

# CCUS and the Energy Transition

*May 9, 2023*

*DEP Citizens Advisory Council*

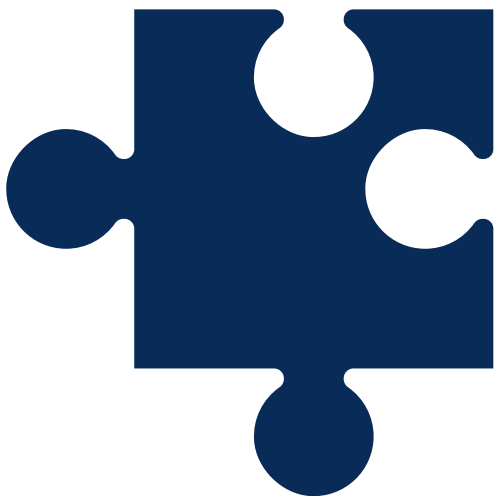
Kristin Carter, PG, CPG

Pennsylvania Geological Survey, Pittsburgh, PA



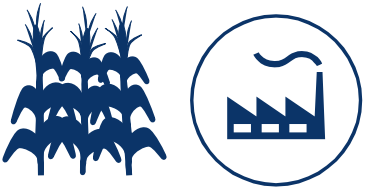
# Today's Focus

- *Define terms: CCUS, energy transition*
- *What is Pennsylvania's experience with CCUS, and why are we vital to the current energy transition?*
- *Pennsylvania's current activities in this space*



*"CCUS"*

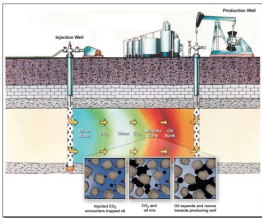
*"Energy Transition"*



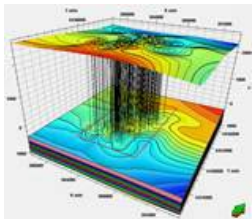
CARBON



CAPTURE



UTILIZATION



STORAGE

# What is CCUS?

Carbon capture, utilization and storage (CCUS) refers to those technologies, activities and applications associated with the removal of carbon dioxide (CO<sub>2</sub>) from the atmosphere for beneficial use applications and/or permanent disposal in porous, subsurface rocks by way of injection wells.



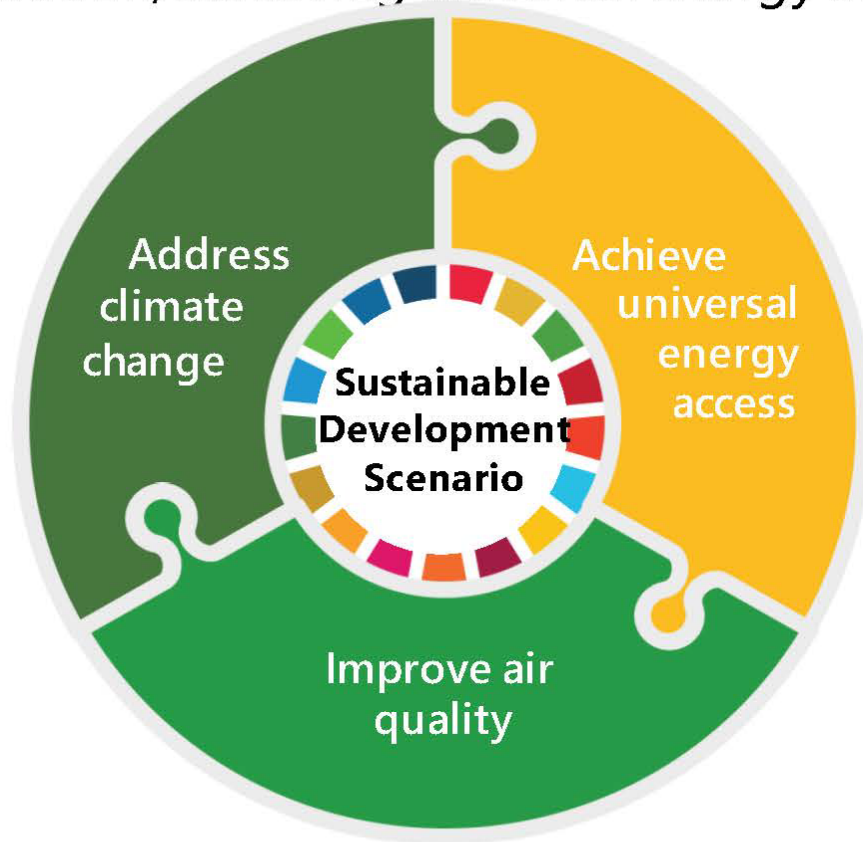
# What Do We Mean By 'Energy Transition'?

*“a significant structural change in an energy system, driven by energy resource availability, energy efficiencies and/or energy demands”*

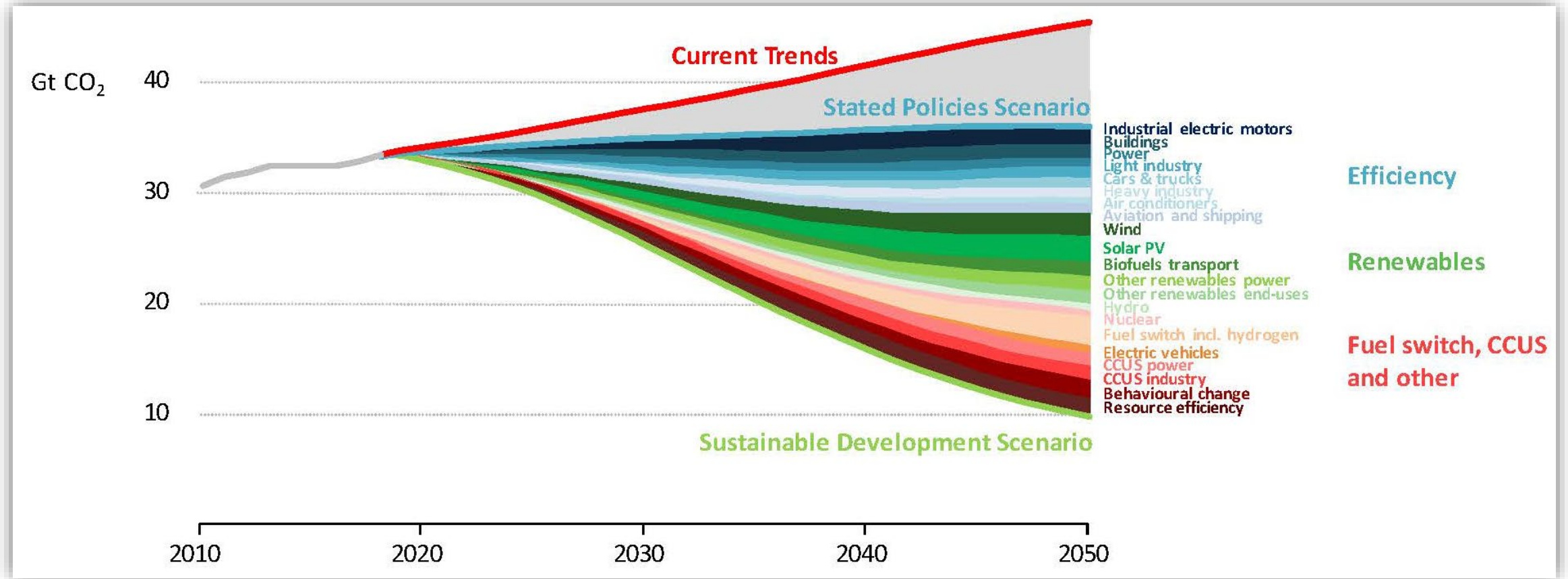
*“a significant structural change in an energy system, driven not just by energy availability, energy efficiency and demand but also the desire to decarbonize our world so to mitigate climate change, promote environmental justice and equitable access to energy resources, and provide energy for the growing global population, all while retaining our existing way of life and economic prosperity”*

