ocean & Geohazard Analysis

NETL CARBON STORAGE

Perform Risk Assessment

Reservoir overpressure	Leakage pathways
Induced seismic events	Hydrate stability zones

Does the environment meet storage criteria?

Yes

No

Unsuitable

Co-Saline Storage Feasibility Assessment

NATIONAL ENERGY TECHNOLOGY LABORATORY

2. Infrastructure

Acquire Key Data & Knowledge

Wells	DAC Facilities
Pipelines	Past incidents
Platforms	Production history
Rigs	Wellbores

Evaluate Data Availability & Coverage

Age	Preventative maintenance
Status	Testing records
Capacity	Monitoring
Type	

Apply Research Tools & Products

Risk likelihood — OGA Ocean & Geohazard Analysis

Remaining useful lifespan — AIIM

Perform Risk Assessment

Operational risks	Well sustained casing pressure
Structure-specific response preparedness	Casing and Plug interval

Is there suitable infrastructure to support co-saline storage?

Yes

No → New installations needed

Co-Saline Storage Feasibility Assessment

3. Potential Hazards

Acquire Key Data & Knowledge

- Critical habitats
- Coastal tourism & rec
- Commercial fishing
- Protected areas
- Vessel traffic
- Species distributions
- EJSJ considerations
- USCG stations

Evaluate Data Availability & Coverage

- Location
- Updated date
- Status
- Vulnerability indices

Apply Research Tools & Products

- Vulnerable areas
- Disadvantaged communities
- Transport/metocean projections

SWIM BLOSOM CSIL CIAM

Perform Risk Assessment

- Environmental risks
- Economic risks
- Social risks
- Coastal response preparedness

Is the area of interest safe or prepared in the event of an emergency?

