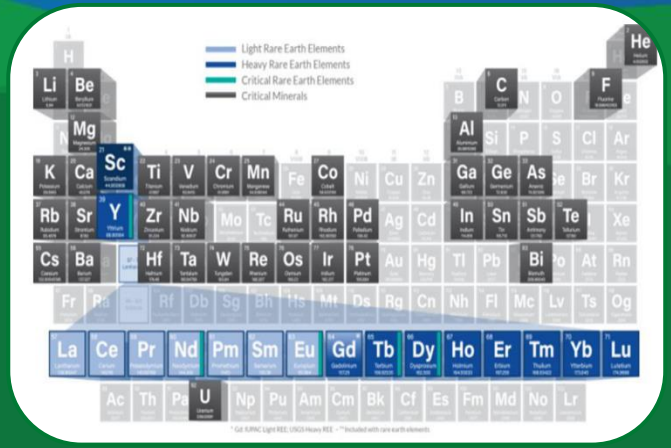
U.S. DEPARTMENT OF ENERGY
Fossil Energy and Carbon Management

The Role in Carbon Management in Achieving Net-Zero Goals

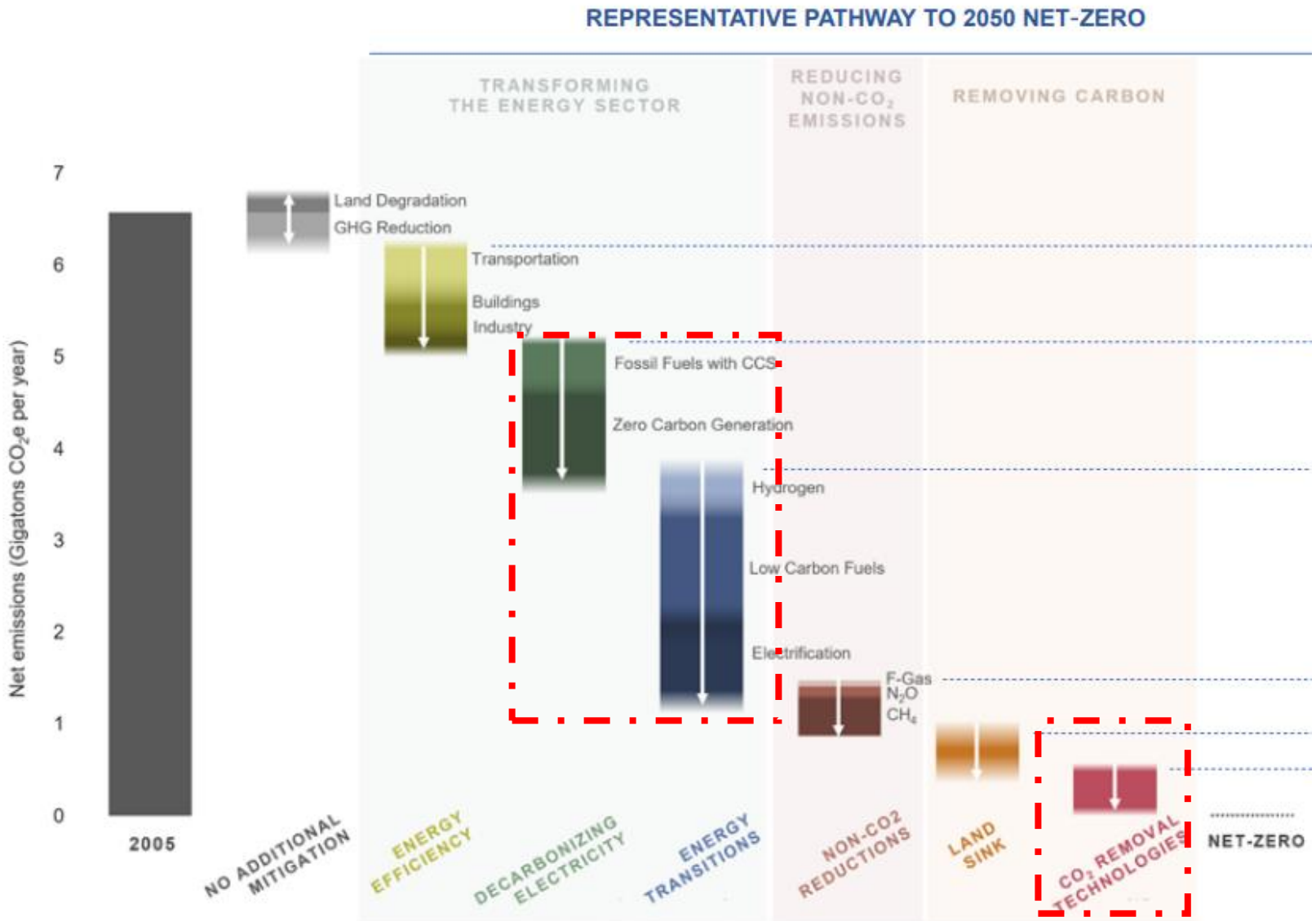
Jen Wilcox, US Department of Energy
OGCI