# CCUS is necessary to mitigate climate change and support SDS

- The Sustainable Development Scenario reduces CO<sub>2</sub> emissions while also tackling air pollution, achieving universal energy access

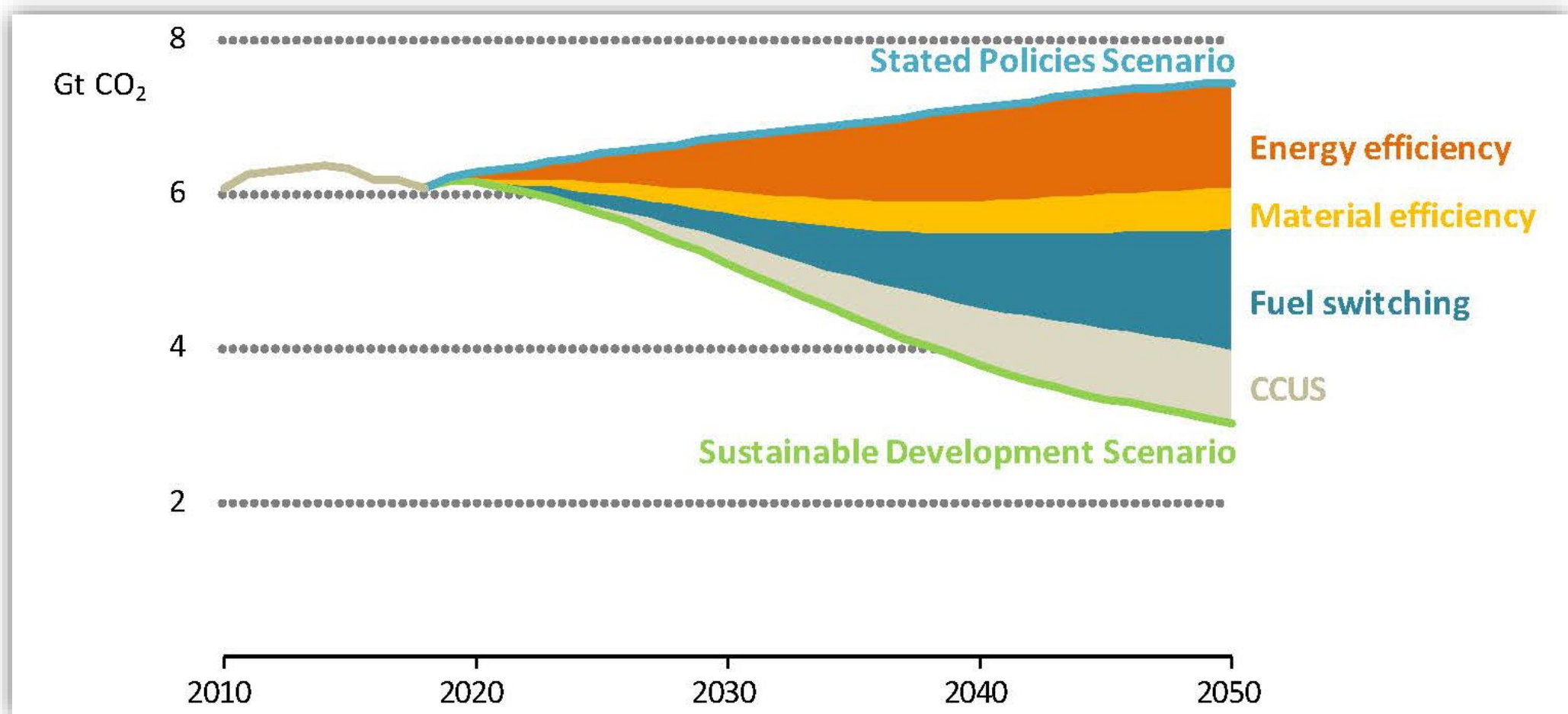


# Energy-Related CO<sub>2</sub> Emissions and Reductions in the SDS by Source



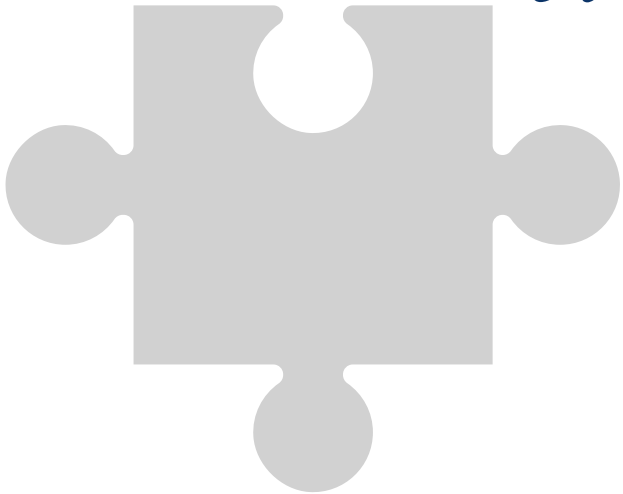
Cozzi, Arsalane, McGlade, Vass, and Crow (2019)  
[Introducing the Sustainable Development Scenario - Event - IEA](#)

