AEO2025 Carbon Capture, Allocation, Transportation, and Sequestration (CCATS) Working Group Meeting

Office of Integrated and International Energy Analysis
June 5, 2024

NEMS needs a new module to represent carbon capture

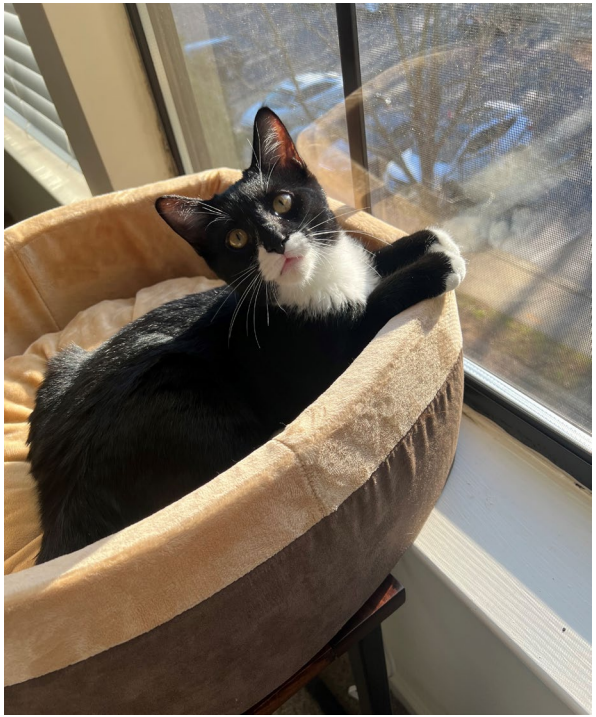
- Current National Energy Modelling System (NEMS) representation is the Capture, Transport, Utilization, and Storage Submodule (CTUS)

- CTUS is very difficult to update and maintain:
  - Code is distributed across multiple NEMS modules.
  - Sources of CO_2 supply are not modeled consistently.
  - CTUS does not model a centralized market.
  - CTUS is written in Fortran and GAMS.

- A new module is an opportunity for EIA to start from a blank slate, incorporating methods and data that were unavailable when CTUS was written.

We will implement CCATS for AEO2025

- CCATS will include updated network, market, and policy representations.
- Optimization model based on endogenously produced CO_2 supplies:
  - Model results will include supply allocations and prices.
- CCATS is designed to be flexible and accommodate potential future changes.
- CCATS will be written in Python using the “pyomo” optimization library.



Market representation requirements

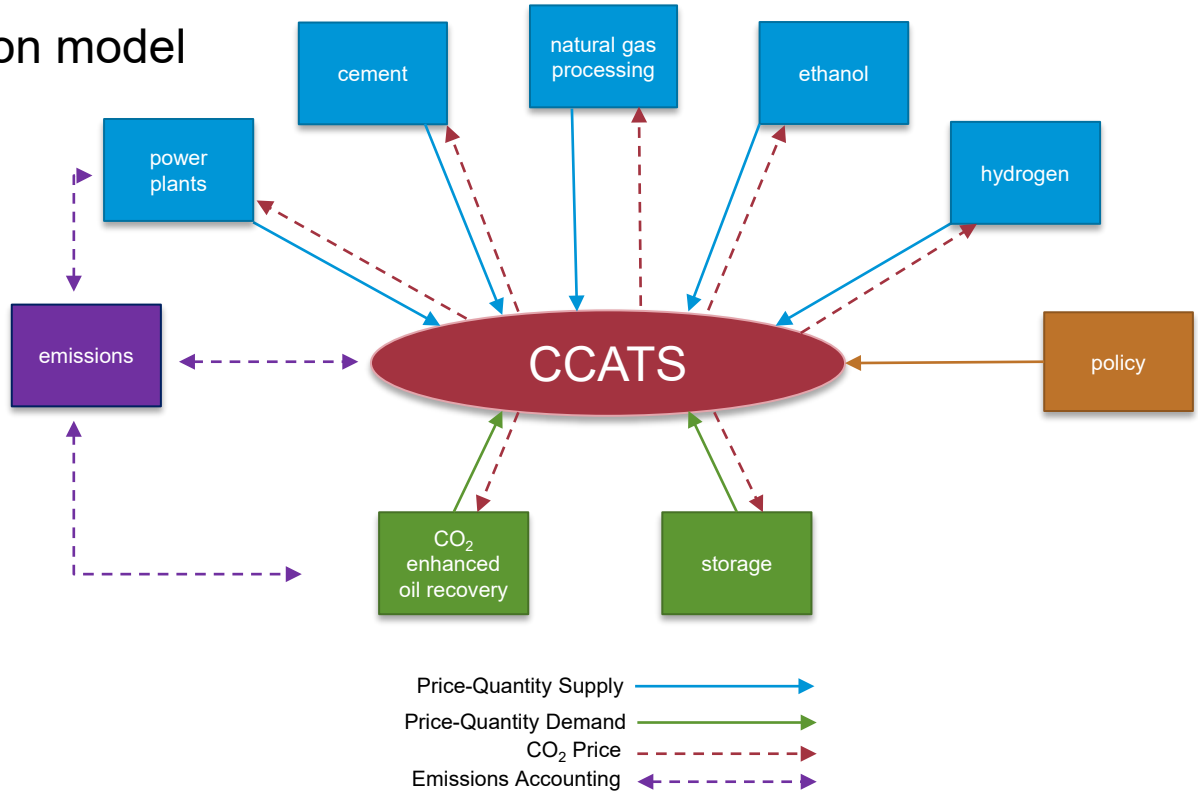
- Potentially economical sources of CO_2 supply with significant carbon capture potential
- CO_2 enhanced oil recovery (EOR) demand and CO_2 sequestration in saline formations
- CO_2 transportation with pipelines, including existing pipeline network
- 45Q tax credit
- Centralized optimization allocating CO_2 supply to demand, after assessing various costs and policy incentives