October 18th, 2022



Role of Carbon Capture and Carbon Removal in Achieving Net-Zero

- Point-source carbon capture necessary for infrastructure and industries with limited decarbonization options today, like cement
- Carbon dioxide removal critical for counterbalancing hard to decarbonize sectors, like agriculture, to reach net-zero
- US Long-term climate strategy shows that even scenarios with lower removal, will still require *some* removal



https://www.whitehouse.gov/wp-content/uploads/2021/10/US-Long-Term-Strategy.pdf

Fossil Energy and Carbon Management (FECM)

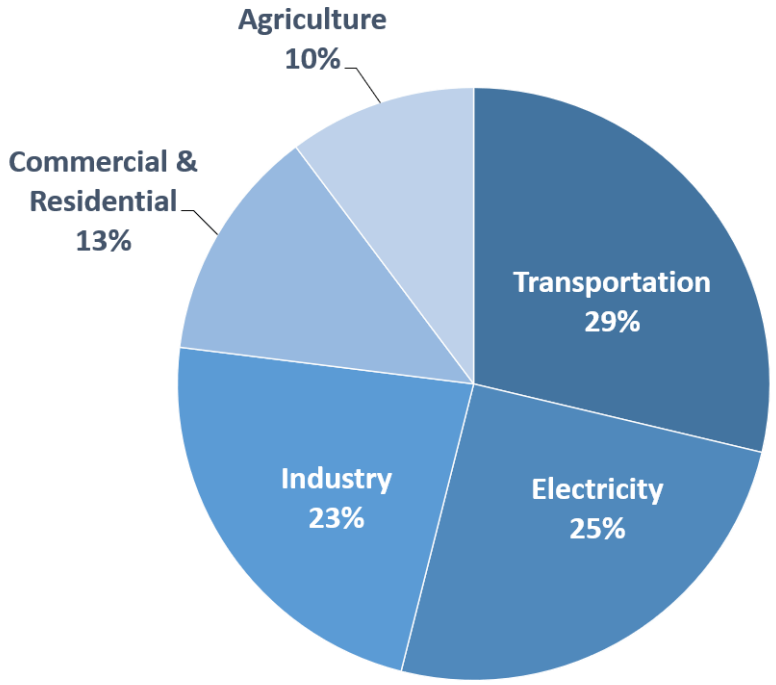
Office of Fossil Energy and Carbon Management

DOE-FE is now DOE-FECM

New name for our office reflects our **new vision**

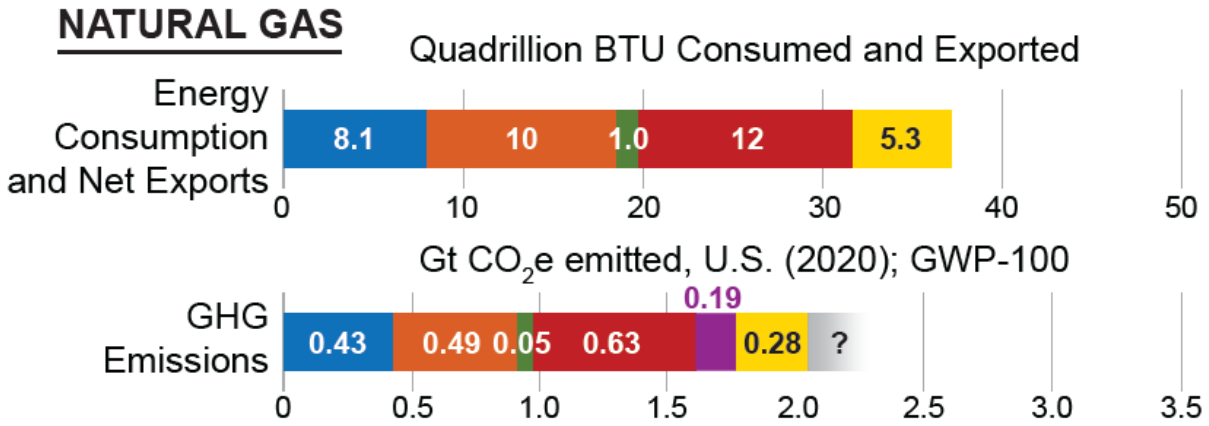
- President Biden's goals:
  - 50% emissions reduction by 2030
  - CO_2 emissions-free power sector by 2035
  - Net zero emissions economy by no later than 2050

