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Problem:

- The validated, volumetric DOE CS method (Goodman et al., 2016) for calculating resource potential is identical for onshore and offshore systems.

\[
G_{CO2} = A_t \cdot h_g \cdot \Phi_t \cdot \rho \cdot E_{saline}
\]

- \(G_{CO2}\): Amount of CO2
- \(A_t\): Total area
- \(h_g\): Gross height
- \(\Phi_t\): Total porosity
- \(\rho\): CO2 density at storage site
- \(E_{saline}\): Saline efficiency

Offshore ≠ Onshore

- CO2 density
- Unlithified sediments are more porous and permeable

Solution:

Adapted the DOE CS method for offshore saline systems to account for key differences.

OCSS: Offshore CO₂ Saline Storage Methodology

Methodology supporting top-down assessments for offshore saline systems

- **Science-based screening methodology** to estimate saline storage potential
  - Storage estimates ($G_{CO₂}$) and saline efficiency ($E_{saline}$) estimates are calculated using all possible variable combinations
  - Produces distributions of $G_{CO₂}$
  - Does not factor in time-dependent processes

\[
E_{saline} = E_A E_H E_\Phi E_d E_v
\]
\[
G_{CO₂} = A_t h_g \Phi_t \rho E_{saline}
\]

**Values Delivered:**
Provides top-down, volumetric saline storage estimates for regional, long-term planning

Fills assessment need before site-specific, or commercial estimates

Romeo et al. 2022


U.S. DEPARTMENT OF ENERGY
OCSS Methodology

Accounting the offshore saline system

- **CO₂ density and phase** given overlying water column
- **Setback distances** to support risk mitigation
- **Depositional environments** (Gorecki et al., 2009)

[Diagram of CO₂ storage in the ocean floor with key points labeled:]

- Key:
  - d = Depth (m)
  - t = Temperature (°C)
  - W = Water Column
  - S = Seafloor
  - T = Reservoir Top
  - M = Reservoir Midpoint
  - B = Reservoir Bottom

[Map indicating applied setback distances and pathways from leakage.]

Romeo et al. 2022

Offshore CO₂ Saline Storage Calculator

Desktop tool mechanizing the OCCS Methodology

• Standalone (Python v3.7)

• Enables multi-scale assessments

• Leverages power of spatial data

• Flexible tool enables customization
  • 10 - 20 parameters
  • Data availability
    • Interpreted well logs
    • Literature
    • Spatial data

Tool is currently available on EDX

https://edx.netl.doe.gov/dataset/offshore-co2-saline-storage-calculator
OCSS Calculator Outputs

Tool outputs for visualization and additional analytics

A. Data table
B. Summary table
C. Variable distributions*
D. Phase distributions*
E. Spatial data*

* Optional outputs

https://edx.netl.doe.gov/dataset/offshore-co2-saline-storage-calculator
Applications in the Northern Gulf of Mexico

Evaluated 18 geologic domains for saline storage resources

Domains defined by Subsurface Trend Analysis™
(Mark-Moser et al., 2018; Rose, Bauer, Mark-Moser 2020)

- Petrophysical Well Logs dataset
- Sands well logs
- STA™ domains

Well logs (Bean et al., 2018)
- 2–50 logs selected per domain
  - Net sand thickness of >10ft
  - Shale seal (>50 ft)

Expert knowledge & literature
- Depositional environments:
  Alluvial fan, slope basin, delta, peritidal, and shelf
- Effective porosity, microscopic, and volumetric displacements
  (Gorecki et al., 2009)

Spatial data representing potential leakage pathways
- Faults, plumes, chemosynthetic communities, and seeps

All data is available on Energy Data exchange

Key findings

Saline storage potential

- Produced 160 – 65 million estimates, ranging from 0.5 – 10,000 Gt

- All resulting densities of CO₂ at depth categorized phase as supercritical or liquid

- Saline efficiency ($E_{\text{saline}}$) identified as the most significant factor (0 – 0.14)

- Multiscale analysis possible
  - Total area ($A_T$) ranged from ~6,000 – >45,000 km²
Streamlining with NETL Tools & Models

**Offshore Risk Modeling Suite**

- Model fate & transport of release events
- Map socio-economic and environmentally vulnerabilities and risks
- Assess geohazard likelihood
- Measure the current state of infrastructure integrity
- Spatially quantify uncertainty
- Share and visualize data, models, and tools

Improving resource estimates & risk prevention strategies

Leveraging the Offshore Risk Modeling suite to inform injection site selection

Offshore CO2 Storage Calculator

Down-select areas for safe injection site selection and risk mitigation

Potential leakage pathways

https://edx.netl.doe.gov/offshore/portfolio-items/risk-modeling-suite
Building an analytical workflow using big data-driven models to identify optimal and cost-effective reservoirs, subsurface conditions, and infrastructure for reuse.

- Demonstrate & validate the application for three case studies.

Values Delivered:
Identify safe, economically-viable opportunities for carbon storage, co-saline storage, geothermal, and beneficiation for renewable applications supporting regulators, industry, and research.

What’s next: EDX4CCS

EDX4CCS

- **Data**, Integration, generation, and deployment to feed SMART, NRAP, and regulatory models
- **Tools**, Develop or integrate the deployment of tools for data interaction and visualization, decision-support such as for pipelines, regulatory permitting, resource characterization, data visualization, and more
- **Core CCS EDX DisCO₂ver platform**, Broader community virtualized data computing platform, and central EDX CCS data and tool hub

https://edx.netl.doe.gov/about
Netl Resources

Data & Tools


Relevant Publications


NETL RESOURCES

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