

NETL's Techno-Economic Modeling Resources for Analyzing Decarbonization Strategies Using CCUS

David Morgan,¹ Alana Sheriff,^{1,2} Allison Guinan,^{1,2} Timothy Grant,¹ Travis Warner,^{1,2} Derek Vikara,^{1,2} and Luciane Cunha¹
¹National Energy Technology Laboratory (NETL), Pittsburgh, PA; ²NETL support contractor, Pittsburgh, PA

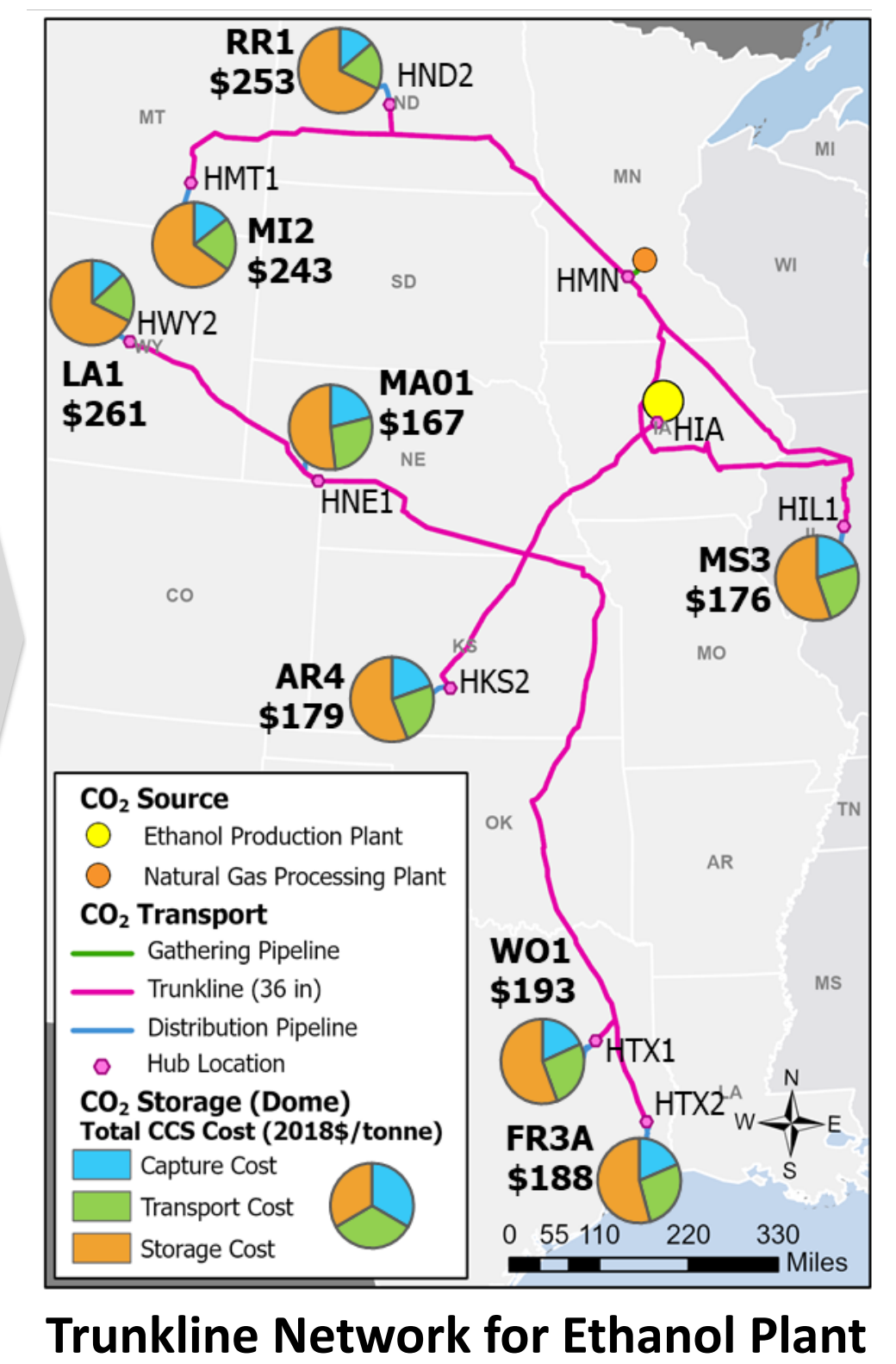
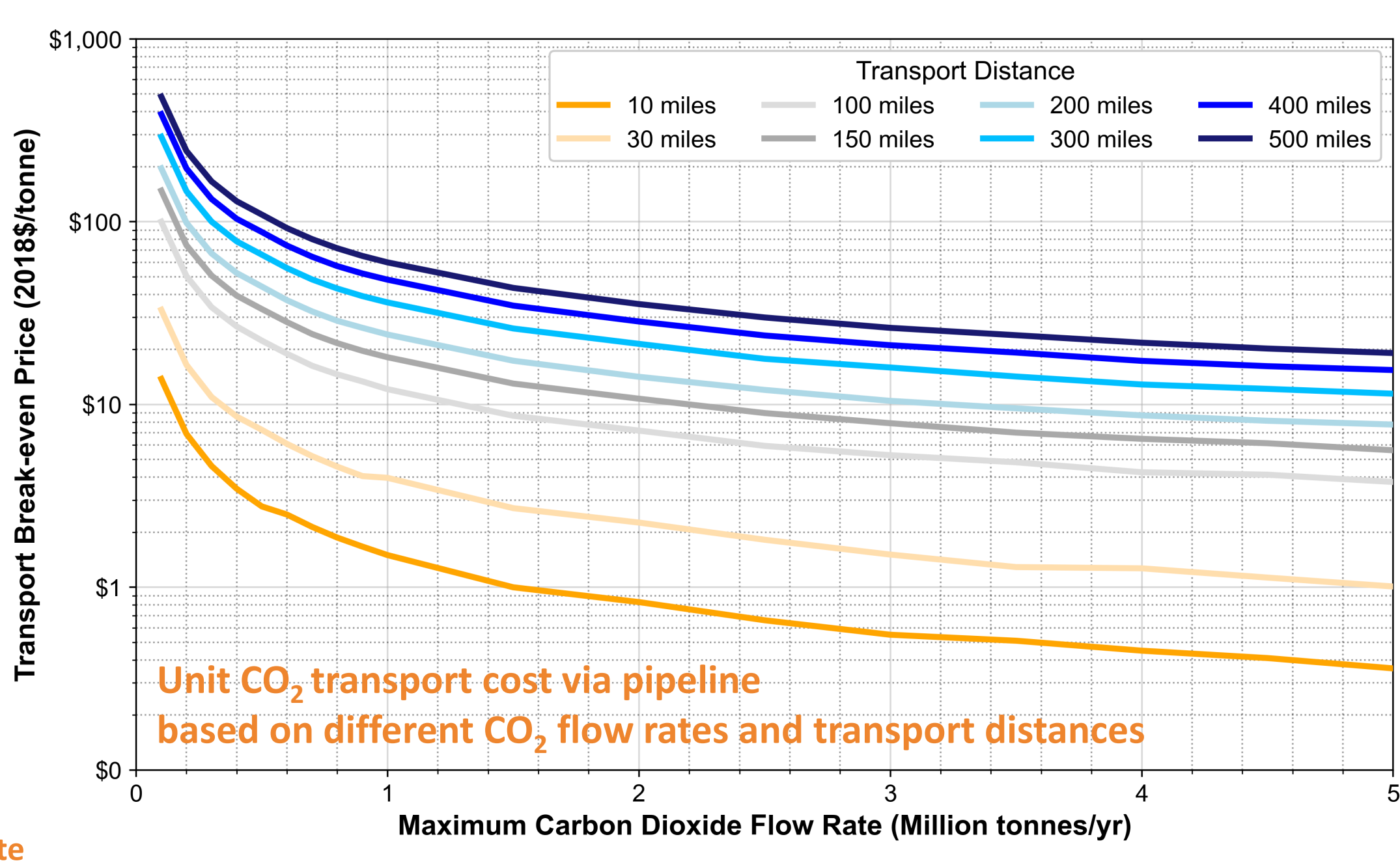
Overview