# Industrial Decarbonization Requires Multiple Strategies



Cozzi, Aarsalane, McGlade, Vass, and Crow (2019)  
[Introducing the Sustainable Development Scenario - Event - IEA](#)

*What is Pennsylvania's experience with CCUS, and why are we vital to the current energy transition?*

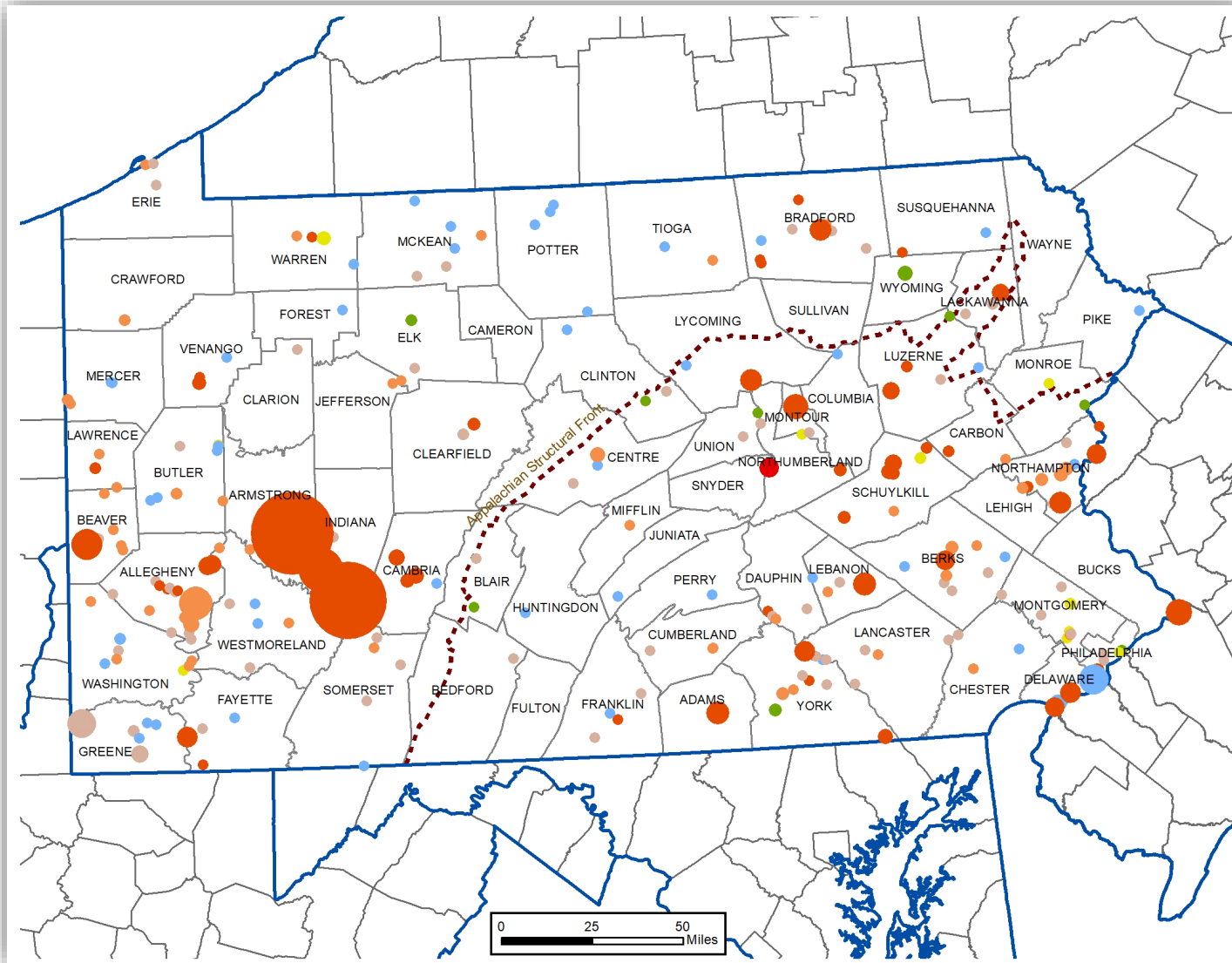


# Pennsylvania's Work in the CCUS Space

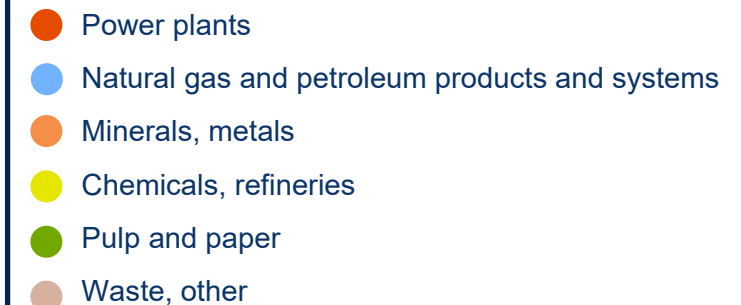
- Midwest Regional Carbon Sequestration Partnership (MRCSP): 2003 – 2019 (published 2020)
- Carbon Management Advisory Group (CMAG): 2008
- Carbon Sequestration Technical Assessment (CSTA): 2009
- Mid-Atlantic U.S. Offshore Carbon Storage Resource Assessment: 2016 – 2019
- Midwest Regional Carbon Initiative (MRCI): 2019 – 2024
- Governor's CCUS Inter-Agency Work Group: 2019 – present
- Mid-APPalachian Carbon Ore, Rare Earth and Critical Minerals (MAPP-CORE) Initiative: 2021 – 2024