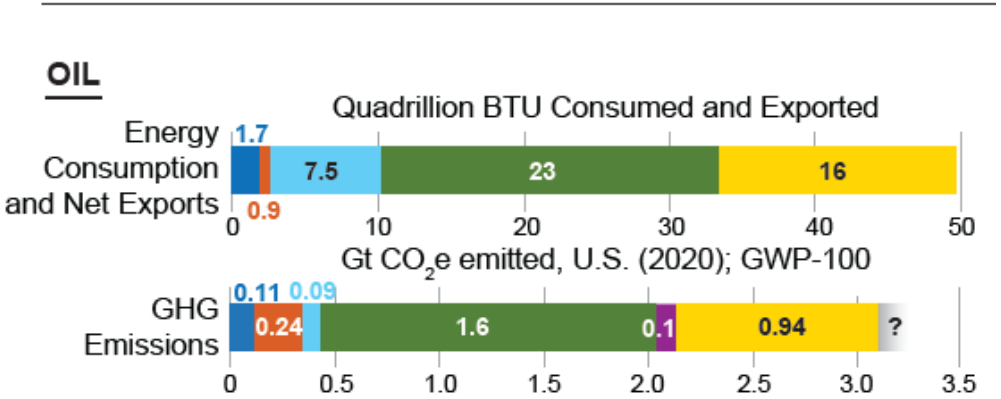
Total U.S. Greenhouse Gas Emissions by Economic Sector in 2019

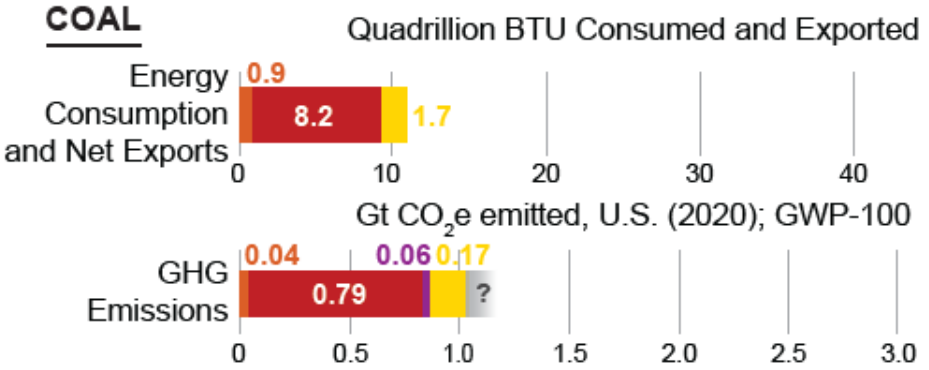


U.S. Environmental Protection Agency (2021). Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990-2019

Fossil Energy and Role of Carbon Management







Heat (commercial, residential) Heat (industrial) Industry (non-heat) Transportation Electric Power
Supply Chain Exports
Additional unknown supply chain emissions associated with coal, natural gas and oil production. Both quantification and mitigation of these emissions is an FECM priority.

FECM Strategic Vision

Advancing Carbon Management Approaches Toward Deep Decarbonization

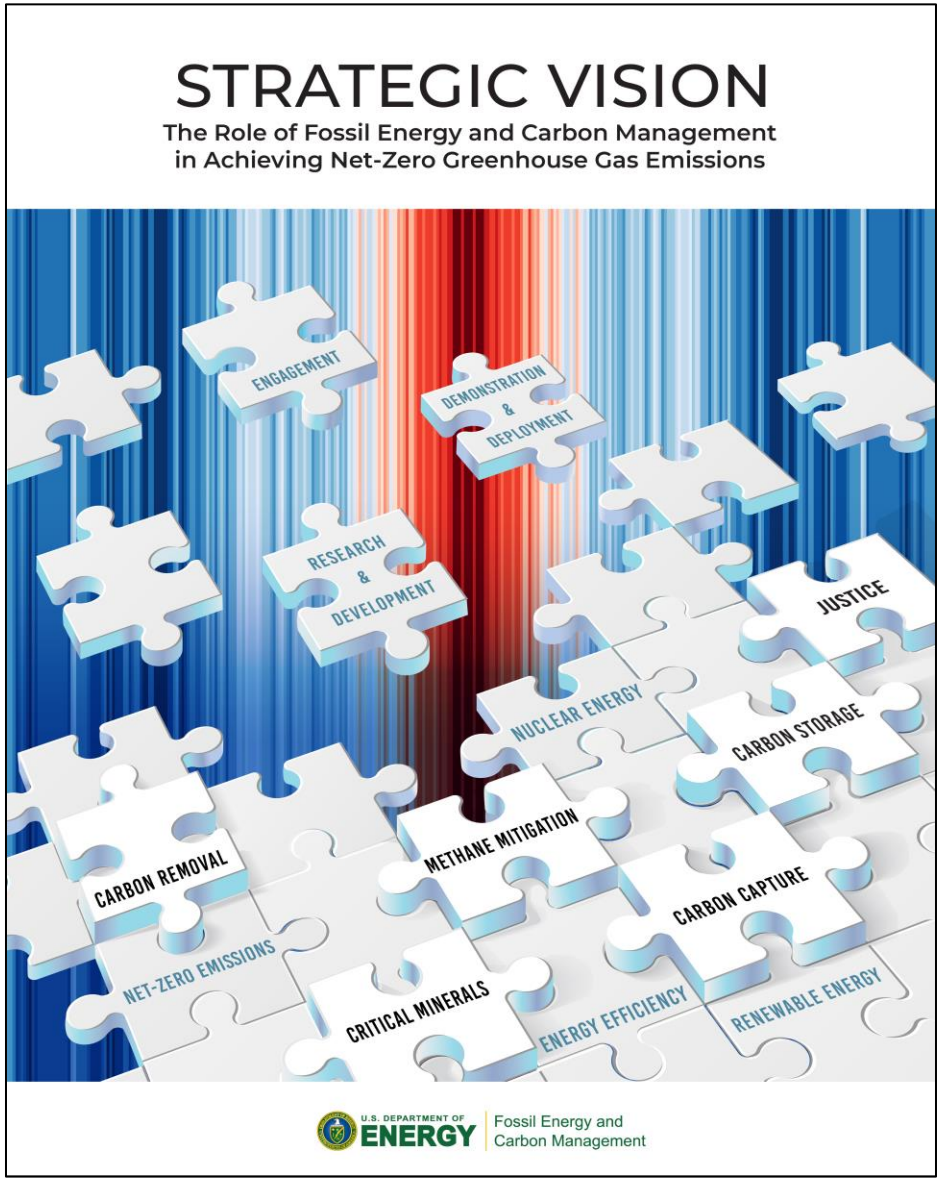
Priorities: *Point-source carbon capture, carbon dioxide conversion, carbon dioxide removal (CDR), and reliable carbon transport and storage*