NETL developed techno-economic models to evaluate the performance characteristics and cost drivers for elements of the carbon capture, utilization, and storage (CCUS/CCS) value chain: CO₂ capture, CO₂ pipeline transport, CO₂ saline storage, and oil production and CO₂ storage using CO₂ enhanced oil recovery (EOR). These tools can be used individually to evaluate the economic opportunity for specific CCUS components, or they can be used in combination to assess integrated CCUS systems. An overview and high-level description of the transport and storage models is presented along with useful outputs that can be generated with each.

FECM/NETL CO₂ Transport Cost Model (CO₂_T_COM) Overview and Use Case Examples

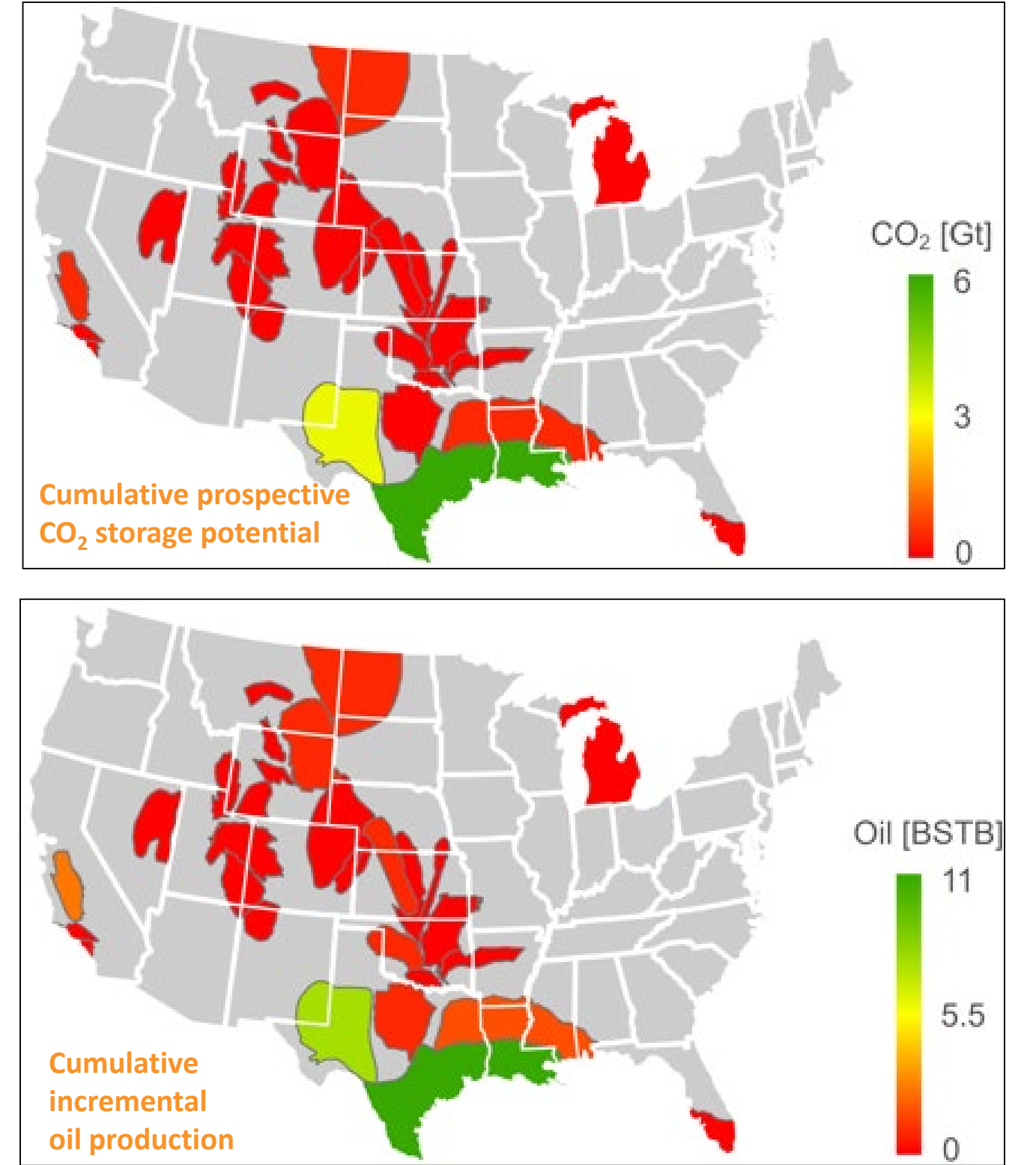
- Excel®-based cash flow model that can optimize the pipeline diameter and number of booster pumps that results in the lowest first-year break-even CO₂ price for a point-to-point CO₂ pipeline project transporting liquid CO₂
- Key inputs:** Average and maximum CO₂ mass flow rates, years of pipeline operation, and total pipeline length

