MEMORANDUM FOR: Angelina LaRose
Assistant Administrator for Energy Analysis

FROM: Lejla Villar
Director, Office of Integrated and International Energy Analysis

SUBJECT: Summary of AEO2025 Carbon Capture, Allocation, Transportation, and Sequestration Working Group held on Wednesday, June 5, 2024

This memorandum summarizes our presentation and discussion at the *Annual Energy Outlook 2025* (AEO2025) Carbon Capture, Allocation, Transportation, and Sequestration (CCATS) Working Group meeting. The CCATS Working Group presentation introduced the new module and summarized the status of module development for AEO2025. After the presentation, meeting participants commented on model development and data topics. The presentation for this meeting is available in a separate document on our website.

Model overview (AEO2025)

We presented an overview of planned data and model features planned for AEO2025:

- Optimization model
  – Cost minimization of utilizing and storing CO_2 supplied by other National Energy Modeling System (NEMS) modules given the constraints of capture, transport, policy, incentives, and storage
- Capture
  – CO_2 supplied by other NEMS modules, specifically power plants, cement, natural gas processing, ethanol, and hydrogen
- Transportation
  – Transportation by pipeline using existing routes or the construction of spurs and trunk lines
  – Network of trans-shipment nodes for transportation throughout continental United States
- Policy and incentives
  – Section 45Q credit for carbon oxide sequestration, including CO_2 captured from power and industrial sources for enhanced oil recovery (EOR) or storage in saline formations
- Storage
  – CO_2 EOR demand determined by the Hydrocarbon Supply Module (HSM)
  – Storage options in saline formations aggregated from the NETL Saline Storage Cost Model

WORKING GROUP PRESENTATION FOR DISCUSSION PURPOSES ONLY.
DO NOT QUOTE OR CITE BECAUSE RESULTS ARE SUBJECT TO CHANGE.

Discussion

During the discussion, participants primarily asked about capture, transport, policy and incentives, EOR or storage, and interactions with other modules. A member of the CCATS team served as the moderator. In between audience questions, the moderator also asked questions received during registration.

Capture discussion

An attendee asked whether users will be able to update capture cost assumptions. We responded that the CCATS input file will include capture costs, so users can update them once we release CCATS publicly.

The moderator asked whether we are including direct air capture in CCATS. We responded that we are not including direct air capture for AEO2025.

Transport discussion

An attendee asked how we create trans-shipment nodes. We explained that an offline preprocessor determines these nodes and that process includes taking pipeline data from the U.S. Department of Transportation and creating nodes to broadly represent the system. We also add additional nodes so that the potential network extends across the continental United States. We elaborated that in the module, trans-shipment pathways visualized as crossing water have the pipeline length required to circumnavigate the body of water.

We were asked if the user will be able to adjust the grid density of trans-shipment nodes. We responded that the grid is created in an offline preprocessor, and although users can change the granularity, we currently do not plan to publicly release the preprocessor. We also explained that the grid density shown in the presentation may be subject to change for AEO2025, based on runtime results.

The moderator asked if pipelines will be the only transportation option included. We responded that for AEO2025, pipelines will be the only transportation option and that we based this decision on runtime constraints and the current state of the industry.

An attendee asked about what assumptions the model was making regarding the permitting and construction time required for CO_2 pipelines and saline storage sites. We responded that across NEMS modules, we assume that unannounced construction cannot occur in the first few model years.

Policy and incentives discussion

One attendee asked if CO_2 sources will stop capturing once the 12-year period for the Section 45Q credit expires, and if so, what would happen to already constructed pipelines. We explained that CCATS will provide other NEMS modules with the price of CO_2, and the other NEMS modules will determine whether to continue capturing CO_2. We also explained that a process will exist for retiring pipelines that are no longer needed.

An attendee asked through what year will we include Section 45Q tax credits in the module. We responded that CCATS will follow the 45Q regulations and that we anticipate between 2045 and 2050, depending on the amount of time assumed for project construction.

We were asked how CO_2 sources will distinguish between the Section 45Q tax credits available for EOR and saline storage. We explained that CCATS will not have separate markets for EOR and saline storage and instead use a system-wide cost minimization.

The moderator asked how EPA Rule 111 will affect power plants in CCATS. We responded that the rule will not be directly modeled in CCATS; instead EPA Rule 111 will be implemented in the Electricity Markets Module (EMM). CCATS will then model the CO_2 flows provided by the EMM.

The moderator asked whether Section 45Q will be the only incentive for carbon capture. We explained that Section 45Q will be the only policy incentive. However, EOR sites will also provide economic incentives for CO_2. We also explained that although Section 45V could provide incentives for carbon capture, the Hydrogen Markets Module (HMM) assumes that for AEO2025 the only hydrogen production pathway will be steam methane reforming and that it will only qualify for Section 45Q.

The moderator asked whether any aspects of Section 45Q are excluded in CCATS. We explained that the only provision of Section 45Q that we do not expect to include is for direct air capture because direct air capture will not be included in AEO2025.

