Analysis of the Impact of 45Q Sequestration Tax Credits Using the Improved Representation of Industrial Carbon Capture in NETL-NEMS

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U.S. DEPARTMENT OF ENERGY

Outline

- Purpose and Overview
- Scenarios
- Results
- Conclusions

Purpose and Overview

- **Purpose**
  - Task was to enhance the CTUS-NETL version of National Energy Modeling System (NEMS) to better represent CO_2 capture opportunities at industrial sources, focusing on Ethanol, Hydrogen and Natural Gas Processing (NGP) facilities
  - Then use the enhanced structure to analyze R&D or policy impacts
- **Overview**
  - The model enhancements have been completed
    - CCUS investment decisions have been added to the Liquid Fuels Market Module (LFMM) for the three industries and linked to the CTUS submodule
  - Scenarios examining 45Q tax credits indicate industrial CCUS is economic; the enhanced model improves projections regrading these sources

Scenarios

- **Two scenarios were constructed to examine how 45Q sequestration tax credits might stimulate industrial and power plant CCUS**

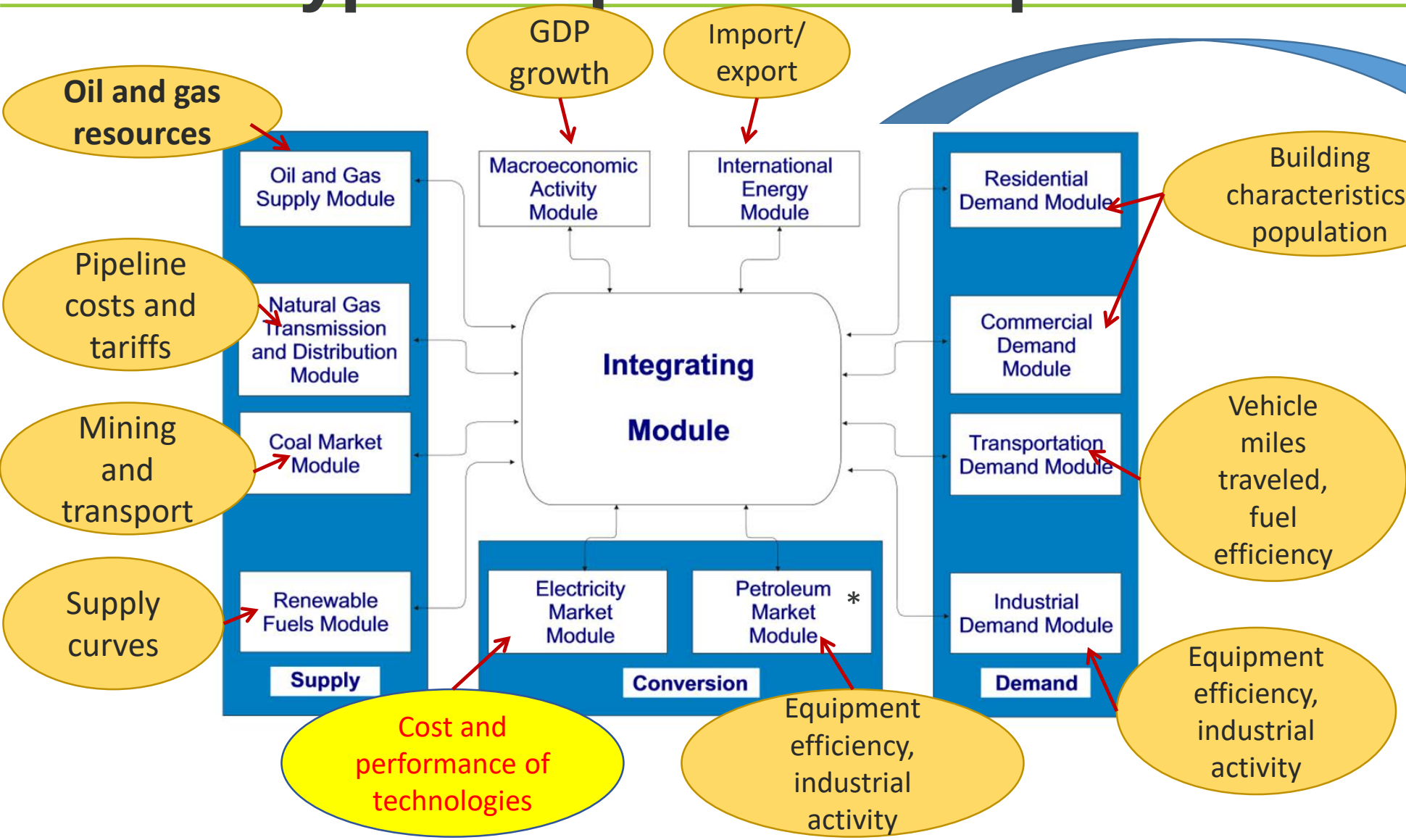
- **Both cases use NETL-NEMS with the enhanced representation of industrial capture**
  - **Reference case (45Q Ref):** 45Q tax credit as legislated (sunsets)
  - **45Q Credits extended (45Q Ext):** tax credits extended through 2050