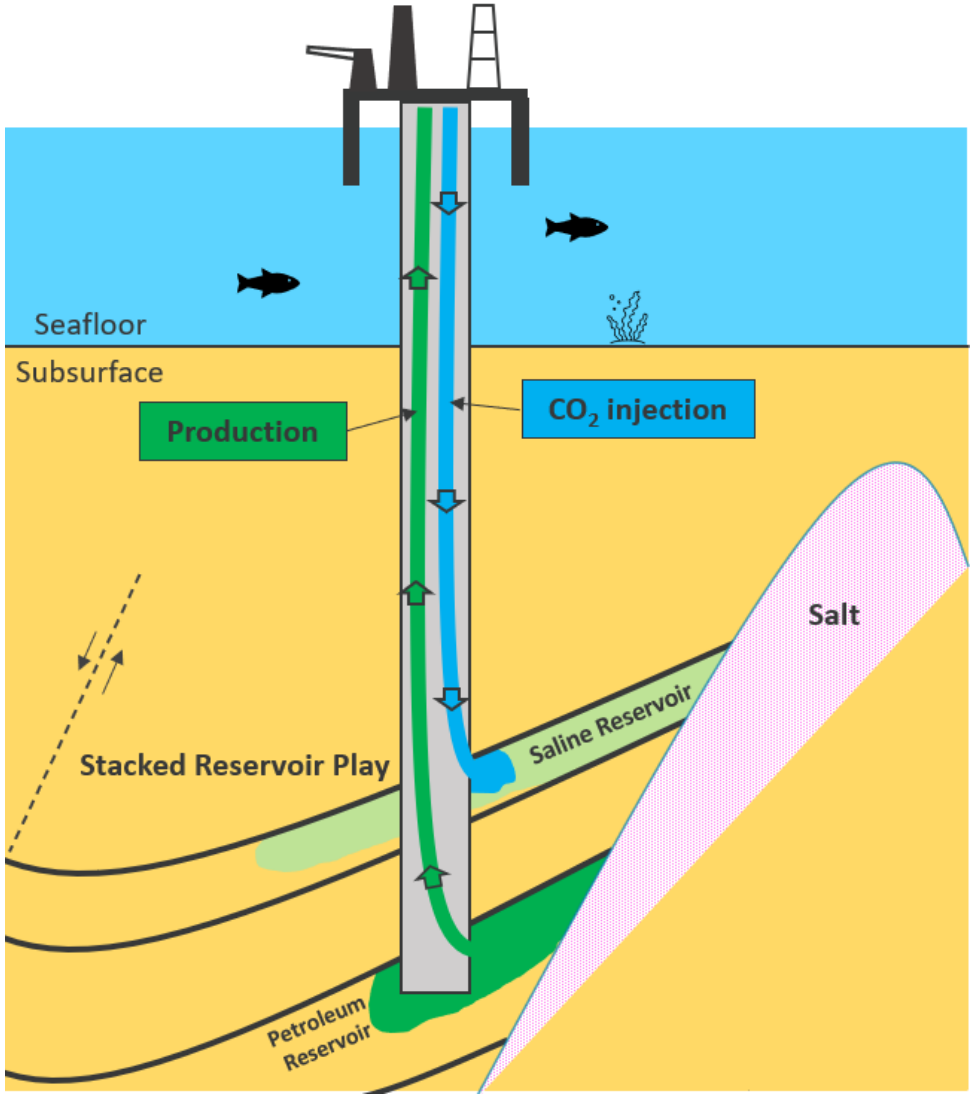
Yes → Suitable

No → Unsuitable

EY23: Next Steps

Demonstrating, Documenting, and Validating the Assessment Workflow

- **Wellbore assessment**
  - Will having injection and production tubes cause issues with wellbore pressure?
- **Geomechanical analysis**
- Accessible **web interface** to conduct analytics using NETL-DOE tools
- Focused on offshore, but see **opportunity for onshore**