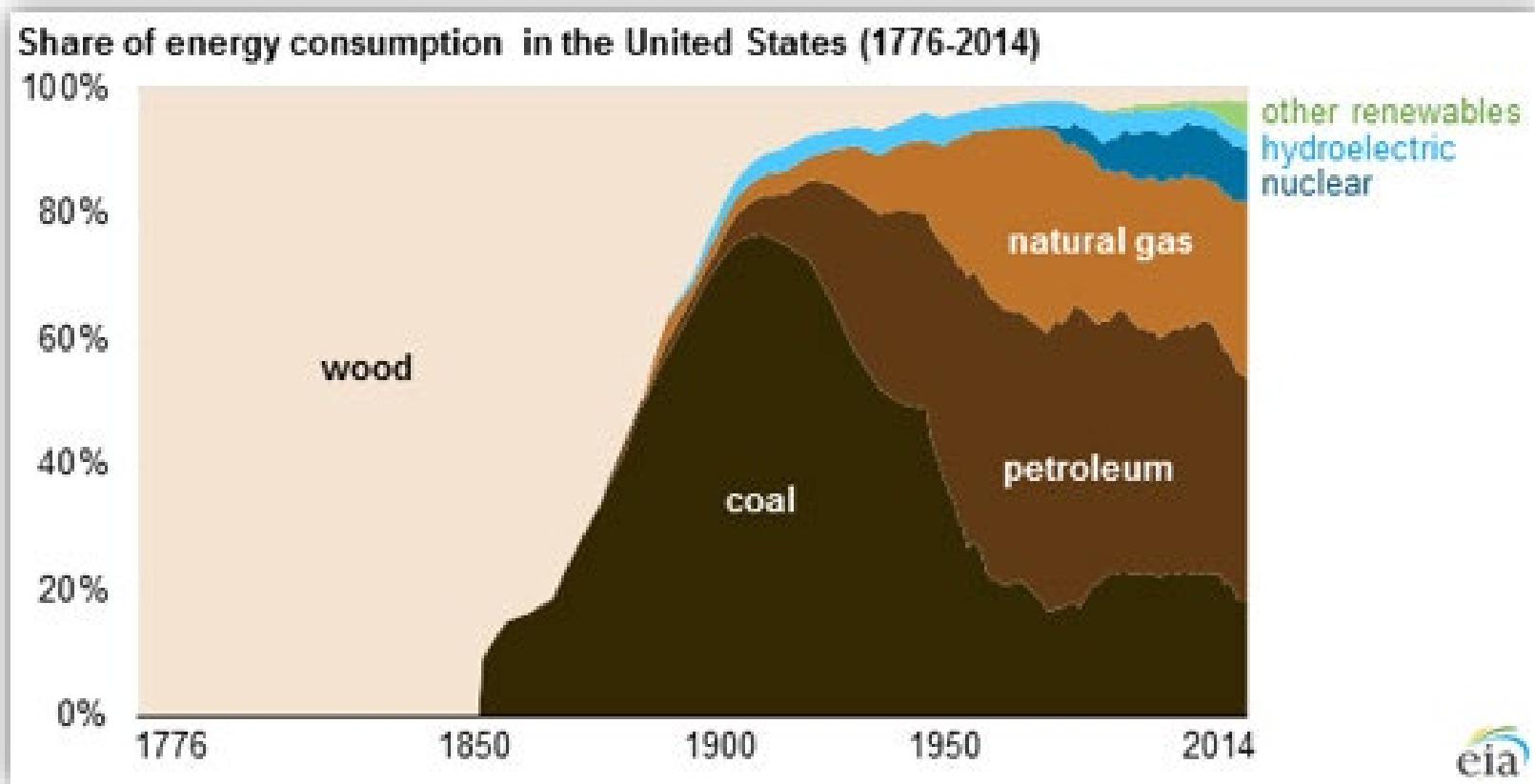
# Pennsylvania's Economy and CO<sub>2</sub> Emissions



- We are energy, power, industry and manufacturing
- Multiple categories of CO<sub>2</sub> emissions all over the state
- 262 CO<sub>2</sub> emitters (U.S. EPA 2018 data)



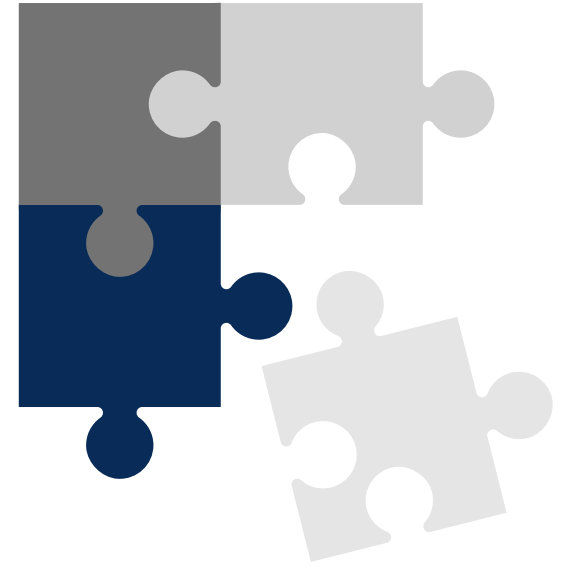
# Pennsylvania and Energy Transitions



[www.eia.gov/todayinenergy/detail.cfm?id=21912](http://www.eia.gov/todayinenergy/detail.cfm?id=21912) (7/2/2015)

- Pennsylvania has been a part of every energy transition since the colonization of America
- Penn's Woods helped to fuel the 18<sup>th</sup> century
- Three fossil fuel sources (petroleum, natural gas and coal) have comprised >80% of total U.S. energy consumption for more than a century