CCATS requires high-resolution data and assumptions

- CO_2 Sources: National Energy Technology Laboratory (NETL) Carbon Capture Retrofit Database
- Transportation: NETL CO_2 Transport Cost Model
- Existing Pipeline Infrastructure: Department of Transportation (DOT) National Pipeline Mapping System
- Storage: NETL Saline Storage Cost Model

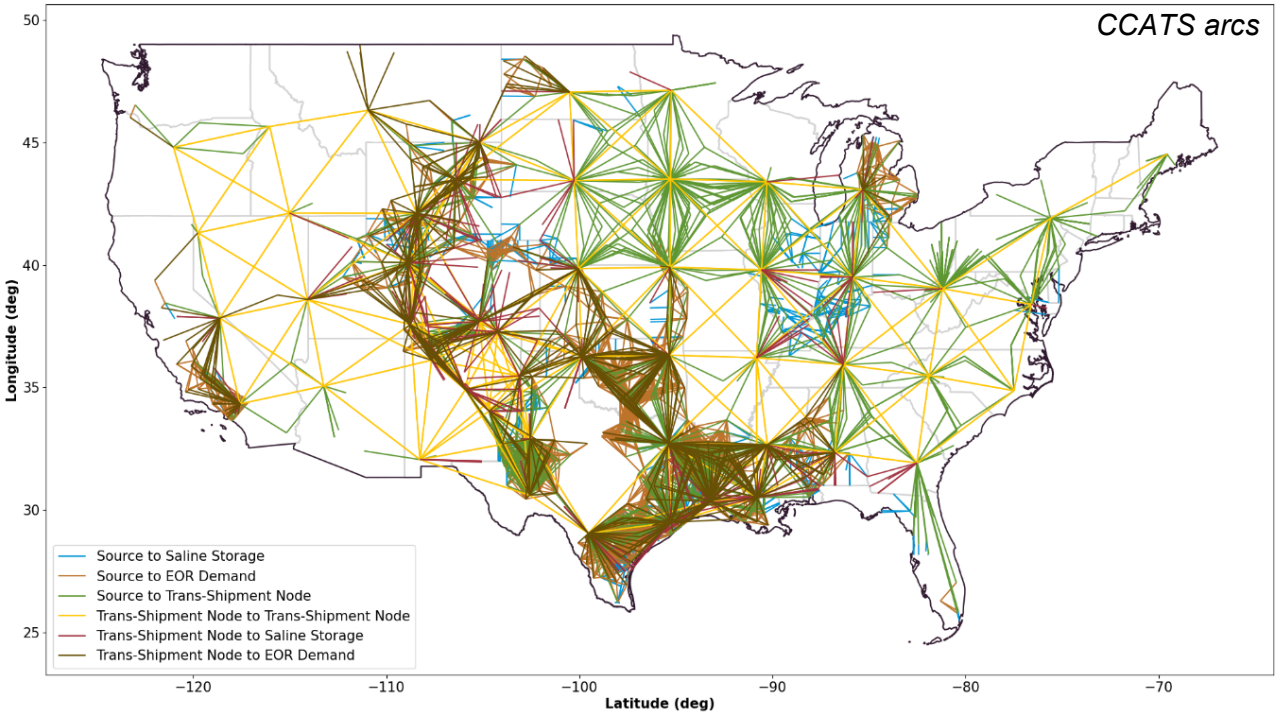
Model structure

- CCATS is an optimization model that projects:
  - CO_2 transportation flows
  - CO_2 EOR demand
  - CO_2 storage
  - CO_2 prices



