Overview of the FECM/NETL CO_2 Saline Storage Cost Model (CO2_S_COM)

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Disclaimer

CO2_S_COM Overview

- Excel-based techno-economic model for onshore CO_2 saline storage
- Calculates revenues and costs for a saline storage project from the perspective of the operator of that project
- Key inputs:
  - Maximum daily and average annual CO_2 mass flow rates
  - Duration of injection
  - Price for storing CO_2
- Includes database of geologic properties for 314 storage formations in lower 48 states
- Key use of the model:
  - Cycle through the storage formations
  - Calculate costs of storage for each formation
  - Calculate potential storage resource for each storage formation
  - Present the results on a national or regional basis (e.g., as cost-supply curves)

How Costs are Calculated in CO2_S_COM

Activities

- Foundation of model is the cost of discrete items referred to as activities
  - The model has hundred of activities
  - Activity costs are calculated as follows:

    ac(t) = acf * op(t) * se(t)

    where:

    ac(t) = activity cost in year t

    acf = activity cost factor

    op(t) = operational or physical process variable that costs depend, often time dependent

    se(t) = scheduling variable that is 1 in years when activity occurs and 0 otherwise
  - Activity cost factors are constants for a specific storage formation but may vary by formation
  - Operational or physical process variables are calculated by the model for each storage formation; for example:
    - Number of injection wells needed
    - Average annual CO_2 mass flow rate into an injection well
    - CO_2 plume and pressure front areas as a function of time

How Costs are Calculated in CO2_S_COM (Cont'd)

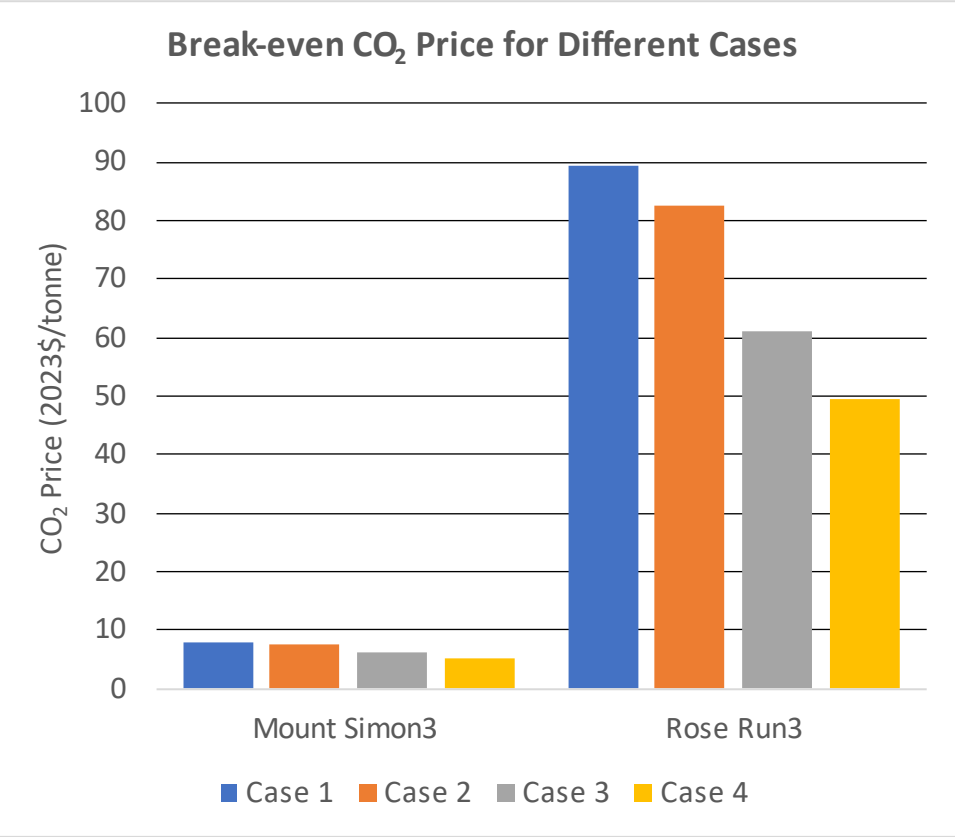
- Model divides a storage project into five stages and calculates costs for first four stages
  - Site screening, site selection and site characterization
  - Permitting and construction
  - Operations (injection of CO_2)
  - Post injection site care (PISC) and site closure
  - Long-term stewardship (assumes state is responsible)
- Includes costs for large number of monitoring technologies
  - Deep monitoring wells
  - Geophysical technologies (seismic and others)
  - Groundwater wells, vadose zone monitoring, and air monitoring
- Calculates costs for three components of financial responsibility
  - Corrective action, injection well plugging, and PISC and site closure
- Calculates costs for implementing financial instruments to comply with financial responsibility
  - Trust fund, escrow account, insurance, surety bonds, and self insurance
  - Emergency and remedial response is not directly calculated, but is assumed to be covered by an insurance policy