- **Cases include lower EOR O&M costs, high economic and electricity demand growth assumptions, and program goals for power carbon capture, utilization, and storage as in prior AEO2017 45Q analysis**

45Q Tax Credits

- **The "Furthering Carbon Capture, Utilization, Technology, Underground Storage, and Reduced Emissions Act" or "FUTURE Act" was passed as part of the Bipartisan Budget Act of 2018 in February. The FUTURE Act expands and extends the existing Section 45Q CO_2 sequestration tax credit**
  - The tax credit provides a 12-year, permanent sequestration tax credit for qualified facilities that capture and permanently store CO_2
  - The tax credit is available to both power and industrial sources of CO_2
    - The tax credit for CO_2 used for **EOR** ramps in starting at $12.83 per metric ton in 2017, rising linearly to **$35** per metric ton by 2026. After 2026, credits rise with inflation
    - The tax credit for CO_2 that is permanently stored in **saline aquifers** ramps in starting at $22.66 per metric ton in 2017, rising linearly to **$50** per ton by 2026. After 2026, credits rise with inflation
  - Facilities must start construction by January 1, 2024, to be eligible for the tax credit

NEMS – typical inputs and outputs

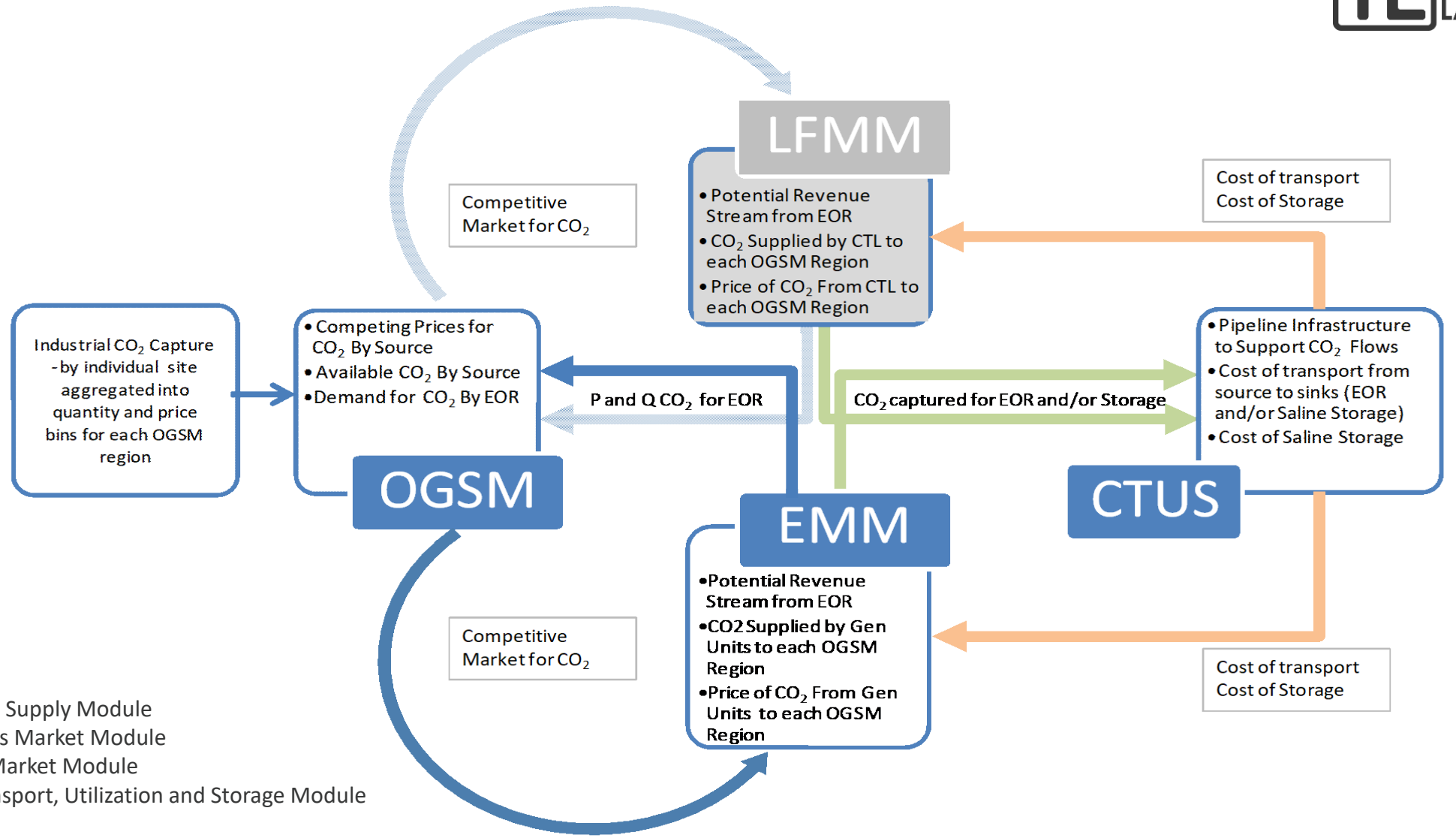


Outputs:

- Production
- Consumption
- Emissions
- Prices

* Now known as Liquid Fuel Market Module

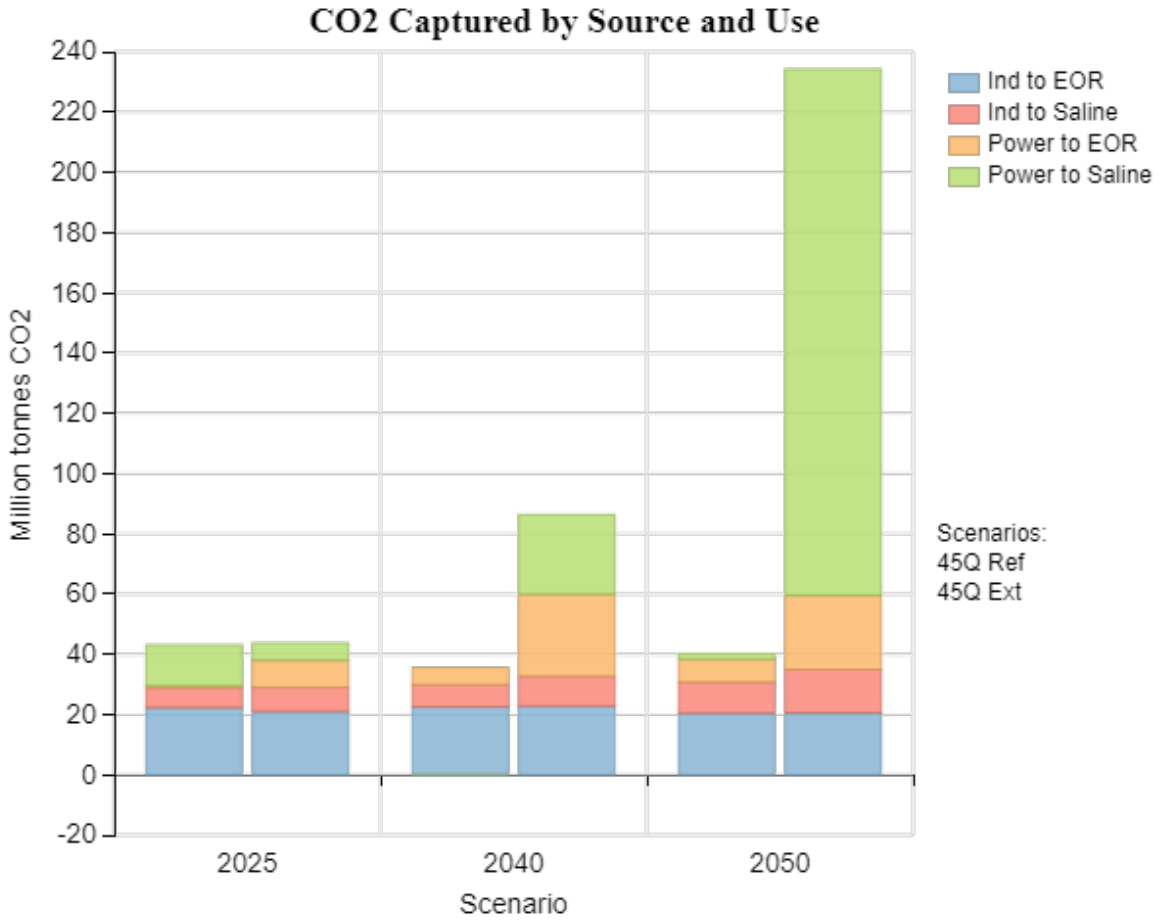
Schematic of Model Structure



OGSM: Oil and Gas Supply Module
LFMM: Liquid Fuels Market Module
EMM: Electricity Market Module
CTUS: Carbon, Transport, Utilization and Storage Module

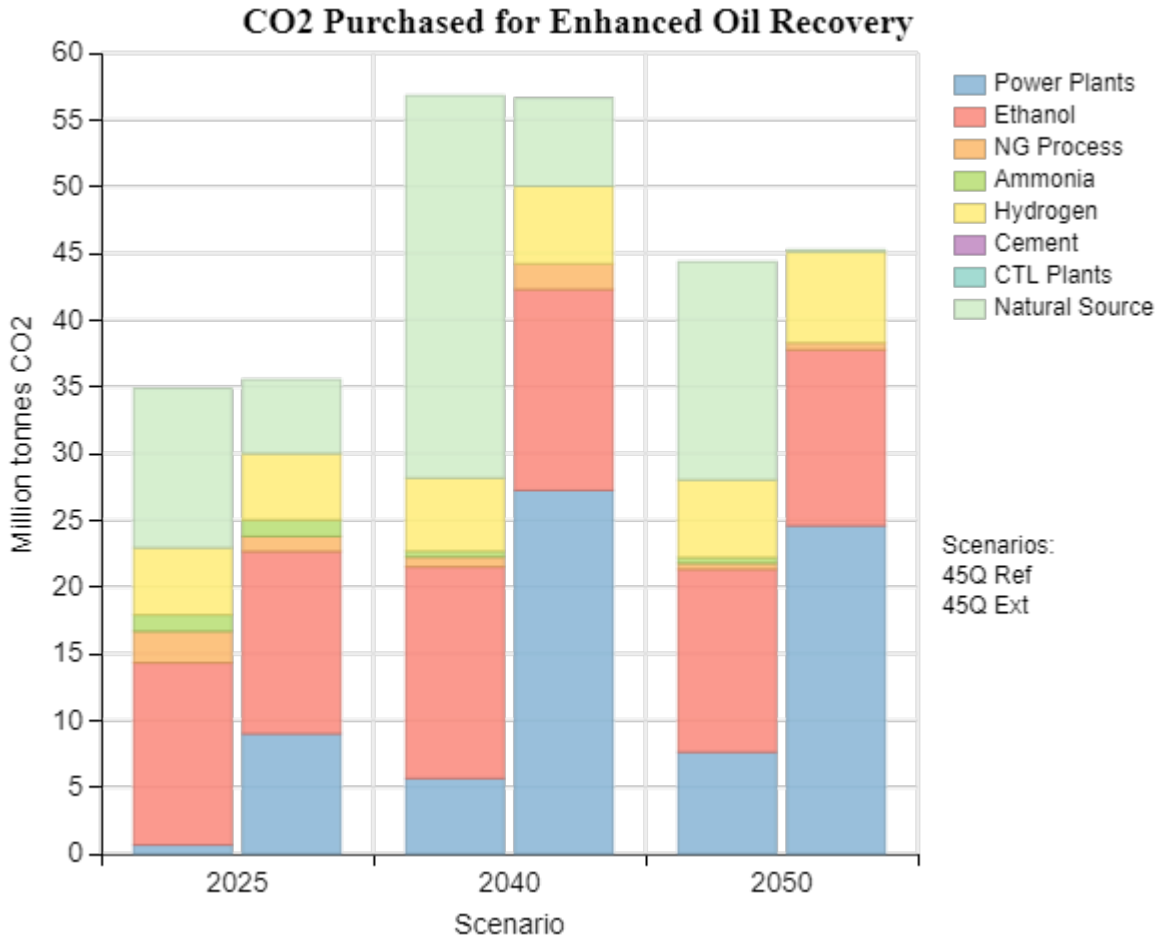
Industrial Sources Responsive to 45Q

- **CO_2 captured at power plants expands dramatically when the 45Q tax credit is extended**
  - R&D goals bring down the cost of coal CCUS after the tax credit expires in the 45Q Ref case
- **Much of the increase in captured CO_2 is sent to saline storage, rather than EOR**
- **Industrial CO_2 capture does not expand significantly with the extension**
  - Most of the CCUS is retrofit rather than new capacity because ethanol and hydrogen production is not expanding
  - Natural gas processing CCUS in new facilities is not modeled, but the CO_2 capture potential is likely small based on existing plant potential