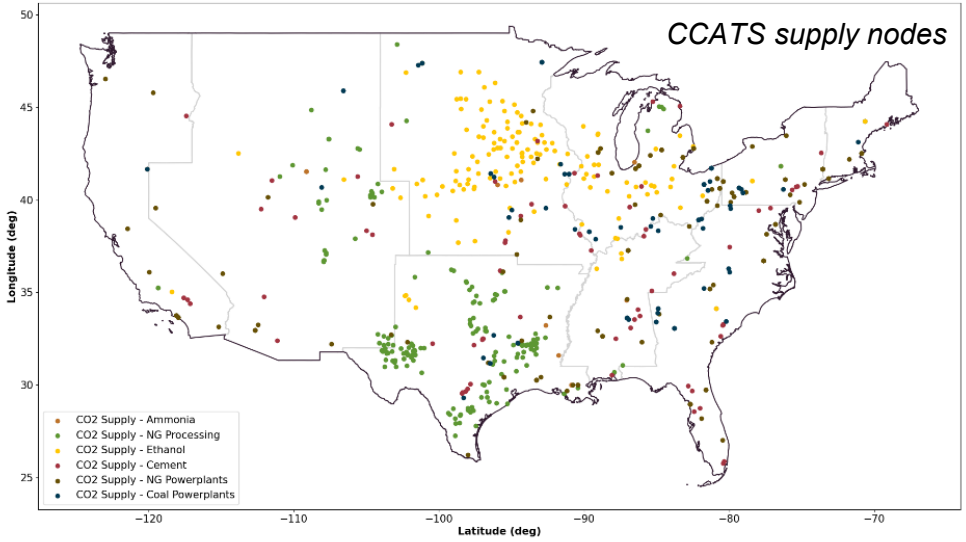
CO_2 network

- Node types:
  - Supply
  - Trans-shipment
  - CO_2 EOR
  - Storage
- Arc types:
  - Existing
  - Potential



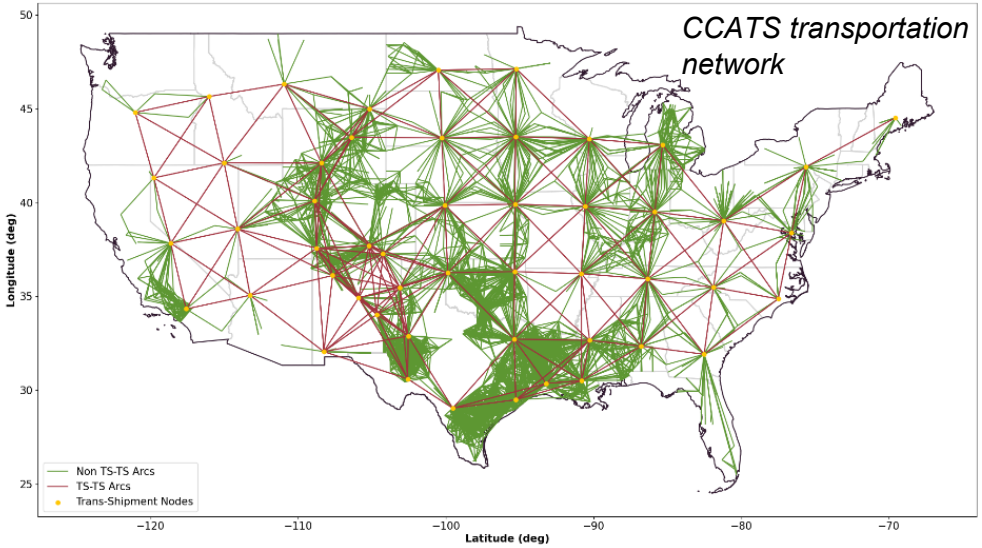
CO_2 supply representation

- CO_2 supply from NEMS is at a census-division level:
  - Too highly aggregated for CCATS to have meaningful results
- CCATS will disaggregate these volumes at point-source facilities:
  - Based on NETL CCRD Retrofit Database