Advancing Technologies that Lead to Sustainable Energy Resources

Priorities: *Hydrogen with carbon management, domestic critical minerals (CMs) production, and methane mitigation*

Advancing Justice, Labor, and Engagement

Priorities: *Justice, labor, and international and domestic partnerships*



Carbon Capture and Removal with Equity and Justice

A New Requirement for DOE Carbon Management Projects

- Must advance equity and justice for communities

Project Applications Require New Plans for **Four Priorities**

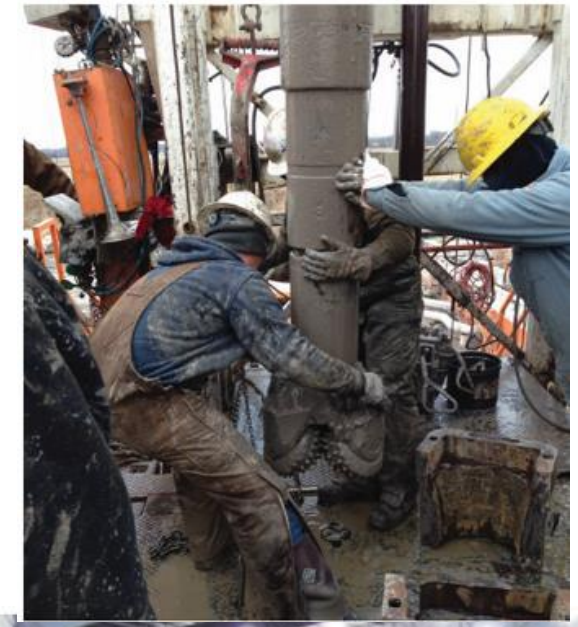
- Community and stakeholder engagement
- Diversity, equity, inclusion, and accessibility
- Justice40 Initiative
- Quality jobs