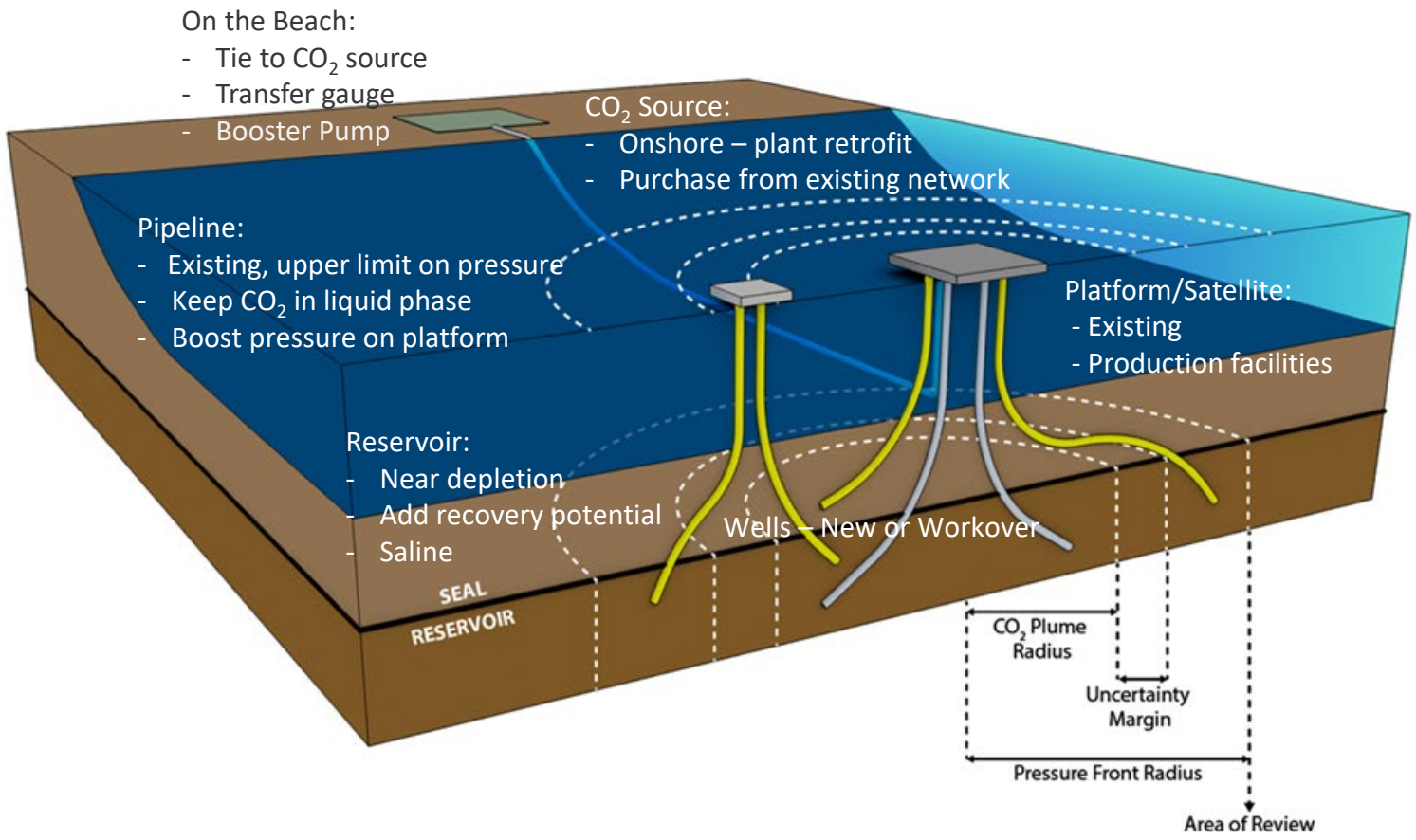
Assessing Economic Viability

Coordinate with NETL's Offshore Saline CS Cost Model Dev Team

Provide inputs for potential case studies to demonstrate economic viability

Evaluate cost factors such as:

- Distance from Shore
  - *Longer pipeline*
  - *Travel distance*
- Water Depth
  - *More steel*
- Plume area
  - *Place onshore challenges under water*
- Injection wells
  - *Directional drilling*