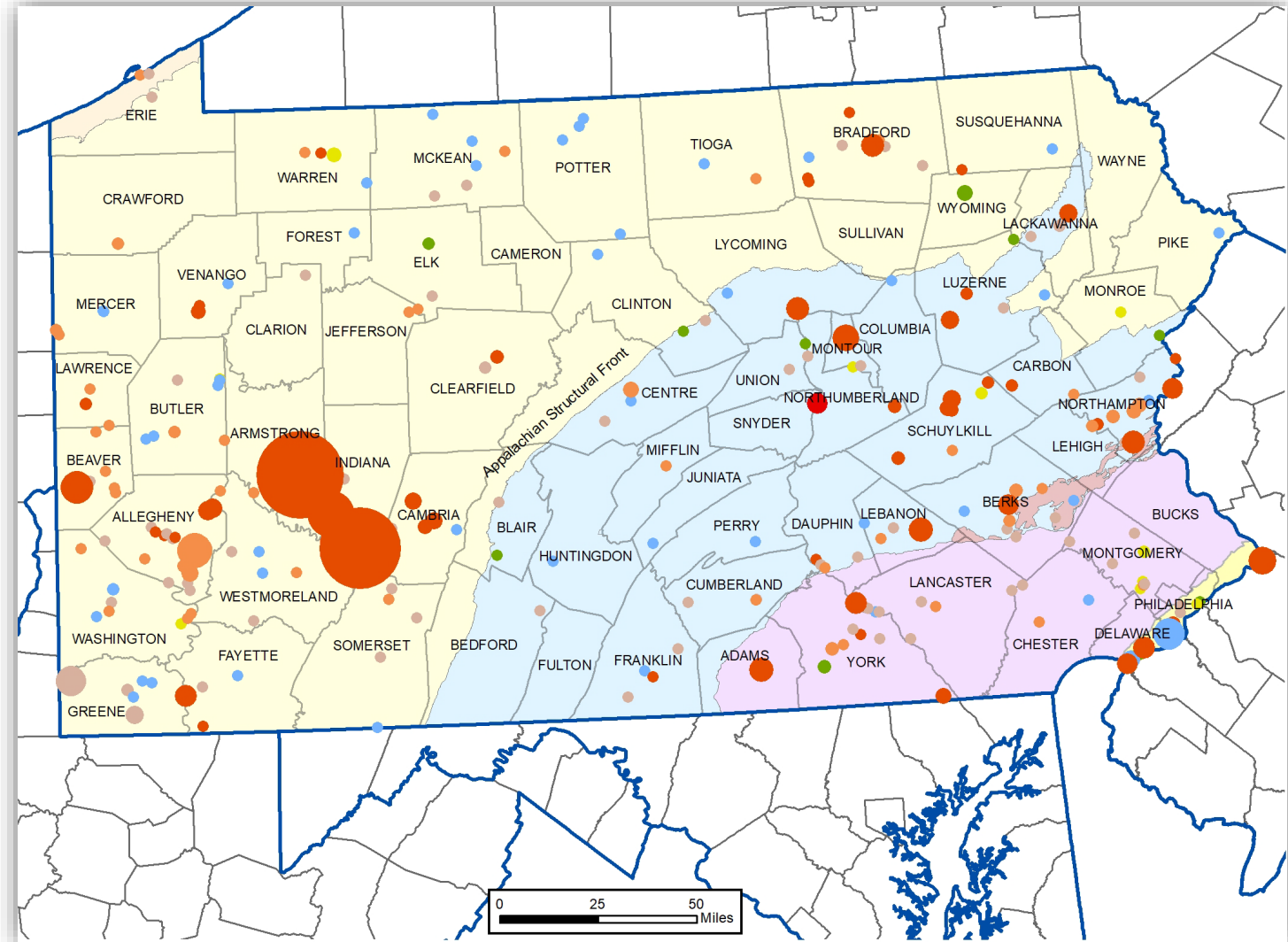


*What's happening here right now?*

# CCUS Inter-Agency Work Group



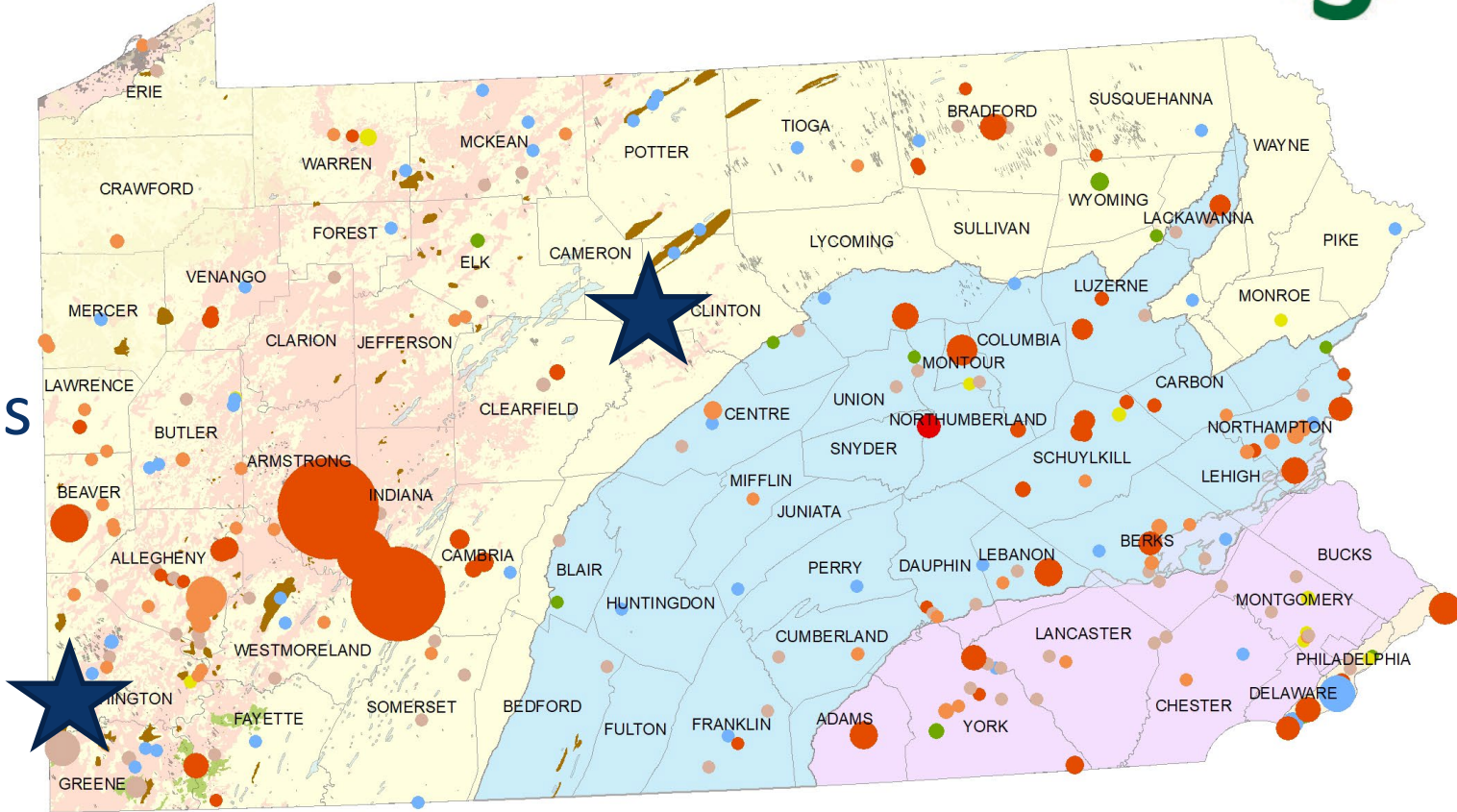
- DCNR, DEP and DCED collaboration, galvanized with an inter-agency MOU
- Technical, regulatory, economic and policy pillars
- Energy Horizons Cross-Sector Collaborative (TeamPA Foundation)
- PA pursuing Class VI UIC Primacy from U.S. EPA