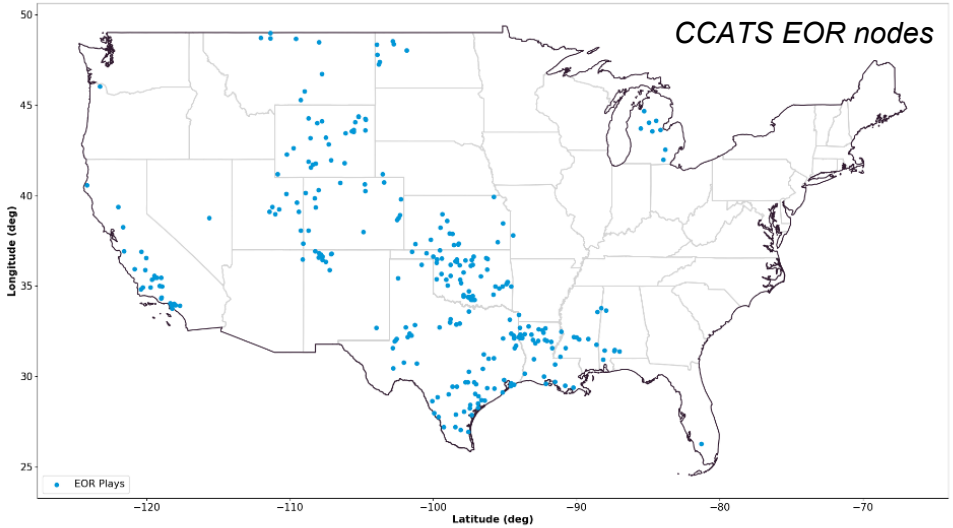
CO_2 transportation

- By pipeline only
- New pipelines include different diameters and pumps:
  - Directly from supply to demand or sequestration (*spur*)
  - Pass through trans-shipment nodes (*trunk*)



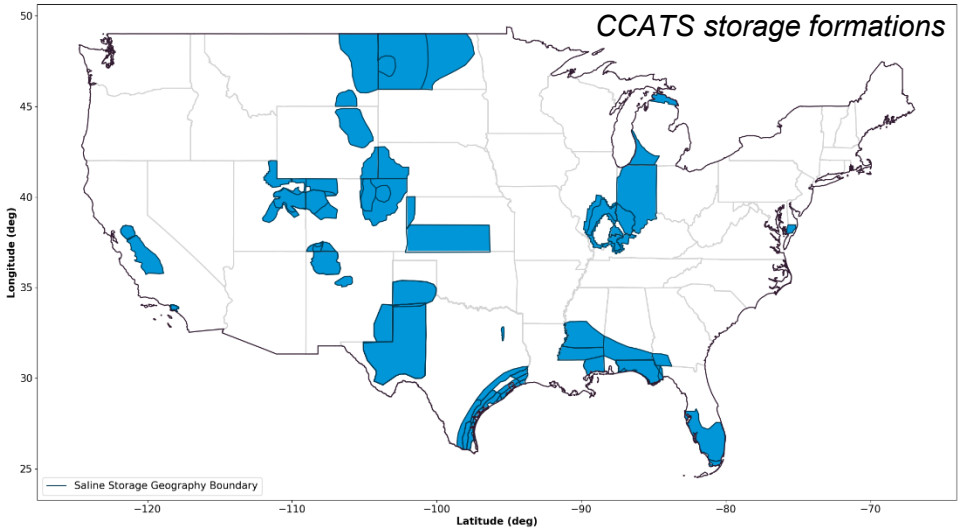
CO_2 EOR representation

- CO_2 demand is limited to endogenous demand from the Hydrocarbon Supply Module (HSM).
- EOR is represented at the geological formation and county level.