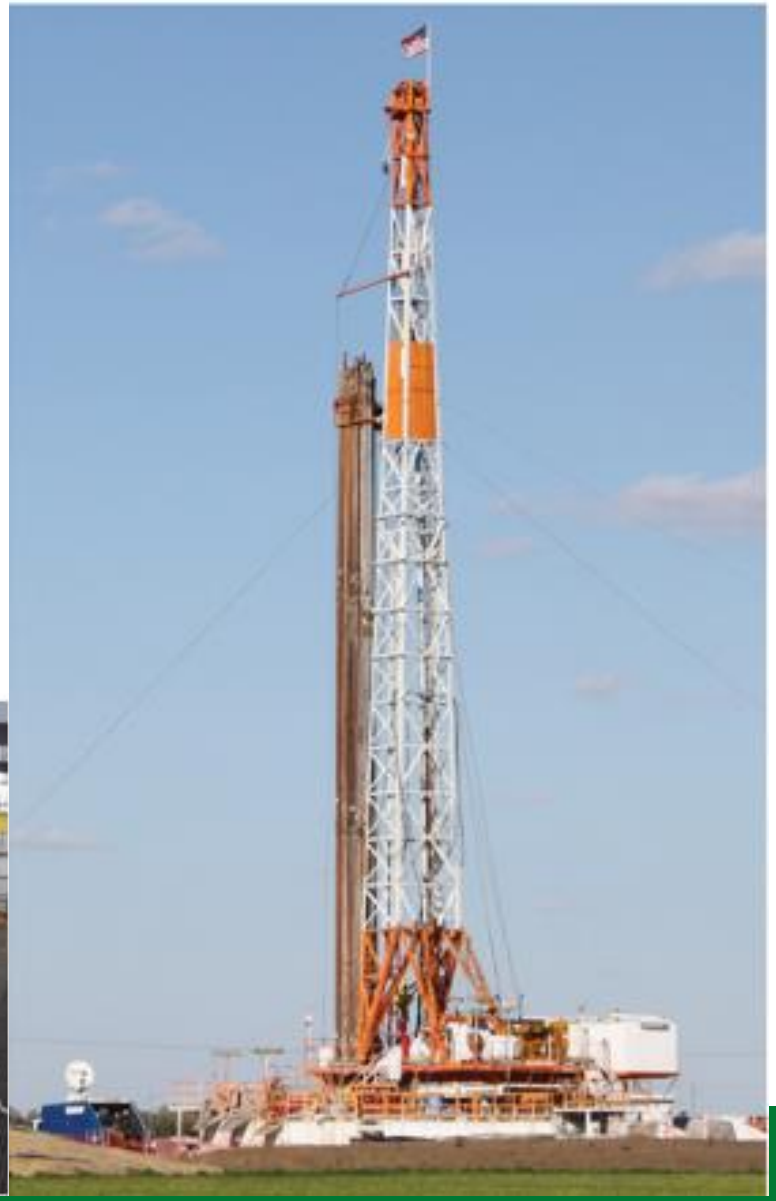
FECM's website (resources) provides guidance for applicants to develop these plans

https://www.energy.gov/fecm/justice-engagement-planning-societal-considerations-impacts-fecm-projects

DOE Has Decades of Safe Storage Experience to Sequester, Monitor, Prevent Re-Emission

- 20+ years of DOE research and roughly 12 $MtCO_2$ permanently stored since 2013
- Tools to measure and monitor
- Get ahead of potential problems
- EPA regulations set to rigorously prevent leakage





Recently Passed Legislation Provides Opportunity for Funding and Stimulating US Innovation

Bipartisan Infrastructure Law - $12B over 5 years

- Build out infrastructure for first-of-a-kind projects
- Create a new gold standard

Inflation Reduction Act - Federal tax credit (45Q) to stimulate private sector projects

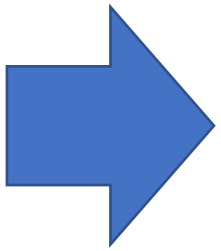
- $85/t$CO_2$ for point-source capture
- $180/t$CO_2$ for direct air capture, coupled to dedicated geologic storage (e.g., Class VI well)
- Reduced minimum project size to 1,000 tons for industrial carbon capture or direct air capture

https://www.energy.gov/fecm/justice-engagement-planning-societal-considerations-impacts-fecm-projects

Legislation is Accelerating Carbon Management

>$12B over five years

Grants
Loans
Credits

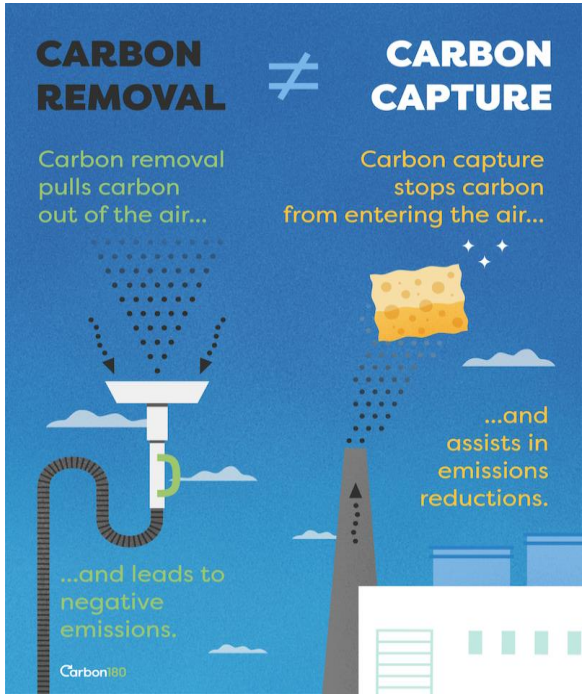


Expected development

- 6 carbon capture demonstration projects and several new small-scale pilots
- 4 direct air capture hubs
- 100+ new dedicated CO_2 storage wells
- New CO_2 pipelines and transportation networks (~10,000 miles moving 10Ms tons CO_2/yr)

https://www.energy.gov/fecm/office-fossil-energy-and-carbon-management

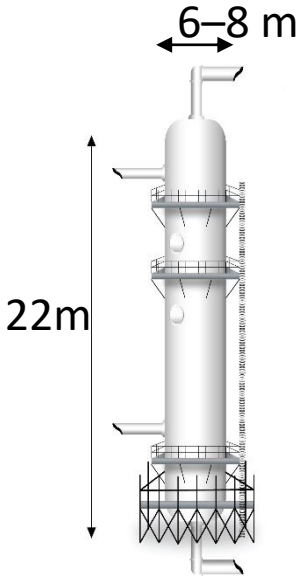
Distinction Between Point-Source Capture and Carbon Dioxide Removal