Capture cost data, CO₂_T_COM, and CO₂_S_COM used to develop CCS networks in the Central U.S. to evaluate integrated CCS costs from the perspective of a given CO₂ source ▶



FECM/NETL CO₂ EOR Evaluation System Overview and Use Case Examples

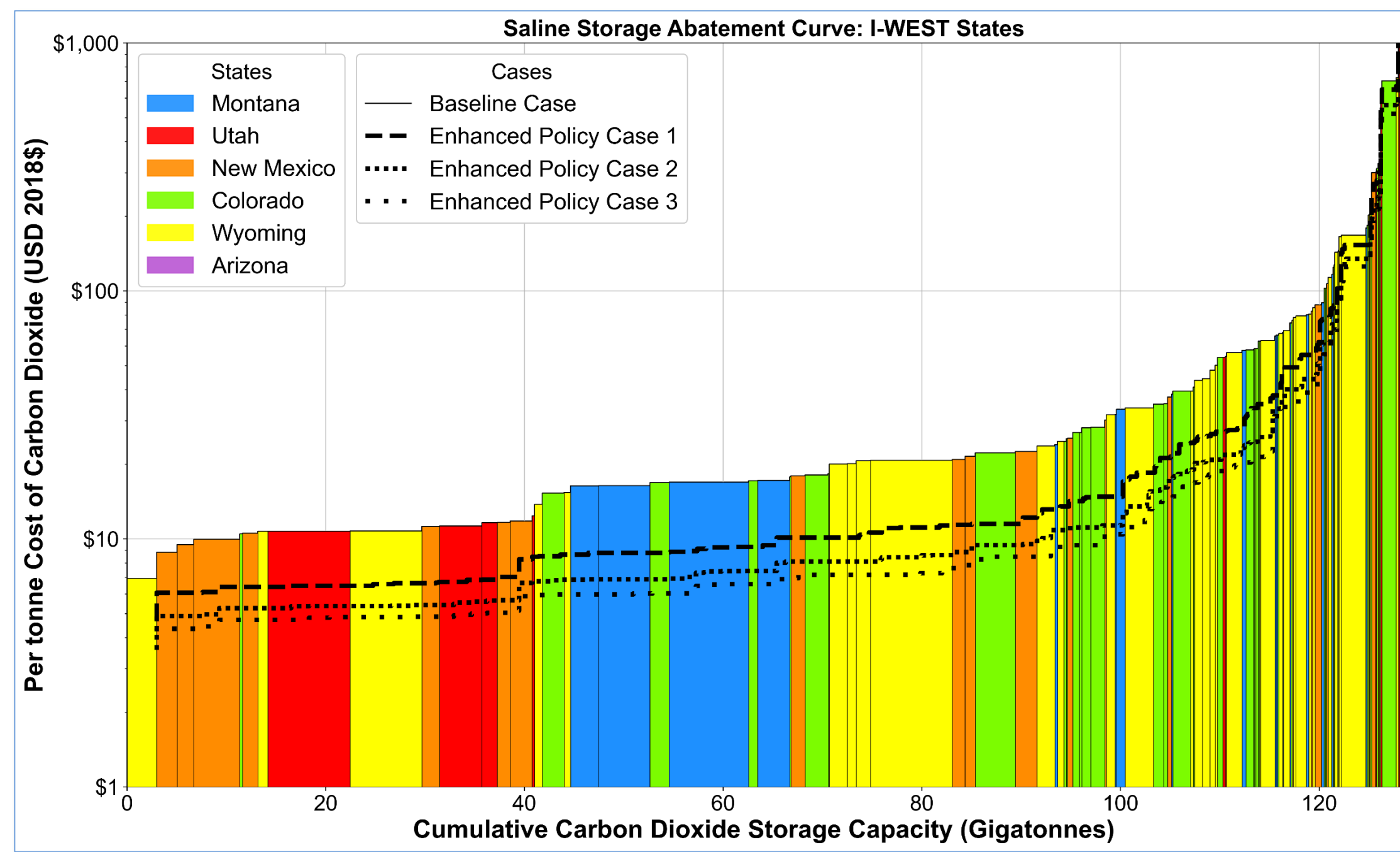
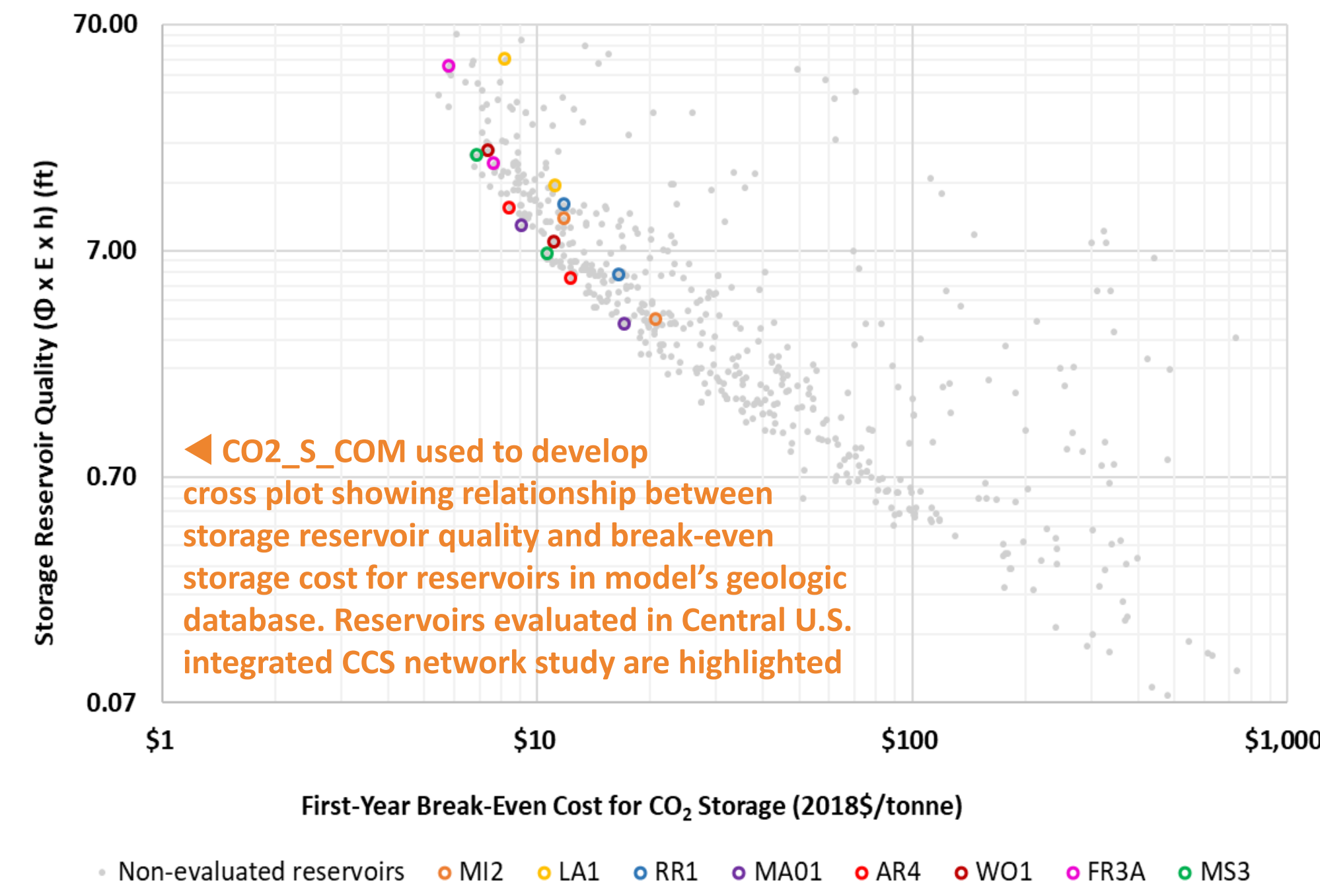
- FE/NETL CO₂ Prophet Model (CO₂_Prophet)**
Fortran-based streamline/stream tube reservoir simulation model that calculates CO₂ stored and oil produced from the injection of CO₂ and water into a pattern
- FE/NETL Onshore CO₂ EOR Cost Model (CO₂_E_COM)**
Fortran-based oil field level model that builds out patterns over time and uses CO₂_Prophet output to calculate field-level fluid flows; calculates revenues, capital expenses, operating expenses, financing costs, and first-year break-even CO₂ prices for a CO₂ EOR field
- FECM/NETL Onshore CO₂ EOR Evaluation Tool (CO₂_E_EvTool) (in development)**
Python script that reads inputs from an Excel® file, loops through an Excel®-based dataset of oil fields, runs CO₂_Prophet and CO₂_E_COM, and summarizes results