CO_2 Purchased for EOR

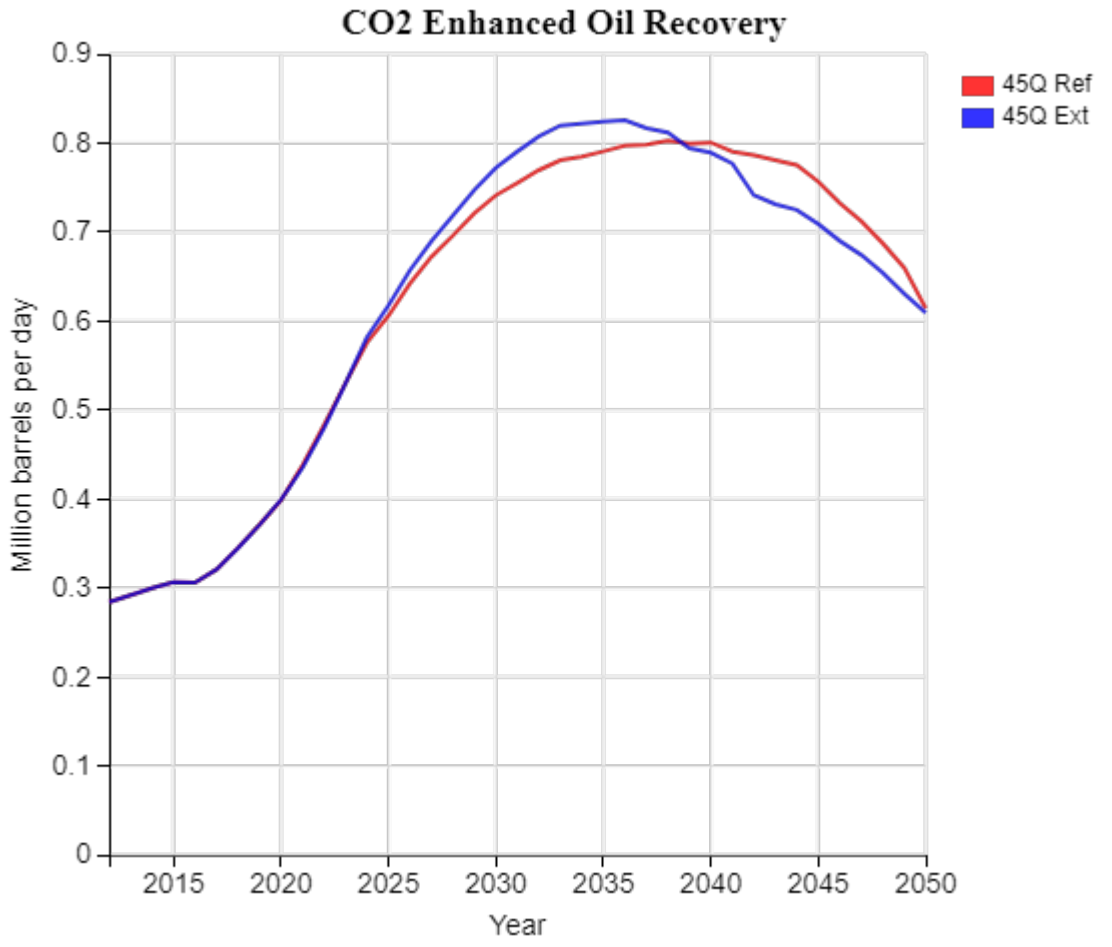
- **The various industrial CO_2 sources compete with CCUS at power plants and natural sources to provide CO_2 to EOR**
  - Ethanol provides the largest share of industrial CO_2, followed by hydrogen
  - Hydrogen capture is higher and NGP is lower as a result of the updated data in this enhanced version of NETL-NEMS
- **When the tax credit is extended, CO_2 captured at power plants expands and natural sources are displaced.**



