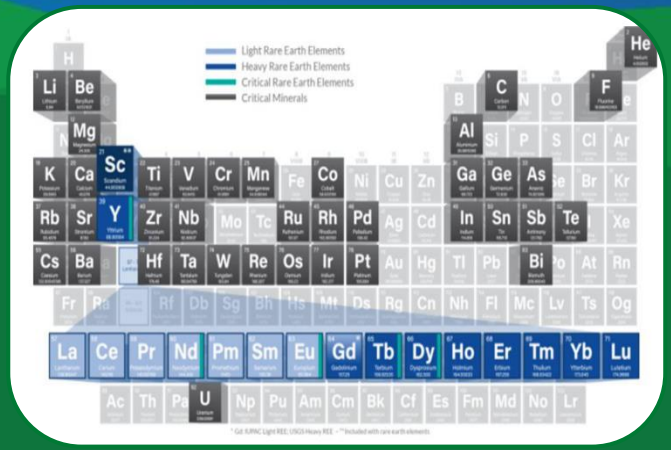
U.S. DEPARTMENT OF ENERGY
Fossil Energy and Carbon Management

The Role in Carbon Management in Achieving Net-Zero Goals

Jen Wilcox, US Department of Energy

GHGT-16

October 25th, 2022



Fossil Energy and Carbon Management (FECM)

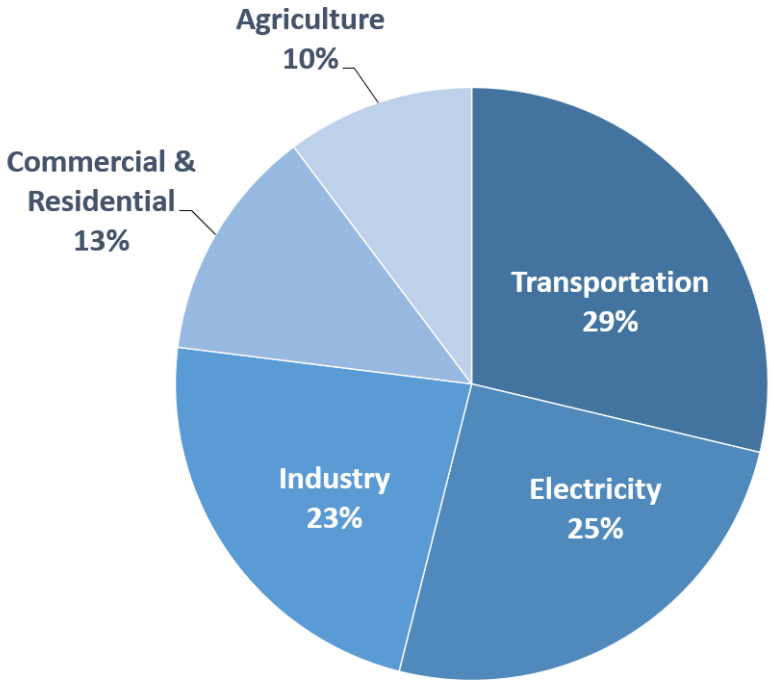
Office of Fossil Energy and Carbon Management