EOR/storage discussion
An attendee asked if EOR will be the only CO_2 utilization or if other pathways such as e-methanol or sustainable aviation fuels (SAFs) would be included. We responded that we based the decision to include or exclude CO_2 pathways on economic potential, NEMS runtime, and available high-quality data. We explained that at this time, EOR is the only utilization pathway included because data for other pathways were limited and that we believe adding other pathways is intractable with NEMS runtime. We added that we will revisit alternative pathways in the future.

An attendee asked about the criteria for making state and federal lands available for CO_2 storage. We responded that these criteria are a work in progress and will be refined this summer.

An attendee commented that storage options appeared to be limited in Ohio and Illinois, despite those states having Class VI permit applications. The attendee then asked whether we would update storage options to account for Class VI permit applications. We responded that we are refining storage data and that we will review the status of applications.

The moderator asked how storage formations will be represented at the well level. We explained that the preprocessor optimizes the size of the injection site and that we are refining this part of the module.

The moderator asked what capacity of CO_2 storage will be included in CCATS. We responded that we anticipate about 50 billion tons of CO_2.

Interactions with other modules discussion
An attendee asked about aligning the investment decisions between the Electricity Markets Module (EMM) and CCATS given that EMM typically assumes a 30-year investment period but Section 45Q provides 12 years of benefits. We responded that EMM assumes 20 years for CCS retrofits and that the EMM team is looking into adjusting it, possibly in the range of 10 to 15 years. EMM also assumes a 30-year life for new construction, which we could change and revisit in the future.

An attendee asked how HMM will determine point source locations for carbon capture. We responded that we will first use the facilities identified by the National Energy Technology Laboratory (NETL) Carbon Capture Retrofit Database (CCRD) as suitable for retrofits. We further explained that additional capacity will be geographically represented based on existing clusters of facilities.

An attendee asked what the technology assumptions will be for new hydrogen production. We responded that the HMM working group is next week and that we will share a requirements document at that time.

An attendee asked how emission reductions will be accounted for in the model and whether we will separately report sequestered and utilized biogenic CO_2. We responded that we are working with the Emissions Policy Module (EPM) to ensure the carbon accounting is done correctly.

An attendee asked whether ethanol production would include both fermentation and fossil fuel emissions. We responded that we will finalize these topics in the coming months.

Miscellaneous
The moderator asked what programming language CCATS will be in. We explained that we are writing CCATS in Python using Pyomo because it will result in code that is fully open source and the team is proficient in Python.

An attendee asked if the presentation would be available to participants afterwards. We responded that it will be available on the AEO working group website and provided the link in the chat.

Attendees

Guests (Webex/phone)	Affiliation
Nigel Jenvey	Baker Hughes
Alyssa Leibold	Bureau of Labor Statistics
Erin Middleton	Carbon Solutions
Jonathan Ogland-Hand	Carbon Solutions
Angela Seligman	Clean Air Task Force
John Thompson	Clean Air Task Force
Nathan Musick	Congressional Budget Office
Philip Lenart	ExxonMobil
Matthew Ives	GTI Energy
Derek Wissmiller	GTI Energy
David Morgan	National Energy Technology Laboratory
Wesley Cole	National Renewable Energy Laboratory
Amogh Prabhu	OnLocation
Sharon Showalter	OnLocation
Frances Wood	OnLocation
Ben King	Rhodium Group
Hannah Kolus	Rhodium Group
Joshua Junge	Sargent & Lundy
Jose Benitez	U.S. Department of Energy
Tomy Granzier-Nakajima	U.S. Department of Energy
Levi Kilcher	U.S. Department of Energy
Natalie Lefton	U.S. Department of Energy
Jennifer Li	U.S. Department of Energy
Brandon McMurtry	U.S. Department of Energy
Misha Adamantiades	U.S. Environmental Protection Agency
Imran Lalani	U.S. Environmental Protection Agency
Stacey Zintgraff	U.S. Environmental Protection Agency
Elisa Alonso	U.S. Geological Survey
Richard Fullenbaum	

EIA staff attendees (Webex/phone)
Monica Abboud
Jeffrey Bennett
Erin Boedecker
Richard Bowers
Singfoong Cheah
Zach Chairez
Peter Colletti
Matthew Corne
Anna Cororaton
Jim Diefenderfer

Janea Dixon
Michael Dwyer
Kathryn Dyl
Mindi Farber-DeAnda
Alexander Felhofer
Peter Gross
Christina Jenq
Ari Kahan
Mala Kline
Vikram Linga
John Maples
Laura Martin
BoonTeck Ong
Kendyl Partridge
Mark Schipper
Elizabeth Sendich
Estella Shi
Sauleh Siddiqui
Nicholas Skarzynski
Matthew Skelton
Andrew Smiddy
William Sommer
Claire Su
Manussawee Sukunta
John Taber
Edward Thomas
Stephanie Tsao
Gregory Vance
Mary Webber
Joshua Whitlinger
James Willbanks
Stephen York