Note CO_2 is incremental above 2015 levels

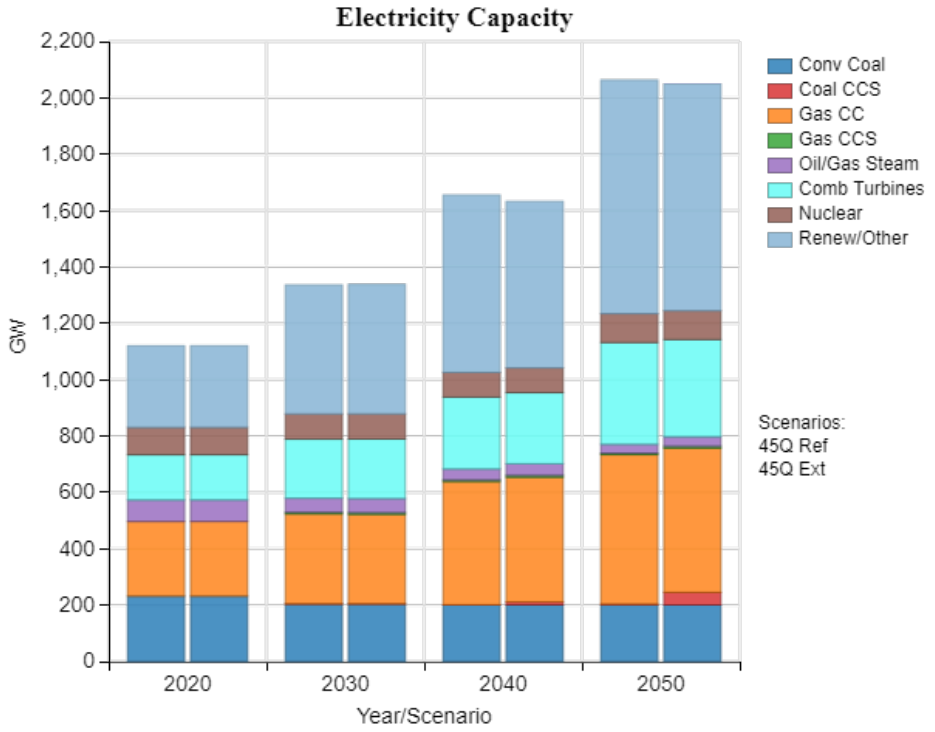
EOR Production

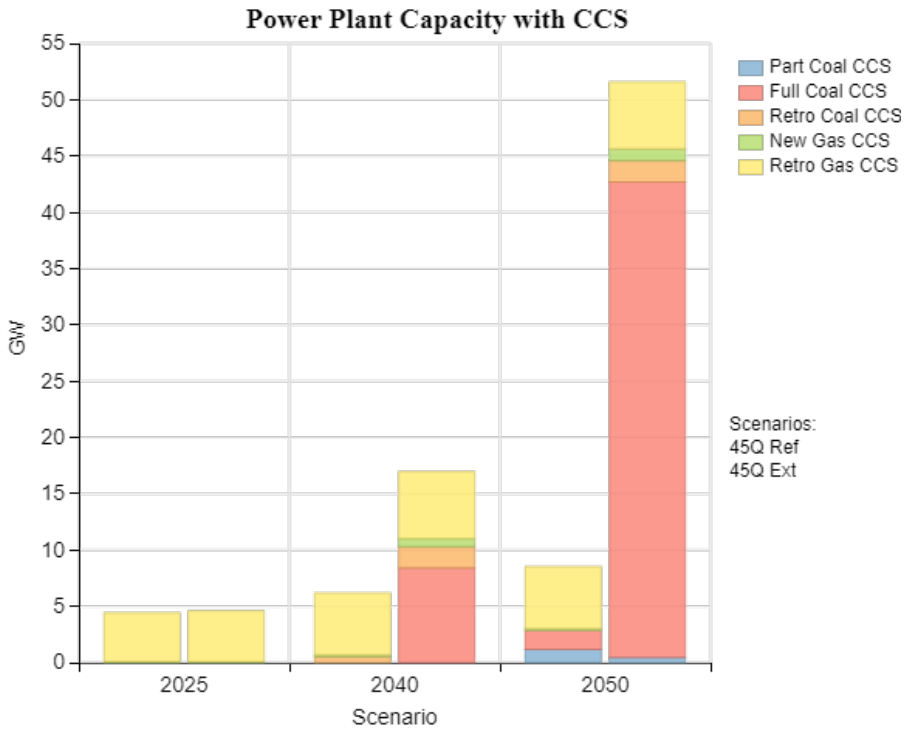
- **Total oil production is relatively unchanged by the extension of the 45Q credits.**
  - Some production is accelerated, but in both cases production tapers down as existing fields are depleted