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

FECM Strategic Vision

Advancing Carbon Management Approaches Toward Deep Decarbonization

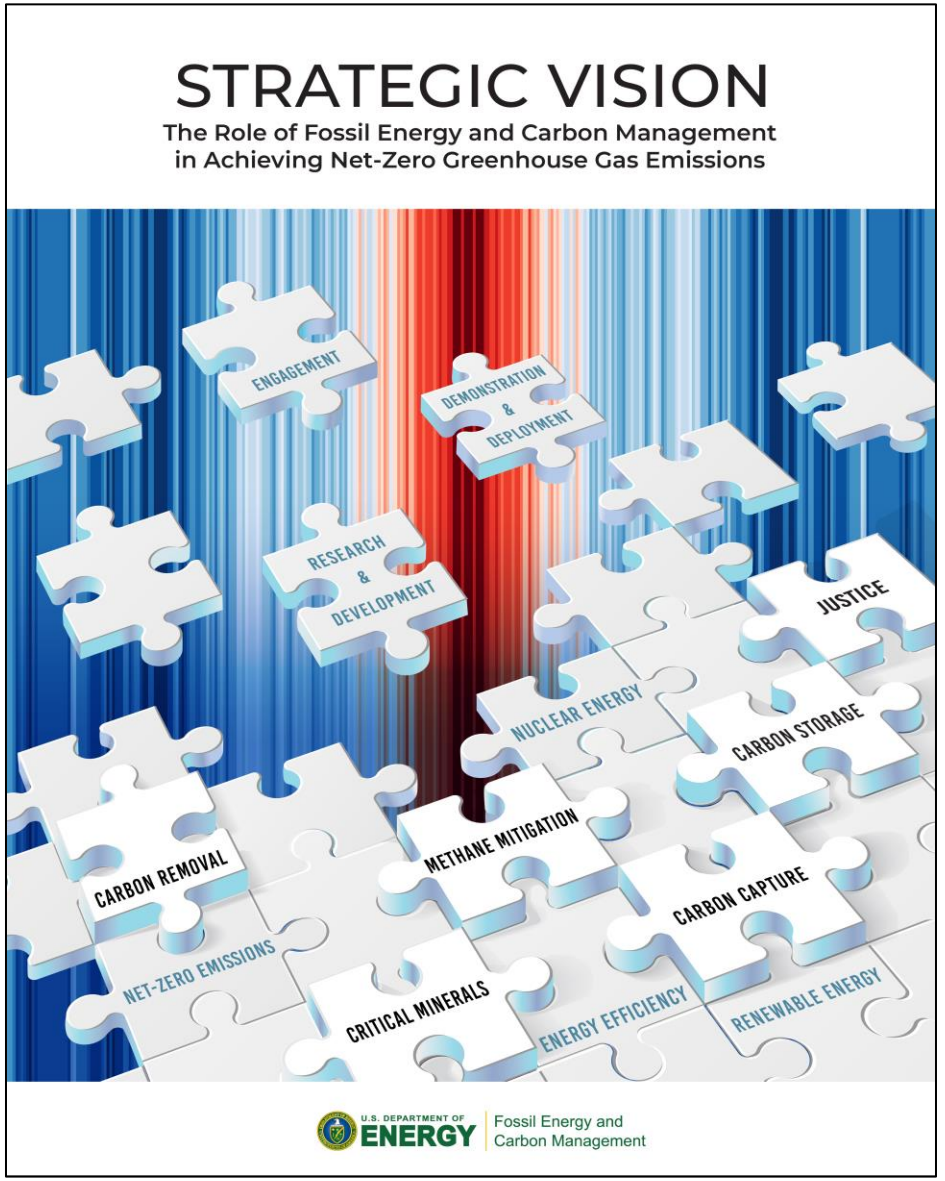
Priorities: *Point-source carbon capture, carbon dioxide conversion, carbon dioxide removal (CDR), and reliable carbon transport and storage*

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**

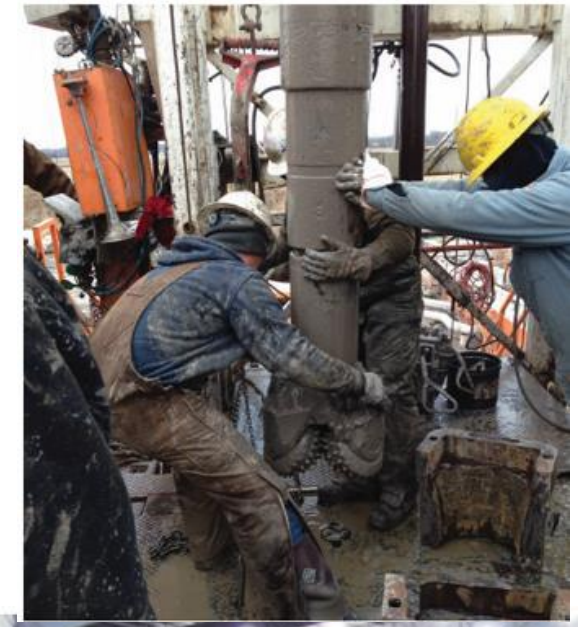
- Community and stakeholder engagement
- Diversity, equity, inclusion, and accessibility
- Justice40 Initiative
- Quality jobs