Source: https://grist.org/wp-content/uploads/2021/12/carbon180-carbon-removal-is-not-carbon-capture.png

Different designs and various technologies lead to different impacts, energy, land, and water requirements

Power Plant MEA Scrubber



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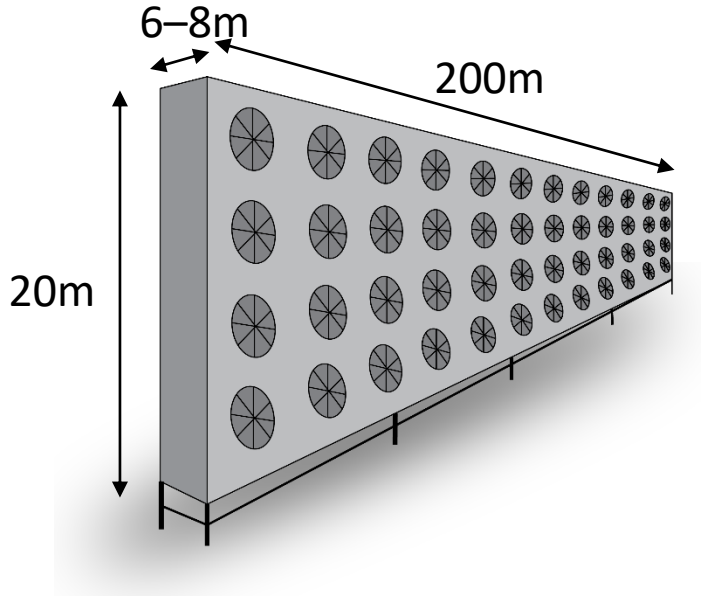
DAC Contactor



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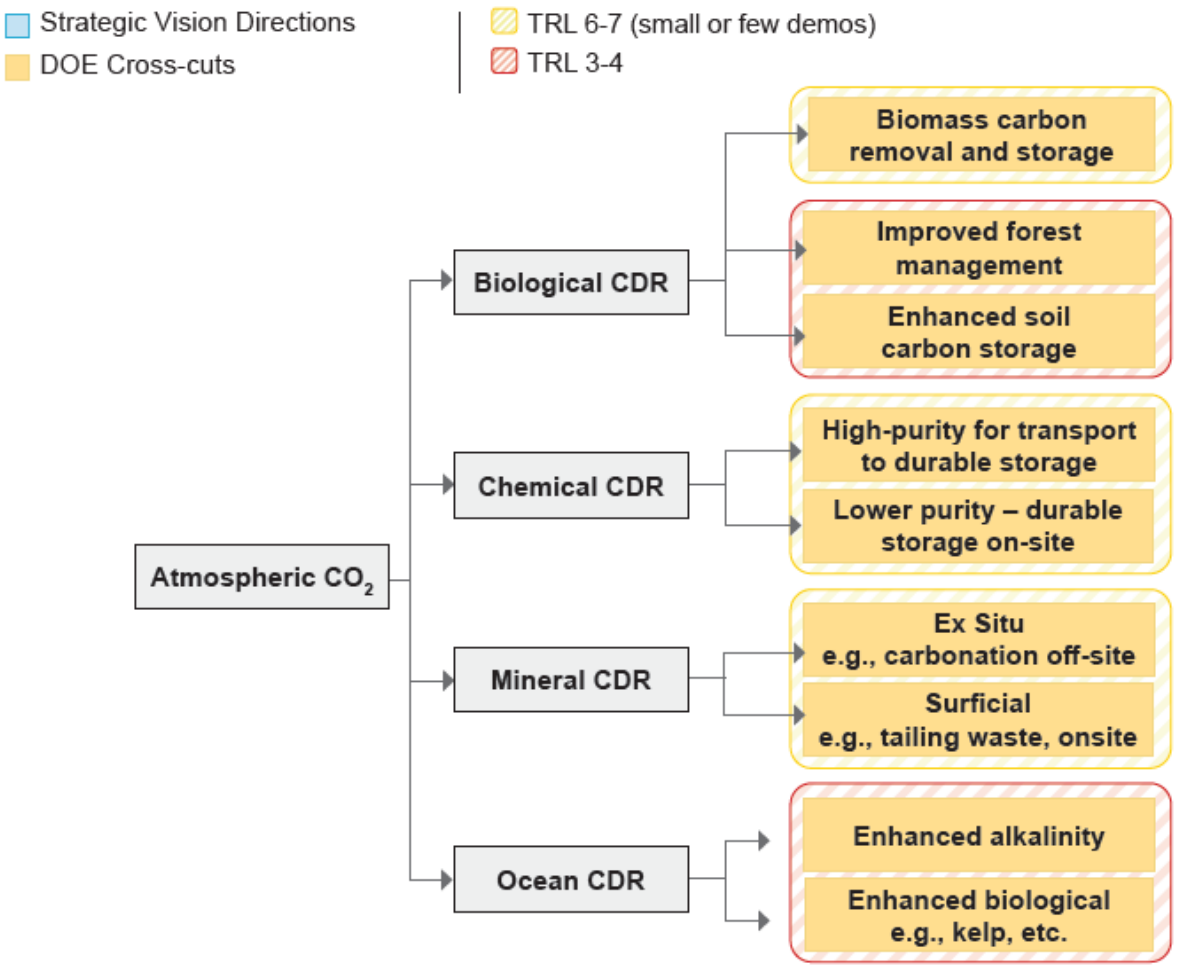
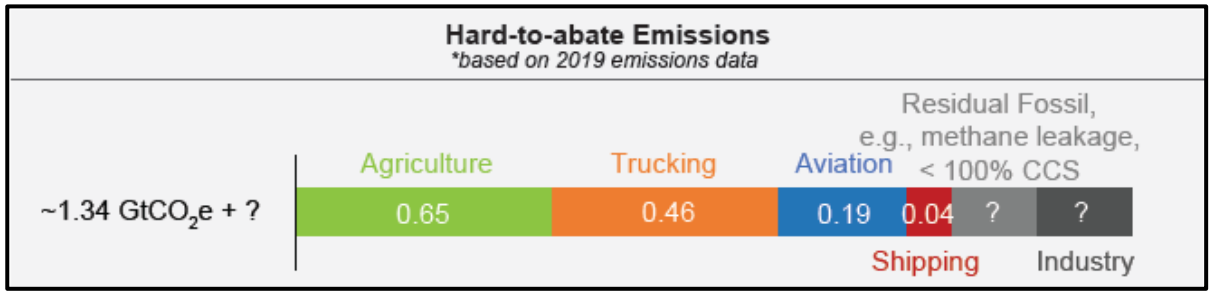
CDR Pathways and Hard-to-Abate Emissions