# Pennsylvania CCUS Projects

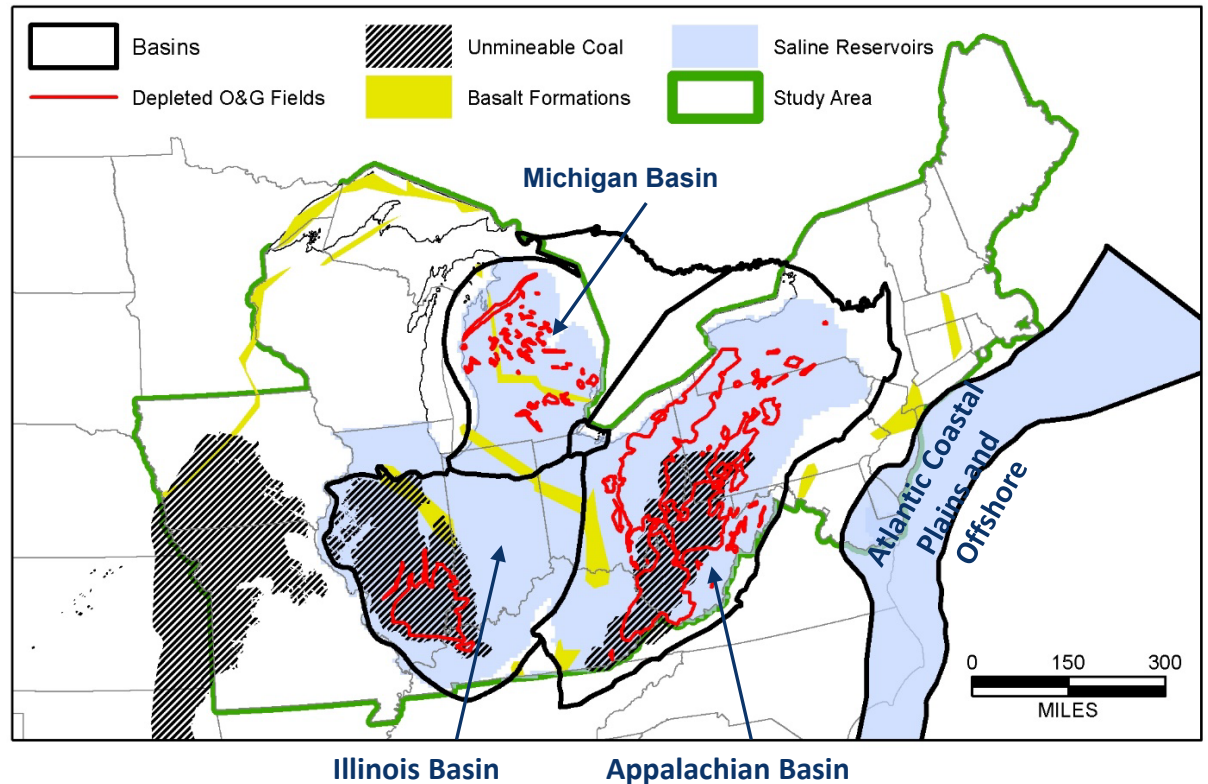
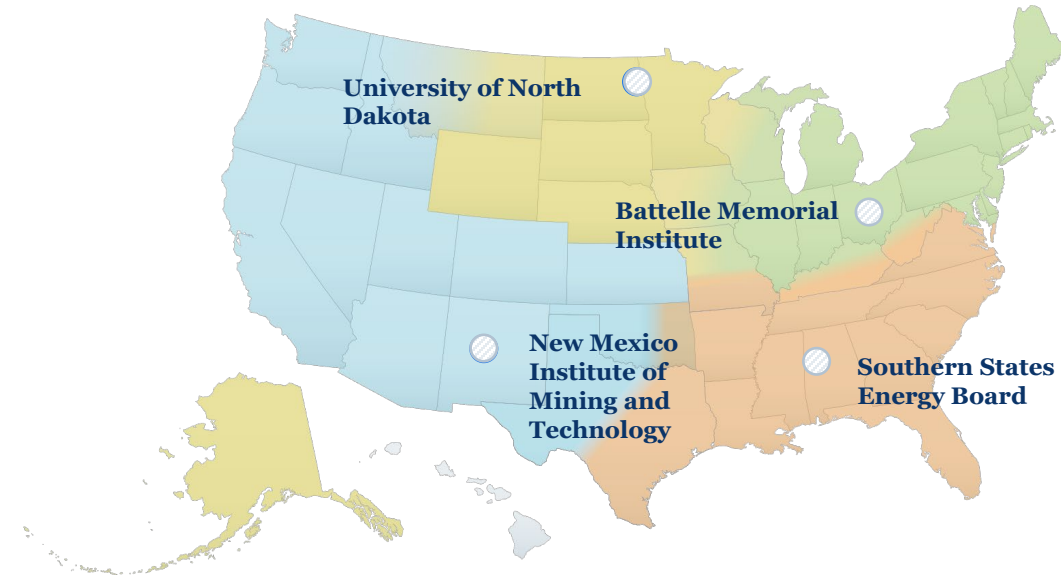


- KeyState to Zero, Clinton County – Onsite shale gas supply, onsite gas synthesis ( $H_2$ ,  $NH_3$ , Urea/DEF), local carbon sequestration
- 21<sup>st</sup> Century Power Plant, southwestern PA/  
northern WV – modular PFBC power plant,  
fueled with biomass and coal waste, local carbon sequestration