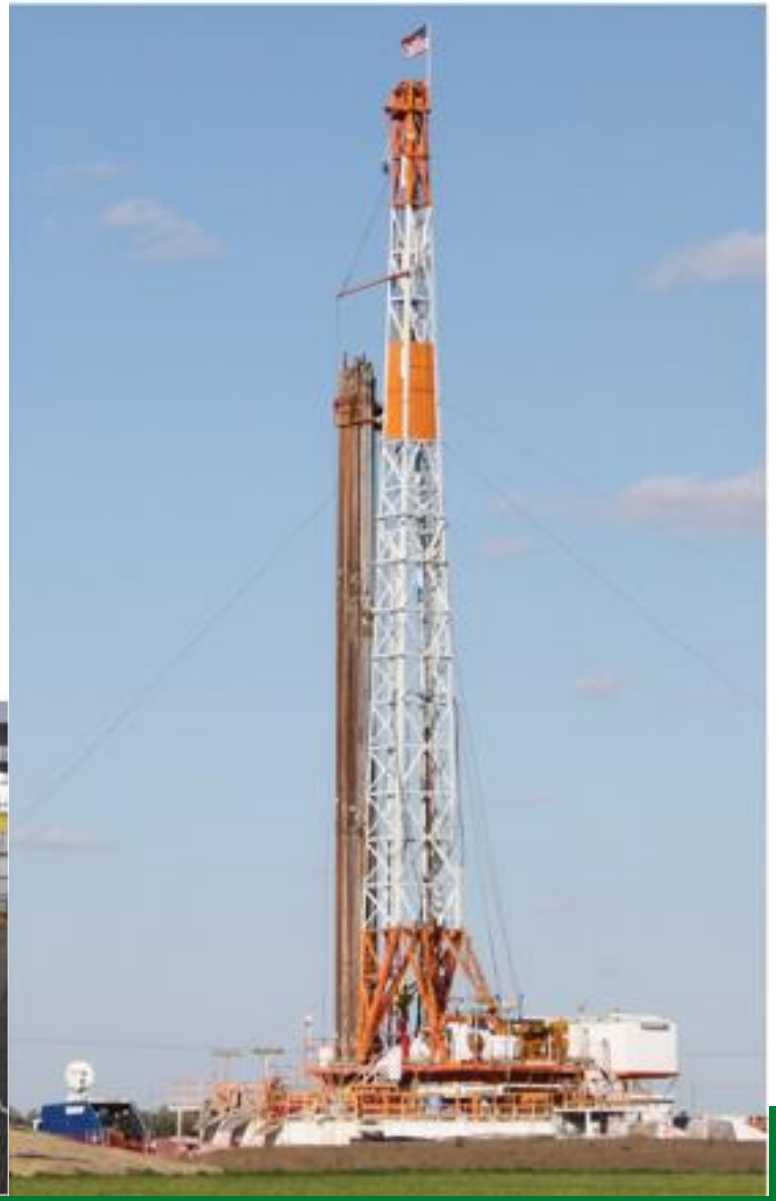
FECM's website (resources) provides guidance for applicants to develop these plans

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

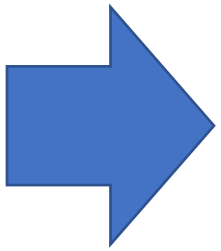
- $85/t$CO_2$ for point-source capture
- $180/t$CO_2$ for direct air capture, coupled to dedicated geologic storage (e.g., Class VI well)
- Reduced minimum project size to 1,000 tons for industrial carbon capture or direct air capture

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



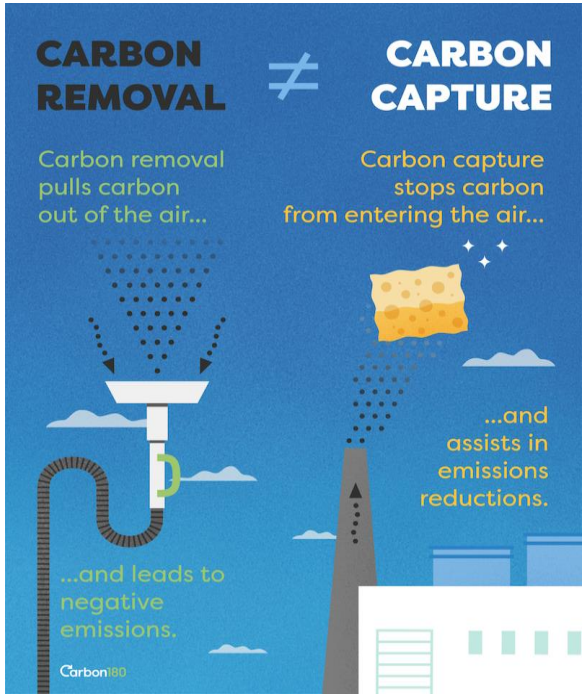
Expected development

- 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)