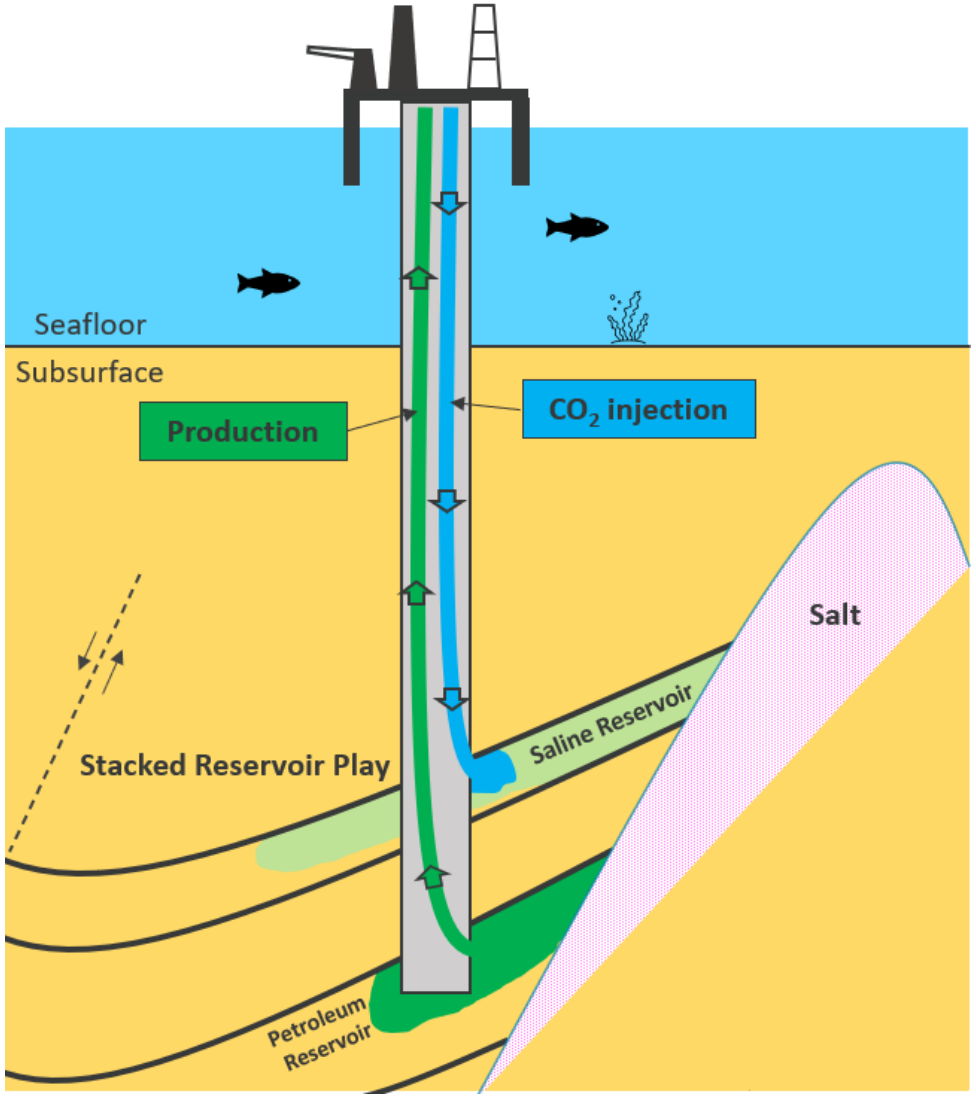


Key Project Outcomes & Impact

- ***Demonstration*** of a smart, AI-informed, advanced modeling approach to **estimating co-saline storage resources** and economic feasibility

- ***Publication*** of proposed hybrid approach to catalyze industry and regulatory interest

- ***Web interface*** that enables access to workflow, models, and tools to assess viability of co-saline storage in a given location



Additional Considerations

- Co-saline concept is **not limited to offshore** environment…
- Opportunity to **apply NRAP tools** to assess risk and economic viability
- **Limitations** to where this can be applied, but can serve to support transition, expedite CCS activities
- Beyond the technical and economical aspects, **there are regulatory gaps** that need to be addressed to enable this approach
  - Class II and Class IV, but unaware of regulation that links them