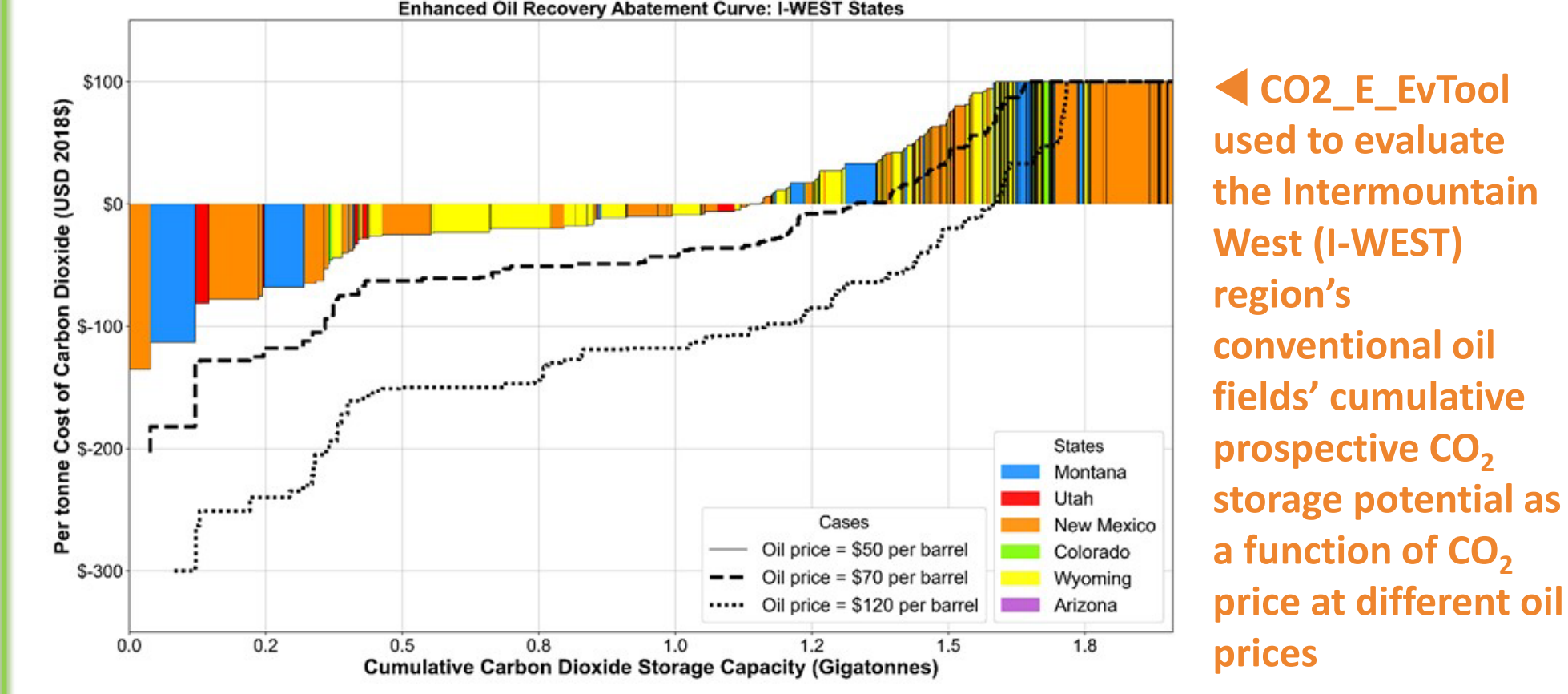
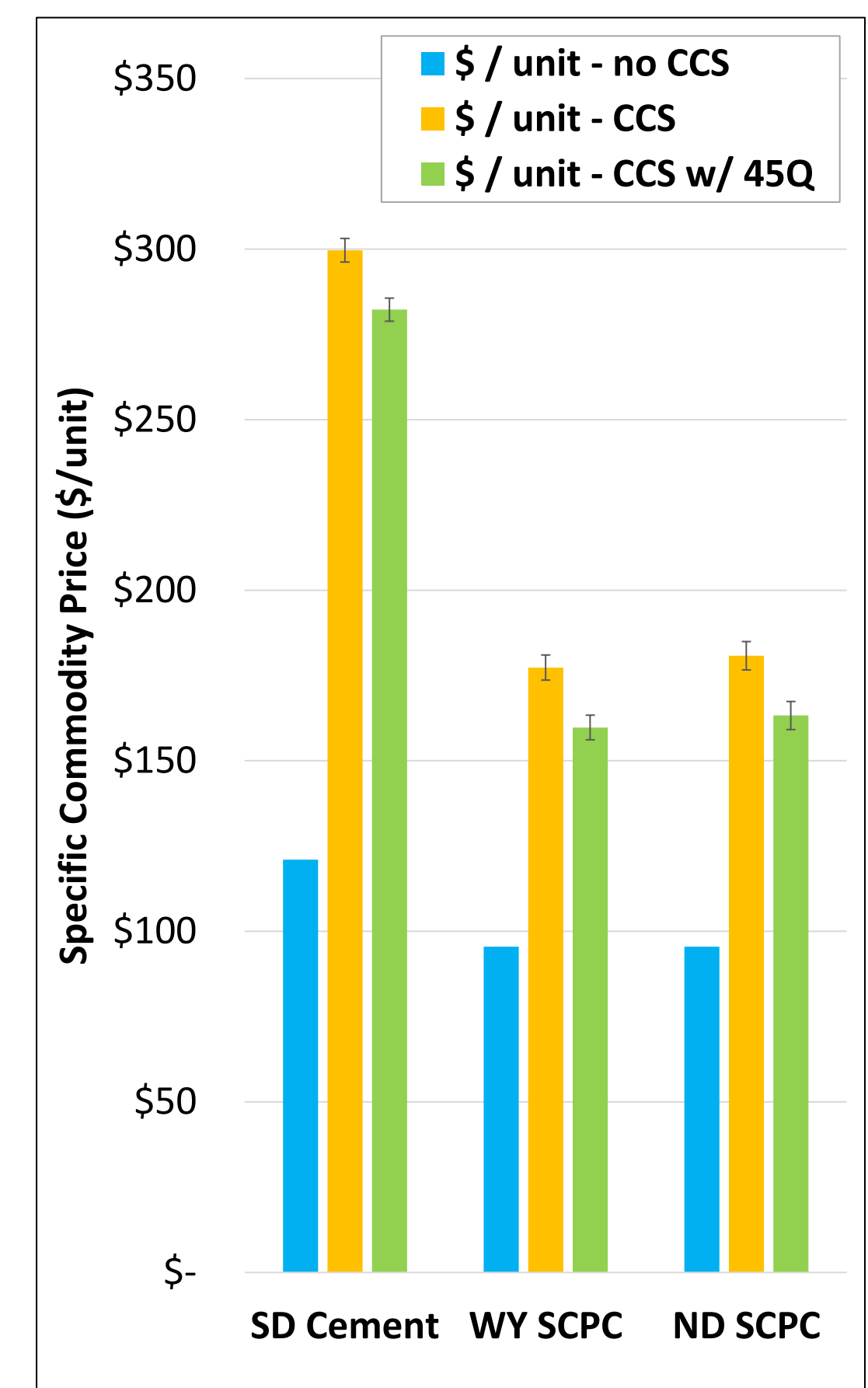
FECM/NETL CO₂ Saline Storage Cost Model (CO₂_S_COM) Overview and Use Case Examples