FOA Release September 23, 2022: https://www.energy.gov/oced/carbon-capture-demonstration-projects-program

Broader Press Release: https://www.energy.gov/articles/biden-harris-administration-announces-49-billion-deploy-infrastructure-necessary-manage

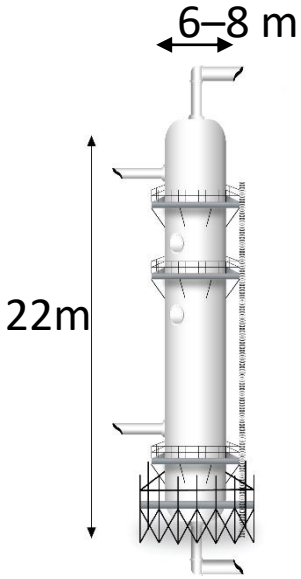
Distinction Between Point-Source Capture and Carbon Dioxide Removal



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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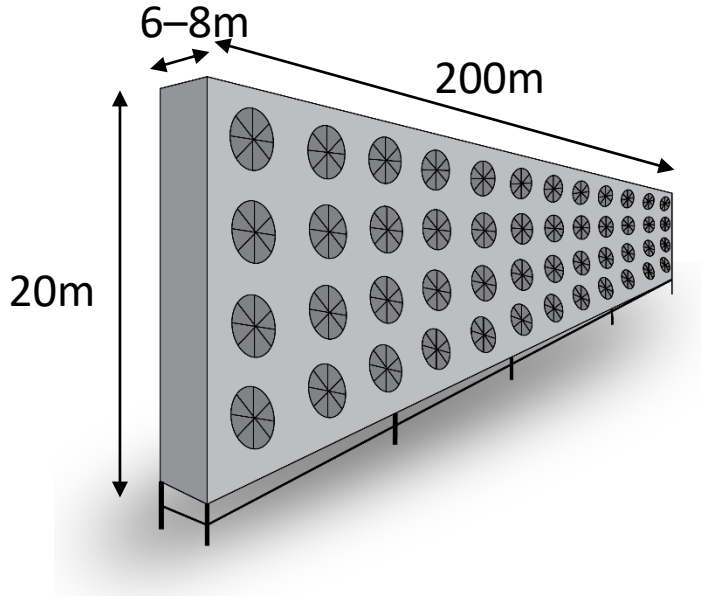
DAC Contactor