Reference: FECM Strategic Vision (April 2022)

Recent FECM Awards Focus on Coupling DAC to Clean Heat

- As a leader in advancing carbon management technologies, FECM is **researching and investing in DAC technologies** to help scale them up for the commercial market
- DAC coupled to durable storage for carbon dioxide removal is **energy intensive, relying on both heat and electricity inputs**
- FECM recently awarded **$11 million** (federal) for 4 FEED studies leveraging existing sources of clean heat for DAC – nuclear, geothermal, and industrial waste heat

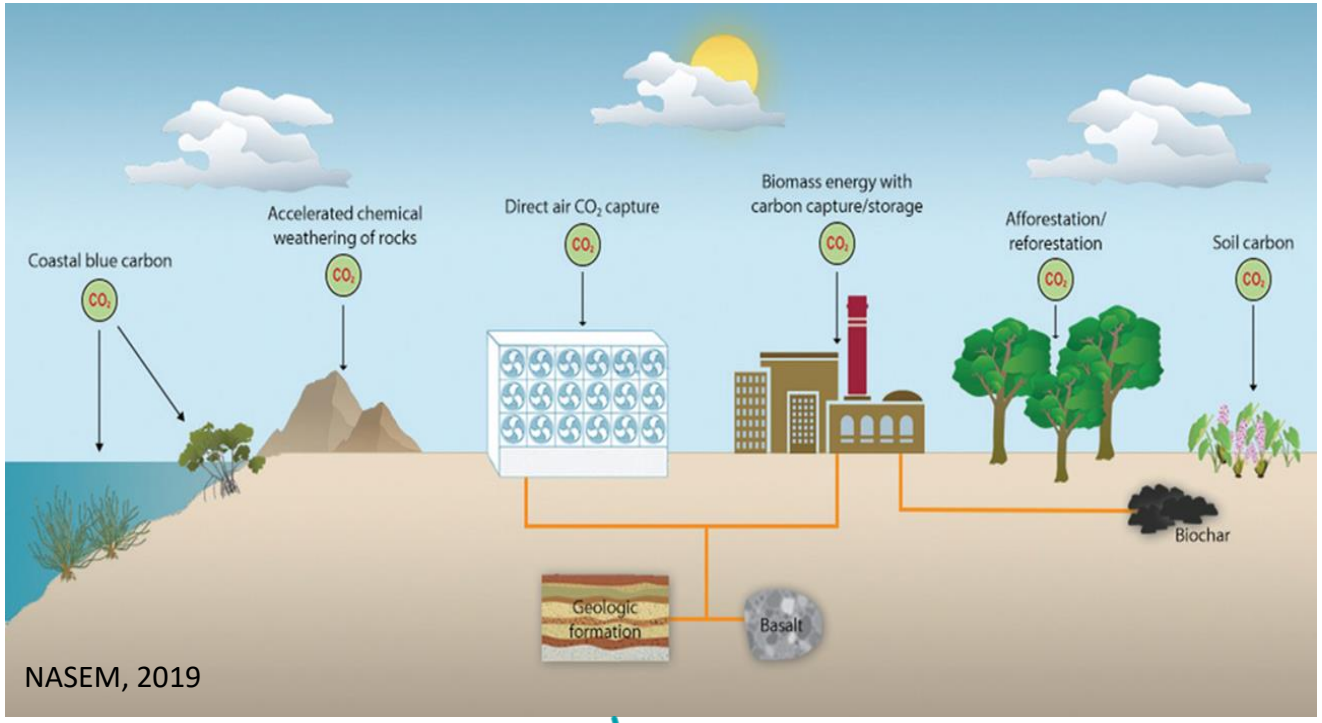
DAC coupled to nuclear heat: $3.4m ($2.5m federal) FEED study led by Battelle with AirCapture, Carbonvert, Sargent & Lundy, Southern Company, and the University of Alabama to be located at Southern Company's Joseph M. Farley nuclear power plant in Columbia, AL. Image: NRC