Electric Capacity

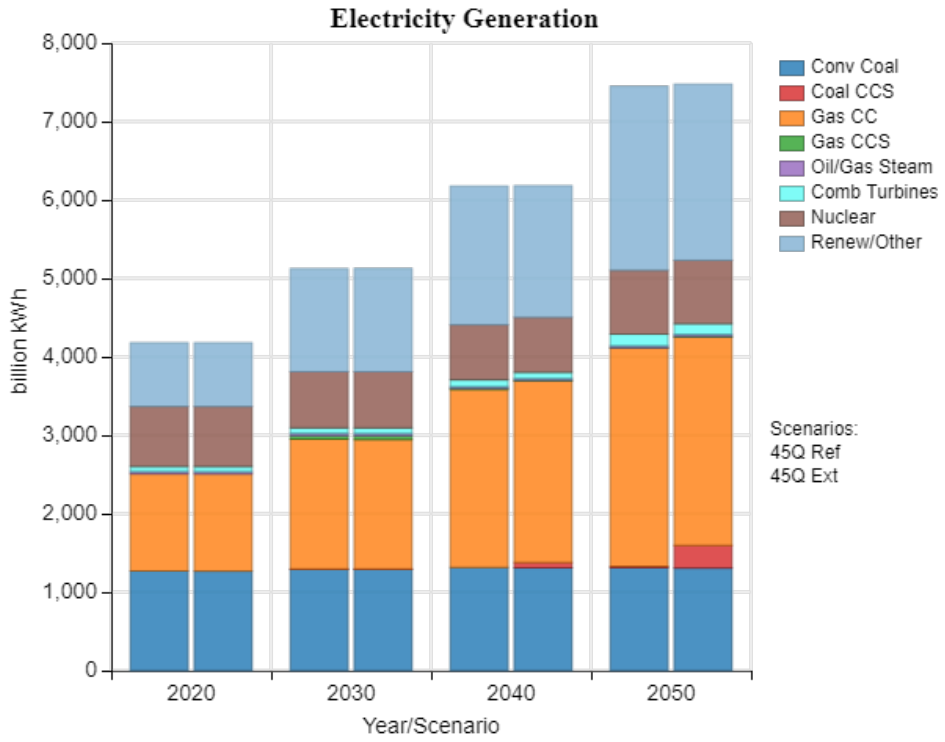
- With the 45Q tax credits extended, power CCUS capacity increases to over 52 GW by 2050 of which 43 GW is new coal CCUS.
- Overall CCUS remains a relatively small share (< 3%) of total electric capacity