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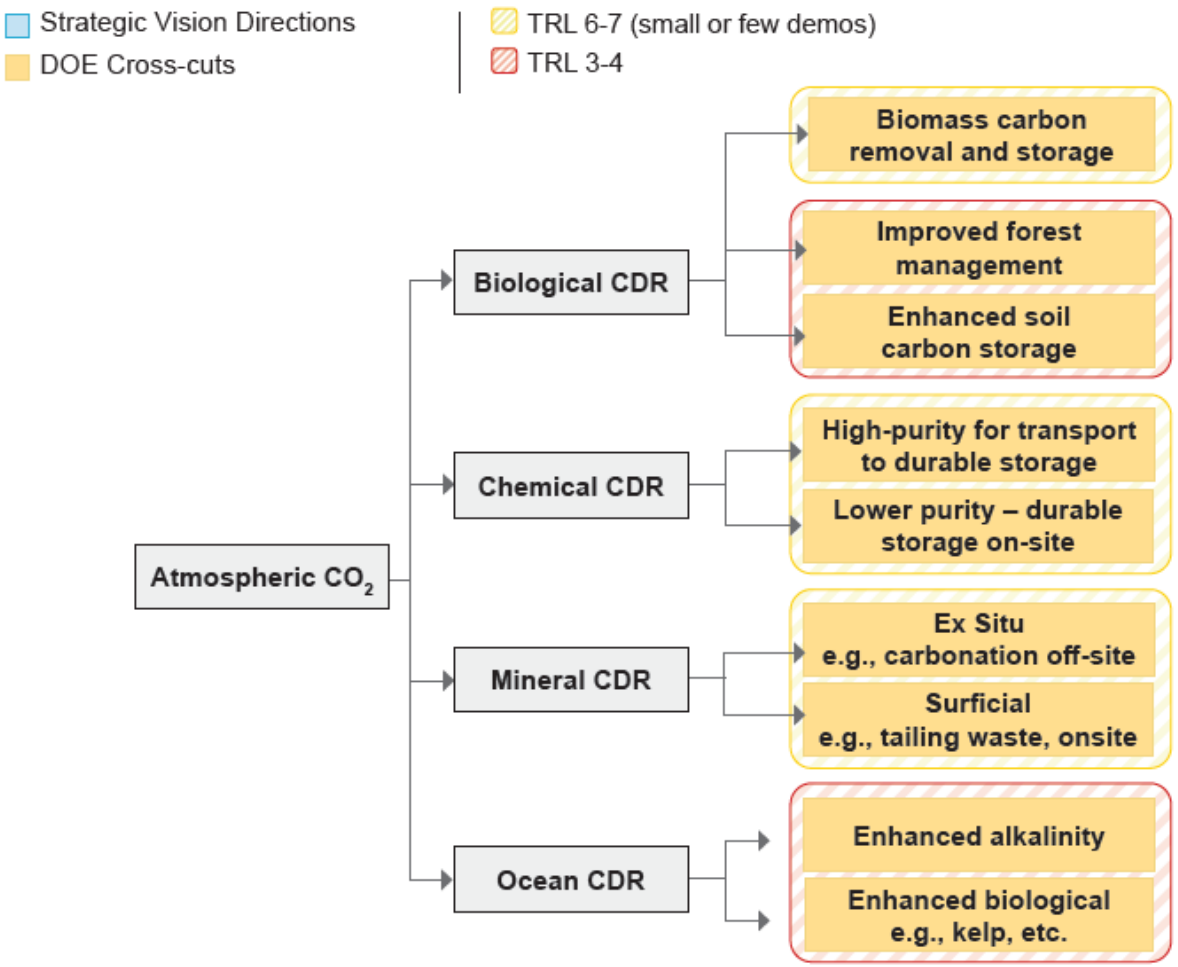
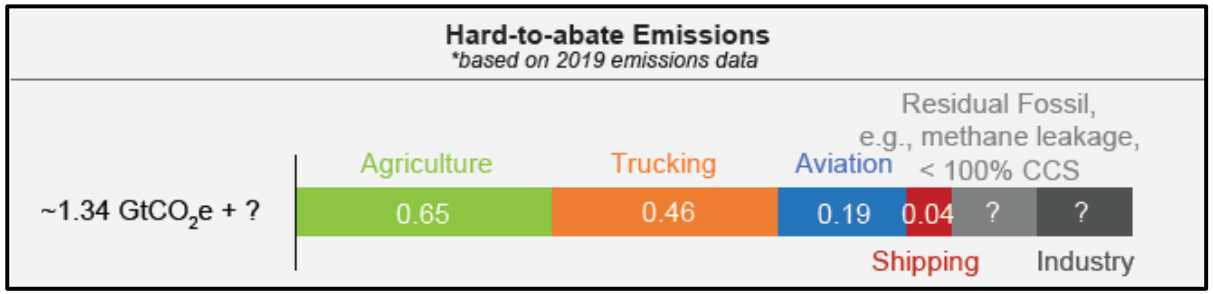
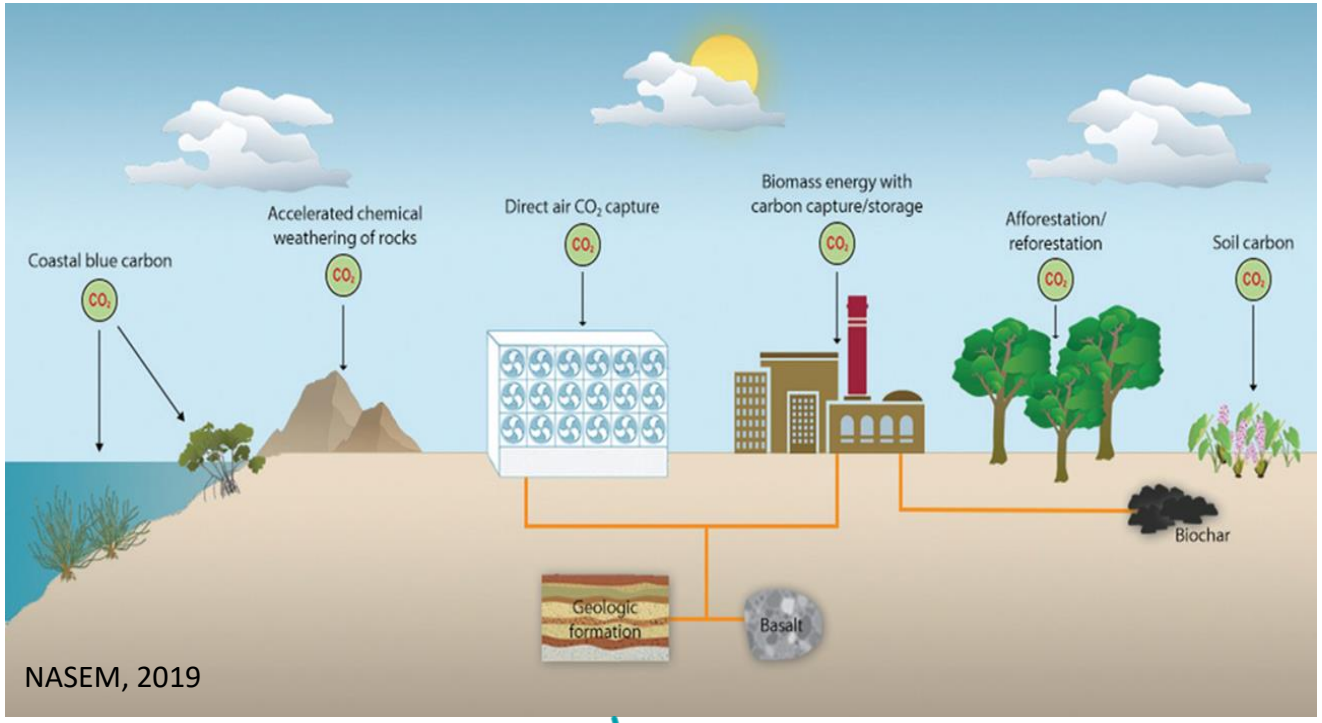
CDR Pathways and Hard-to-Abate Emissions