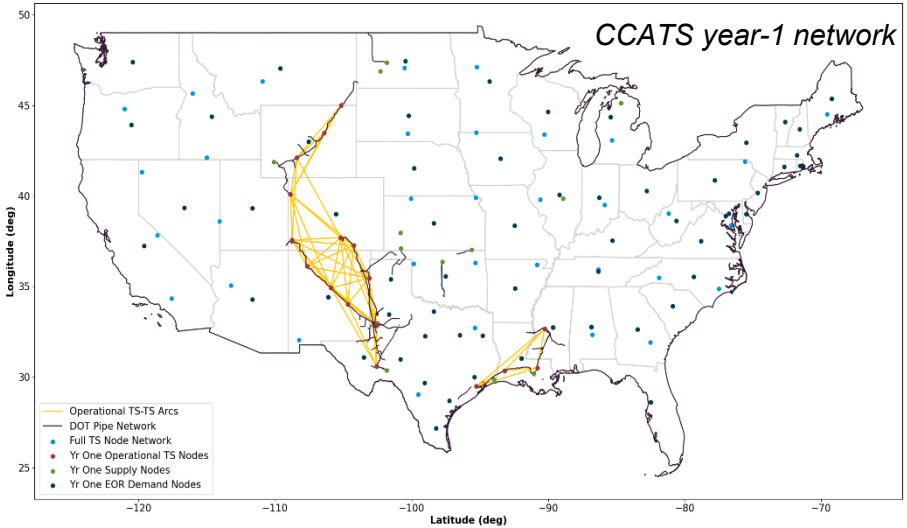
CO_2 storage representation

- Limited to onshore storage in the Lower 48 U.S. states
- Saline formations from the NETL Saline Storage Cost Model
- Excludes overlaying protected state and federal lands, and urban areas



Initial network for early model years

- Existing carbon capture facilities
- Existing pipeline network as trans-shipment nodes
- Existing CO_2 EOR demand at the state or Texas RRC level
- Existing CO_2 sequestration volumes assigned to closest saline formation



Policy representation

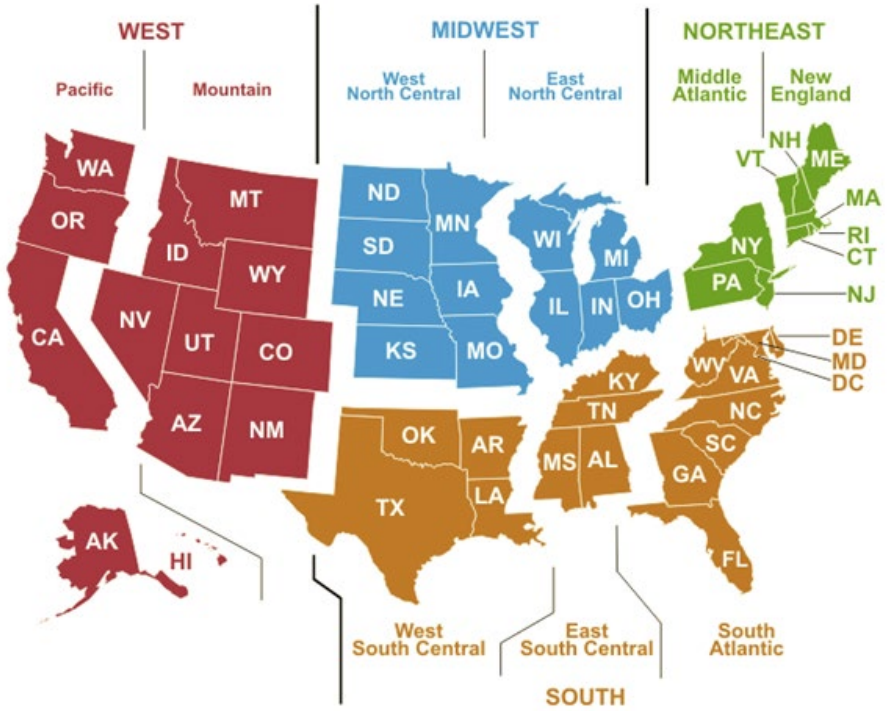
- 45Q tax credits as legislated in the Inflation Reduction Act:
  - CO_2 capture projects must begin construction by 2033 to qualify.
  - CO_2 capture projects must meet minimum CO_2 capture volume thresholds.
- CCATS is designed to be flexible to support future policy changes.

Model formulation

- Optimization problem solves for optimal CO_2 flows, transportation investment, and sequestration investment that minimizes total system costs:
  - Operations costs, investment costs, and policy incentives
- Constraints:
  - Transportation capacity (changing over time with investment)
  - Demand capacity
  - Sequestration capacity (changing over time with investment)

We expect to report results by census division

- CO_2 supply volumes
- CO_2 EOR demand volumes
- CO_2 sequestration volumes
- CO_2 prices



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Appendix

Active CO2 Pipelines