DAC coupled to nuclear heat and power: $3.1m ($2.5m federal) FEED study led by Exelon with Carbon Engineering, Worley Group, 1PointFive, Univ. of Illinois, and PNNL to be located at Exelon's Byron Generating Station for 250k net tons CO_2/year captured with permanent storage. Image: CE

DAC coupled to geothermal energy: $3.1m ($2.5 federal) FEED study led by UIUC with Climeworks, Ormat, Sentinel Peak, Visage Energy, LLNL, and Kiewit to be located at an Ormat geothermal facility in California. Image: Ormat

DAC coupled to steel plant waste heat: $4.3m ($3.5m federal) FEED study led by Univ. Illinois to be integrated with US Steel's Gary Works in Indiana, with CO_2 to be trucked to a ready-mix concrete plant to be mineralized into calcium carbonate.Photo: Adobe 296734139

Advancing Carbon Management Approaches Toward Deep Decarbonization: Carbon Dioxide Removal (CDR)



NASEM, 2019

CDR Areas of Interest in FECM

- Direct Air Capture (DAC)
- Biomass with Carbon Removal and Storage
- Direct Ocean Capture (DOC)
- Accelerated Weathering and Mineralization

- Rigorous LCA and TEA (net-removed costs)
- Low-carbon energy, land, and water resources required
- Leveraging transport and storage infrastructure
- Justice and work force considerations

ENERGY earthshots U.S. DEPARTMENT OF ENERGY | Carbon Negative

Durable and scalable carbon dioxide removal under $100/net metric ton within a decade

Bipartisan Infrastructure Law

FECM - **$6.5 billion** in new carbon management funding over 5 years through the Infrastructure Investment and Jobs Act (Bipartisan Infrastructure Law).

Carbon Dioxide Removal - Direct Air Capture
Regional Direct Air Capture Hubs: $3.5 billion
DAC Technology Prize Competition: $115 million

Carbon Dioxide Utilization and Storage
Carbon Storage Validation and Testing: $2.5 billion
Carbon Utilization Program: $310 million

Front-End Engineering Design Studies
Carbon Capture Technology Program: $100 million

Critical Minerals and Materials
Rare Earth Element Demonstration: $140 million
Rare Earth Mineral Security: $127 million

Office of Clean Energy Demonstrations (OCED)

OCED established December 2021
Principal Deputy Director, Kelly Cummins

- Builds on existing DOE investments in clean energy research and development
- Increases DOE's partnership with industry leaders

OCED Projects Areas:

- Clean hydrogen
- Carbon capture
- Grid-scale energy storage
- Small modular reactors and more

FECM-OCED Project Coordination

Hydrogen Hubs

- $8 billion (for at least four projects, including at least one using fossil fuels with carbon management)

Carbon Capture Demonstrations and Large Pilots

- $3.5 billion

Carbon Dioxide Transportation Infrastructure Finance and Innovation Program Account

- Loan Programs Office: $2.1 billion

Thank You

Learn More About Us

The Office of Fossil Energy and Carbon Management
https://www.energy.gov/fecm

Justice & Engagement
https://www.energy.gov/fecm/justice-engagement-planning-societal-considerations-impacts-fecm-projects

Our Strategic Vision
https://www.energy.gov/sites/default/files/2022-04/2022-Strategic-Vision-The-Role-of-Fossil-Energy-and-Carbon-Management-in-Achieving-Net-Zero-Greenhouse-Gas-Emissions_Updated-4.28.22.pdf