Reference: FECM Strategic Vision (April 2022)

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

Direct Air Capture Hubs – Current Status and Next Steps

- Issued a Request for Information (RFI) in December 2021 that received thousands of pages of responses
- Conducted applicant education workshops in person (OH, LA, and UT) and virtually
- Issued a Notice of Intent on 5/13: FedConnect: Opportunity Summary – our first major step towards getting the funding out the door and into the field
  - Provides a high-level draft plan for DOE's current vision to meet the BIL requirements for the hubs
- Planning a funding announcement for Q4 of FY22 (Fall 2022)

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

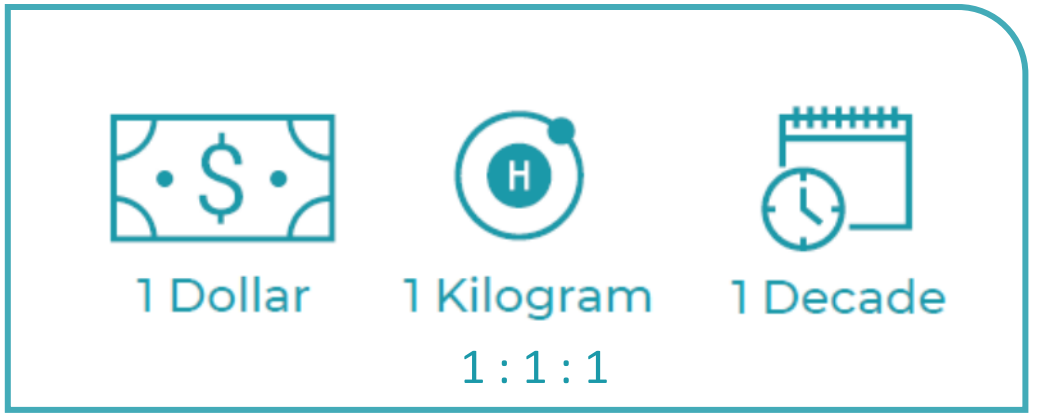
Carbon Dioxide Utilization and Storage
Carbon Storage Validation and Testing: $2.5 billion
Carbon Utilization Program: $310 million