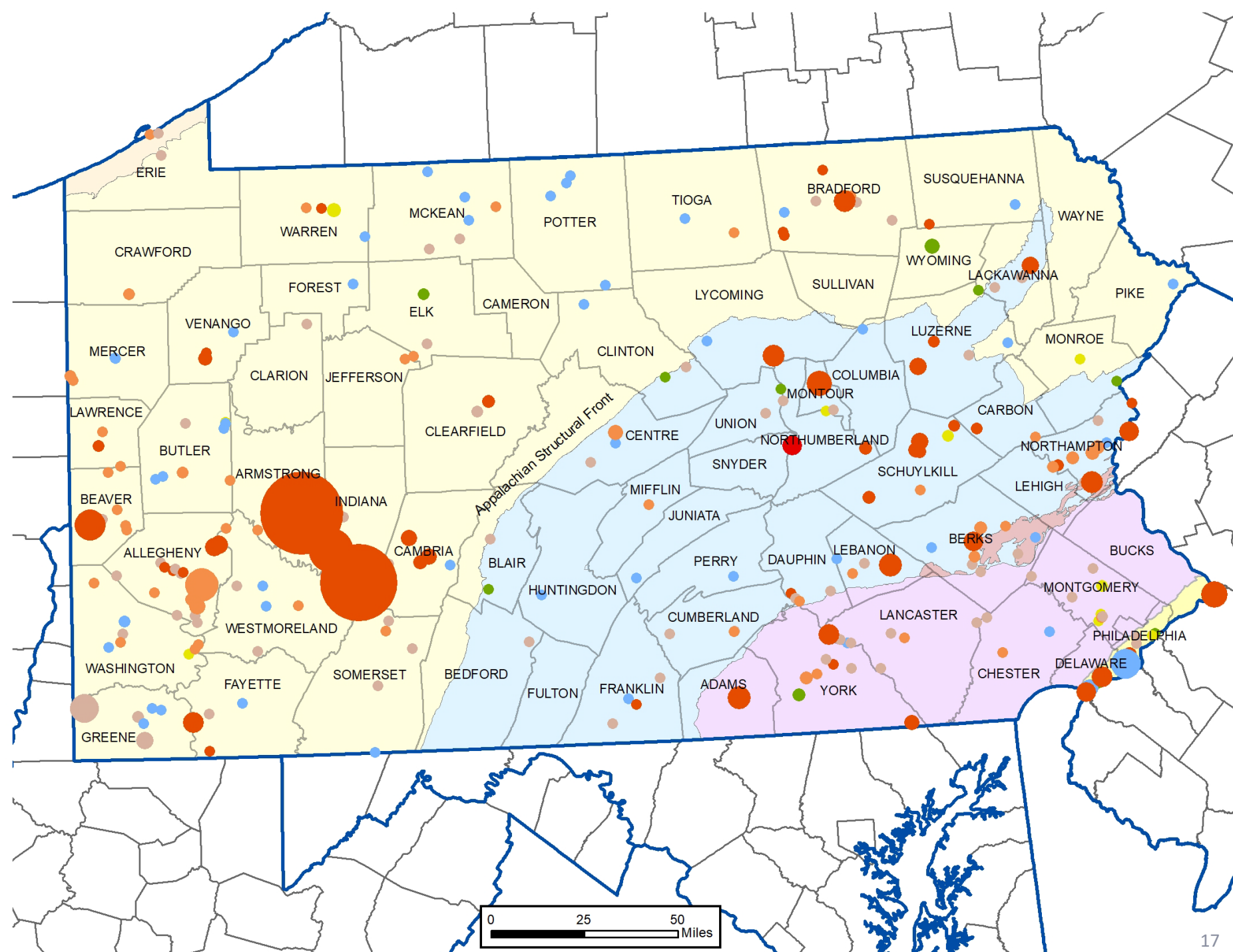
# Midwest Regional Carbon Initiative

- Diverse storage solutions are available throughout the 20-state region, including U.S. Mid-Atlantic Offshore region
- Province similarities provide lessons learned and transferable strategies
- Province differences require new, focused effort to assess CO<sub>2</sub> storage potential





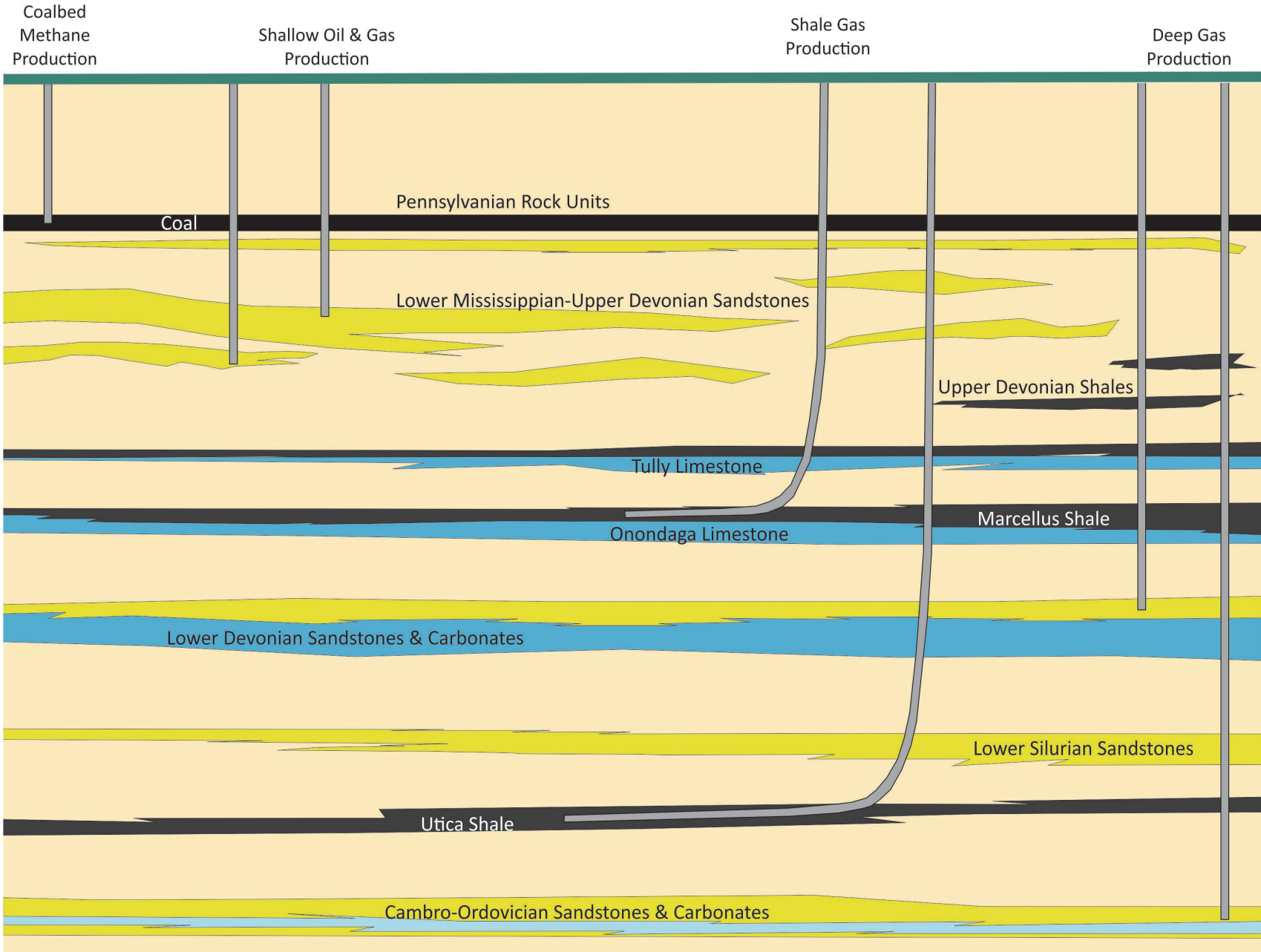
# Pennsylvania's Diverse Geology



Appalachian Plateaus

Coordination of Capture and Transport Infrastructure

- ✓ Size of source vs. volume of sink
  - ✓ OUT: Active mining, petroleum hydrocarbon production
  - ✓ IN: Energy storage (CH<sub>4</sub>, H<sub>2</sub>), Carbon sequestration, Wastewater disposal
  - ✓ Pore Space Ownership/Access
- Utilization
- Stacked Reservoirs
- Permanent Storage
- Coordination of Resource Development