Acknowledgments

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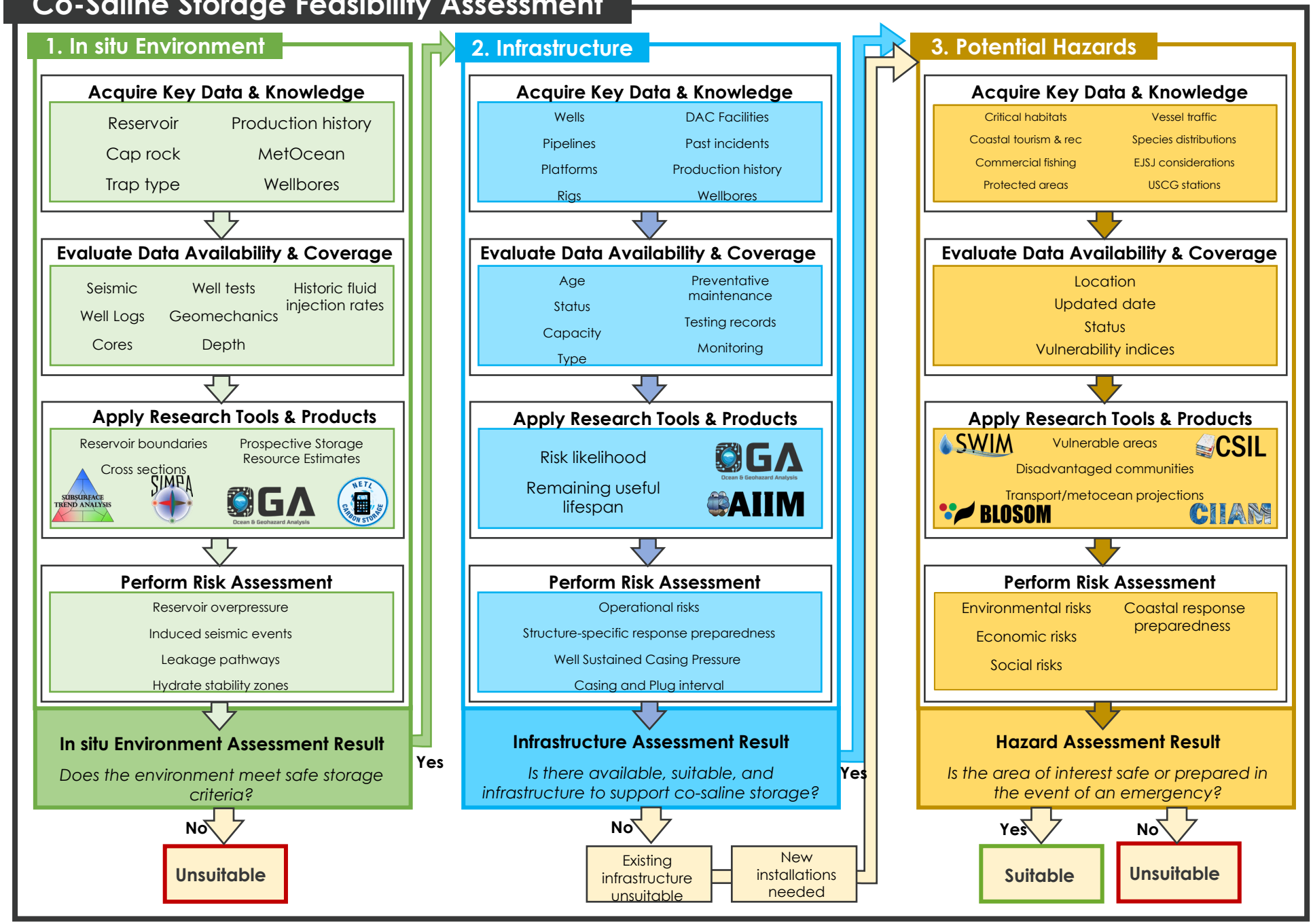
Co-Saline Storage Feasibility Assessment



DOE/NETL Tools Available for Application

- **SWIM** — Rank and compare multiple release scenarios
- **CSIL** — Spatially sum potential impacts and response
- **AIIM** — Forecast remaining lifespan of existing infrastructure
- **CHAM** — Oceanic fate and transport model
- **BLOSOM** — 4D hydrocarbon release model
- **GA** (Ocean & Geohazard Analysis) — Analyze ocean and geologic hazards
- **SIMPA** — Predict unknown faults or fractures that could pose risk of leakage pathways
- **Subsurface Trend Analysis** — Analyze subsurface property trends
- **NETL Carbon Storage** — Estimate prospective CO_2 Storage Volume

Key Co-Saline Assessment Criteria

Conceptual Framework for Evaluating Data and Knowledge Gaps

Data Availability	
Well Properties	Surface location Bottom hole Location Directional survey, TVD Spud date Status Production type
Petrophysical logs	GR, SP DT, Vp, Vs RHOB NPHI Resistivity Caliper PEF
Seismic	2D/3D
Core Analysis	Lab measurements Photos
Engineering Data	Drilling data Production data
Supporting Infrastructure	Wells Pipelines (CO2) Platform

Supporting Geology	
Proven Permanence	Duration?
Suitable Reservoir(s)	Stacked? Net thickness Lithology Lateral continuity, extent Faulting
Suitable Seal(s)	Thickness Lithology Bulk density Lateral continuity, extent Fracturing Faulting
Enclosure	Stratigraphic? Structural? Combo?

Supporting Infrastructure	
Wells	Location Status Production type Spud date
Pipelines	Location Connectivity Type Age
Platforms	Location Type Age