- Excel®-based cash flow model that calculates revenues, costs, and first-year break-even CO₂ price necessary to implement and operate a CO₂ saline storage project that meets the requirements of the EPA Class VI injection well regulations
- Key inputs:** Average and maximum CO₂ mass flow rates, storage formation (select from 314 formations within the model), duration of injection, monitoring strategy, and financial responsibility instrument
- Currently updating a Python version of CO₂_S_COM for the NRAP and SMART Initiatives. The updated model will be able to assess the long-term liability for responding to adverse events (such as leakage of fluid)**

CO₂_S_COM used to model storage cost implications and capacity within the I-WEST region. Scenario analysis used to evaluate storage costs under incremental changes to storage-related technical, policy, or operational conditions from baseline scenario ▼



NETL's CO₂ capture cost data with output from CO₂_T_COM and CO₂_S_COM to assess the impact of the 45Q tax credit (2018) on total CCS costs for three different source types ▼



Models Accessibility

	CO₂_T_COM (2023) Available online		CO₂_Prophet (2020) Available online
	CO₂_S_COM (2017) Available online (2023 update in process)		CO₂_E_COM (2020) Available online

Models in Development

- Carbon Transport and Storage (CTS) Screening Tool** – aimed to help identify cost optimal transport and storage (T&S) options from the perspective of a CO₂ source
- FECM/NETL Offshore CO₂ Saline Storage Cost Model (CO₂_S_COM_Offshore)**
- FECM/NETL Onshore CO₂ EOR Evaluation Tool (CO₂_E_EvTool)**

Disclaimer

These projects were funded by the United States Department of Energy, National Energy Technology Laboratory, in part, through a site support contract. Neither the United States Government nor any agency thereof, nor any of its employees, nor the support contractor, nor any of its employees, makes any warranty, express or implied, or assumes any legal liability or responsibility for the accuracy, completeness, or usefulness of any information, apparatus, product, or process disclosed, or represents that its use would not infringe privately owned rights. Reference herein to any specific commercial product, process, or service by trade name, trademark, manufacturer, or otherwise does not necessarily constitute or imply its endorsement, recommendation, or favoring by the United States Government or any agency thereof. The views and opinions of authors expressed herein do not necessarily state or reflect those of the United States Government or any agency thereof.