Cartoon not to scale

# U.S. Department of Energy (DOE) Funding Opportunity Announcement (FOA) 0002799

FINANCIAL ASSISTANCE

FUNDING OPPORTUNITY ANNOUNCEMENT



Department of Energy (DOE)

Office of Fossil Energy and Carbon Management (FECM)

Regional Initiative to Accelerate Carbon Capture,  
Utilization, and Storage (CCUS) Deployment: Technical  
Assistance for Large-Scale Storage Facilities and Regional  
Carbon Management Hubs

Funding Opportunity Announcement (FOA) Number: DE-FOA-0002799

FOA Type: Initial

Assistance Listing Number:  
Federal Assistance Program 81.089, Fossil Energy Research and  
Development

FOA Issue Date:	12/12/2022
Submission Deadline for Full Applications:	02/10/2023 11:59:59 PM EST
Expected Date for Selection Notifications:	05/12/2023
Expected Date for Award:	09/12/2023

- Regional Initiative to Accelerate Carbon Capture, Utilization, and Storage (CCUS) Deployment
- Areas of Interest (AOI) 2 – “State Geological Data Gathering, Analysis, Sharing, and Engagement”

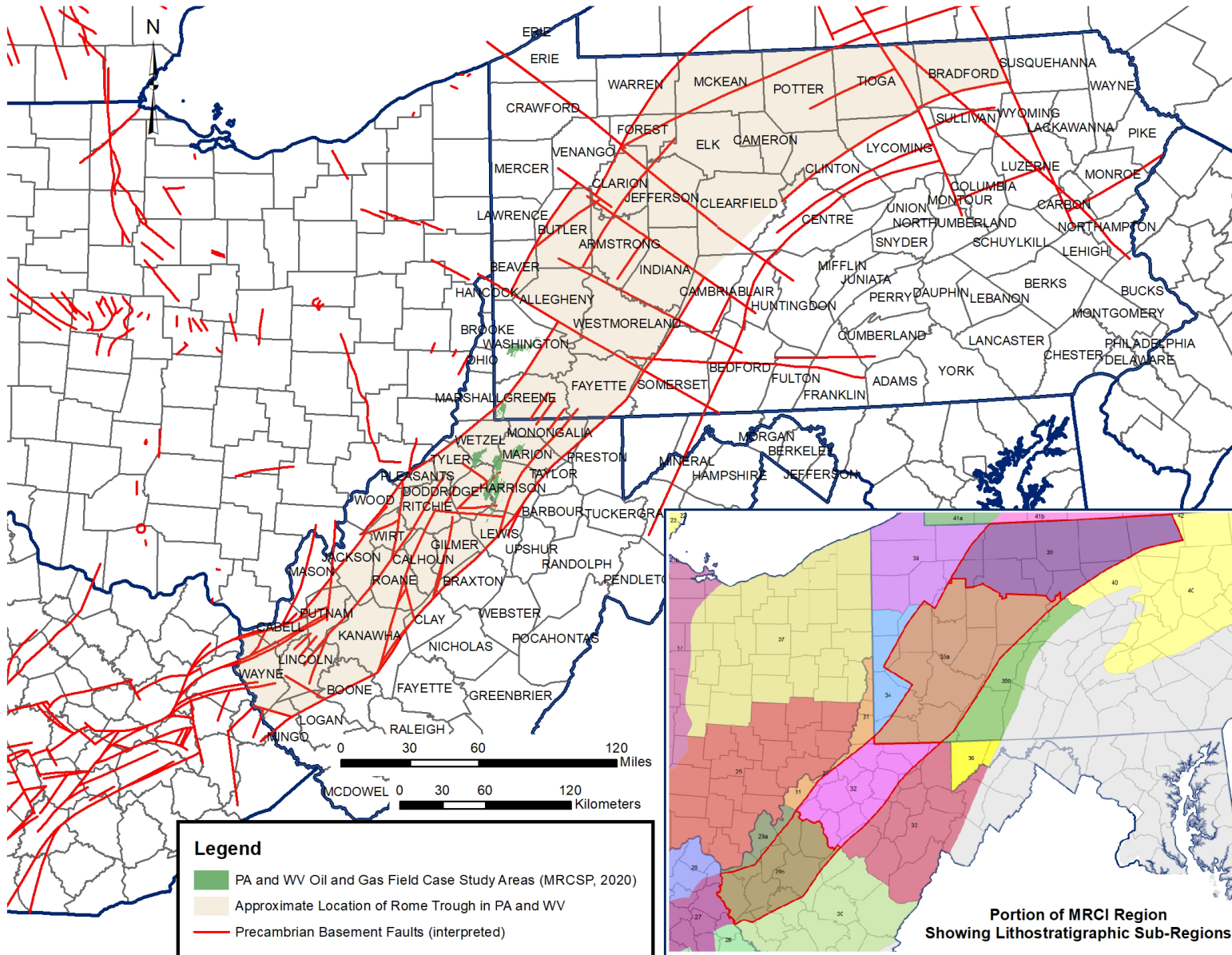
# The Central Appalachian Partnership (CAP) for Carbon Storage Deployment

“The main objective of the CAP Project is to **reduce barriers** for entry to carbon storage project opportunities, particularly in the deepest parts of the Appalachian basin, by **promoting** a better understanding of the study area’s subsurface geologic resources and supporting Class VI UIC injection well permit application needs, thereby **accelerating** the deployment of CCUS at all scales (individual projects to carbon management hubs) in the Appalachian basin.”



# CAP Study Area

- Deepest parts of the Appalachian basin
- Opportunities for stacked geologic storage
- Home to frontline energy and/or otherwise disadvantaged communities



# Parting Thoughts...

- Pennsylvania has hundreds of CO<sub>2</sub> point-source emissions across multiple physiographic provinces and must embrace all options for CCUS to **mitigate climate change while retaining our industry and manufacturing sectors.**
- Commonwealth-specific initiatives, championed by our CCUS Inter-Agency Work Group and the DCNR's Bureau of Geological Survey, are intended to **facilitate CCUS deployment** in the near-term.
- Given its natural resources, industry base and central location in the Mid-Atlantic region, **Pennsylvania is uniquely poised to be an integral part of the current energy transition** with respect to energy production and CCUS applications.

# Thank you!

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