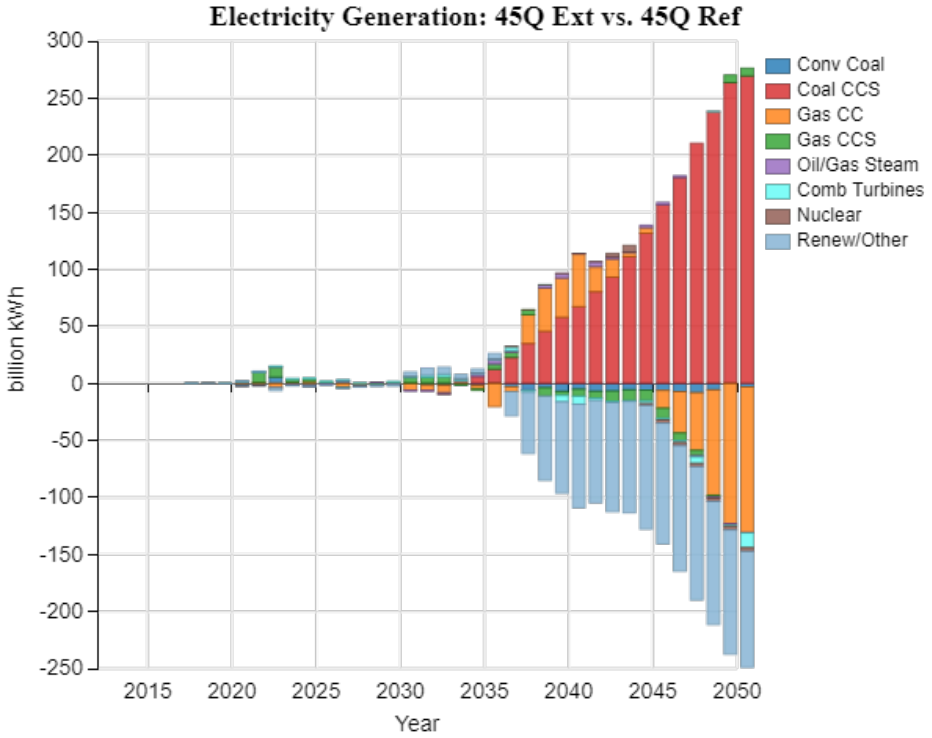




Electricity Generation

- With the extended tax credits, generation from new coal CCS expands and displaces primarily generation from gas without CCS and renewable sources





Conclusions

- Industrial sources are responsive to 45Q in the model but hits a limit quickly
- Over longer time frames, and if the 45Q sunset is removed, CCUS on power generation experiences further deployment growth
- CO2 sent to EOR also reaches a saturation point, but sending CO2 to saline formations is also economically attractive in the model
- CCUS has modest, but important, deployment levels since this provides cost reduction impetus of "learning-by-doing"

For more information…

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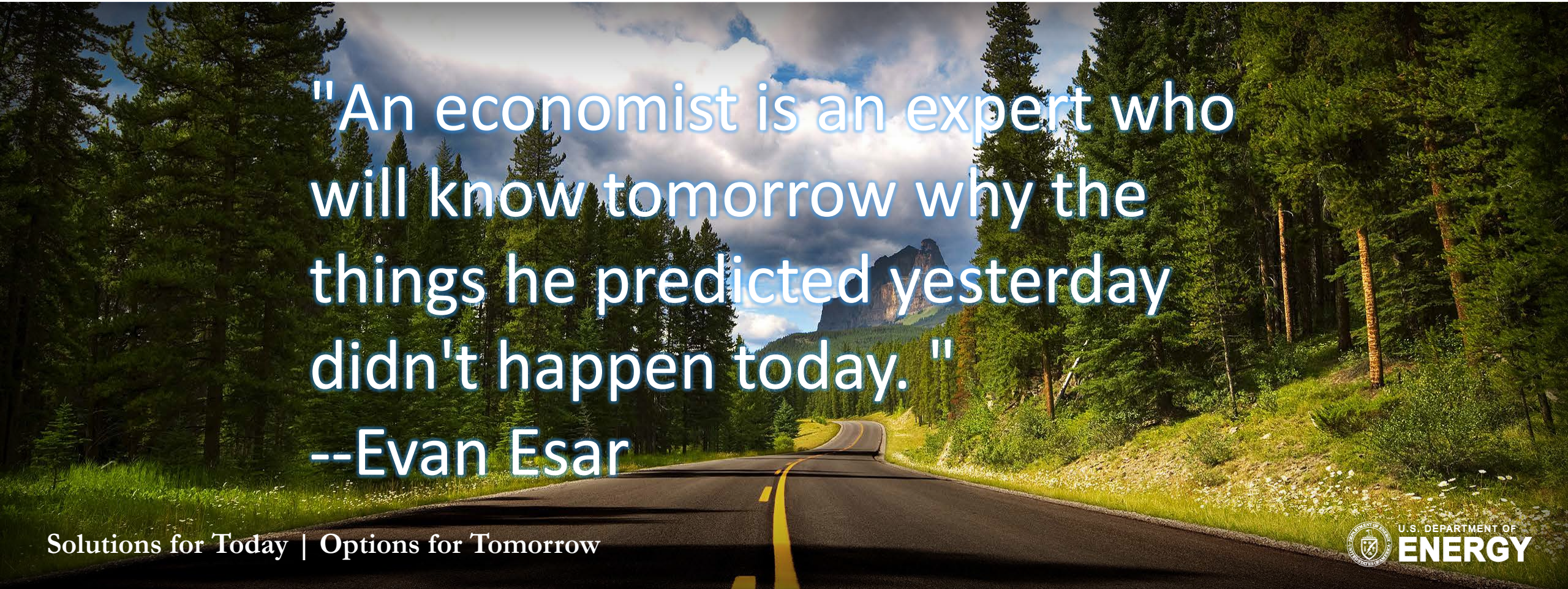

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