Financial Model and Key Outputs

- Financial model includes:
  - Revenues, capital costs and expenses in real and nominal dollars
  - The cost of components of financial responsibility and the cost of financial instruments implemented to satisfy financial responsibility
  - Depreciation and taxes
  - Debt and equity
- Given a price for storing CO_2, model calculates the net present value (NPV) for the project
  - If the NPV for the project exceeds zero, the price of CO_2 is high enough to cover all costs and the project is viable
- Alternatively, model calculates the break-even CO_2 price
  - Break-even CO_2 price occurs when NPV for project equals zero
  - Break-even CO_2 price is the lowest price the storage operator can charge for storing CO_2 and cover all costs
    - Project is viable, but just barely
- Model provides a very large number of additional outputs

Example Results

Sensitivity results for two storage formations

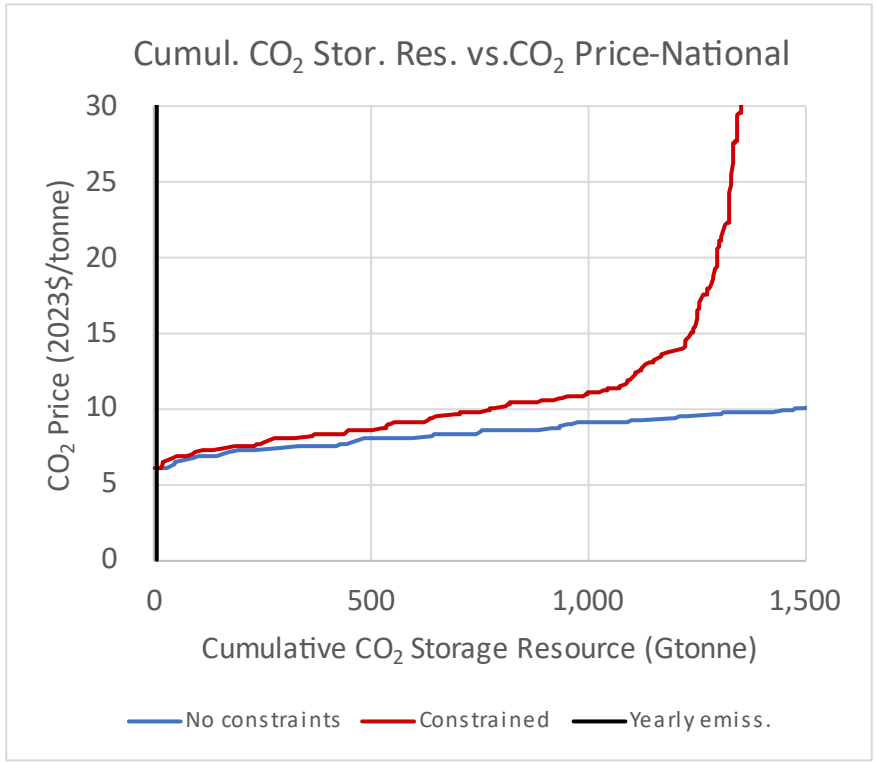


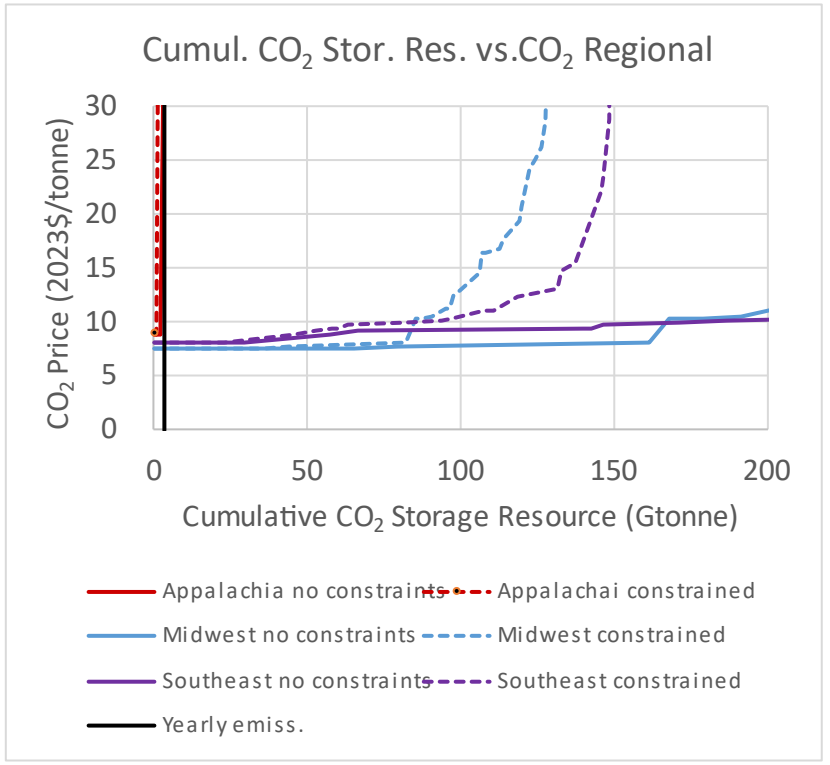
Case	Number of Deep Monitoring Wells	Duration of PISC (years)	Financial Instrument for PISC
Case 1	High	50	Trust fund
Case 2	Moderate	50	Trust fund
Case 3	Moderate	15	Trust fund
Case 4	Moderate	15	Self-insurance

Geology is important!

Example results

CO_2 cost-supply curves





- US emits ~3.5 Giga tonnes CO_{2eq}/year from electricity generation and industrial production
- Ample low-cost CO_2 saline storage options nationally, but a possible lack of storage resource on a regional basis

Other Work

- Worked with FECM HQ and LANL to develop reduced order costs for CO_2 saline storage for use in energy market models
  - Aggregated costs to reduce the number of costs that need to be included in these models
- Developing a site-specific CO_2 saline storage cost model in Python for the NRAP and SMART projects
  - Model will use outputs from NRAP and SMART tools
  - Model will calculate the cost of implementing remedial response actions as part of an ERR Plan
- Developing an Excel-based offshore CO_2 saline storage cost model

Status

- FECM/NETL CO_2 Saline Storage Cost Model (CO2_S_COM)
  - 2017 version available on NETL website
    - FE/NETL CO_2 Saline Storage Cost Model
    - https://netl.doe.gov/energy-analysis/search?search=CO2SalineCostModel
  - Currently undergoing a major upgrade with new version available in winter 2024
- Report on reduced order costs of CO_2 saline storage with spreadsheet files for implementing the costs to be released in early 2024
- Alpha or beta version of site-specific Python-based cost model will be available in spring 2024

Conclusions

- We are interested in working with others to make the cost models better!
- Contact: David Morgan (Strategic Systems Analysis and Engineering)
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- Questions?
- Thank you!