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

Hydrogen Shot: first of the Energy Earthshots

- Accelerate breakthroughs: abundant, affordable, and reliable clean energy
- Facilitate clean hydrogen cost reductions
- Creates $140 billion revenues and 700,000 jobs by 2030



Hydrogen Shot seeks $1/kg clean hydrogen within the decade

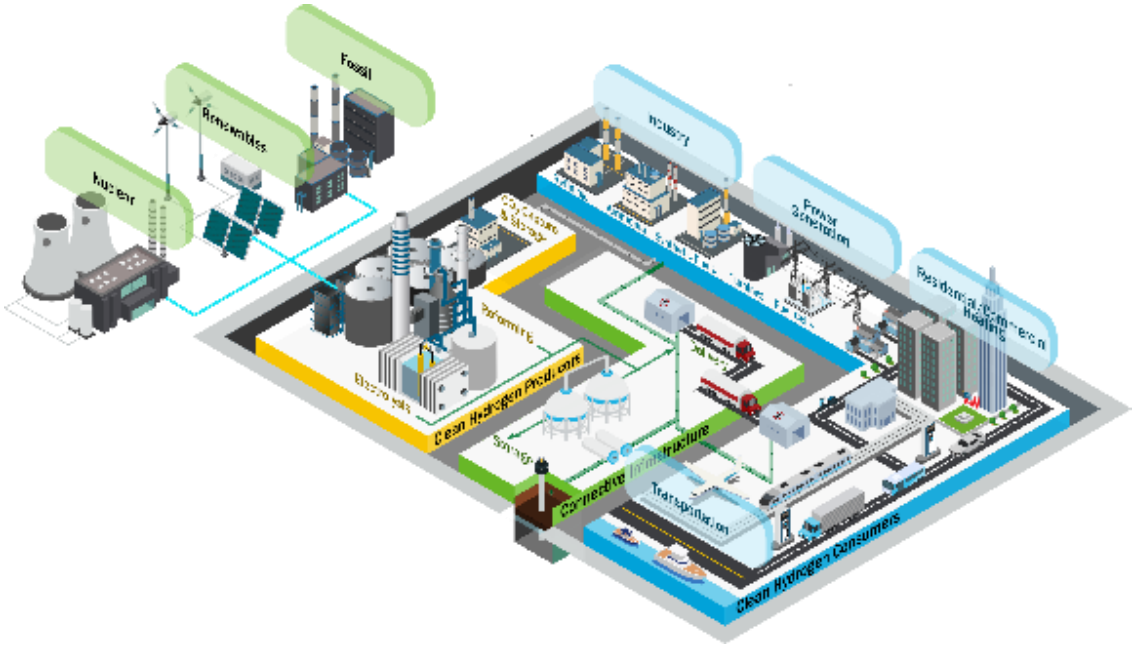
NETL gasification Research & Development targeted to increase efficiency and lower costs of hydrogen production to help achieve administration targets
https://www.energy.gov/eere/fuelcells/hydrogen-shot

Regional Clean Hydrogen Hubs ($8 billion) – Overview

Establish at least four regional clean hydrogen hubs across the country to improve clean hydrogen production, processing, delivery, storage, and end use

- **Feedstock diversity:** at least one hydrogen hub using fossil fuels, one with renewable energy, and one using nuclear energy
- **End use diversity**: at least one hydrogen hub in the electric power generation sector, one in the industrial sector, one in the residential and commercial heating sector, and one in the transportation sector
- **Geographic diversity:** hubs shall be in different regions and use energy resources abundant to that region
- **Natural gas**: at least two hubs shall be in U.S. regions with the greatest natural gas resources
- **Employment**: priority to hubs likely to create training and long-term employment

Regional Clean Hydrogen Hubs – Current Status and Next Steps



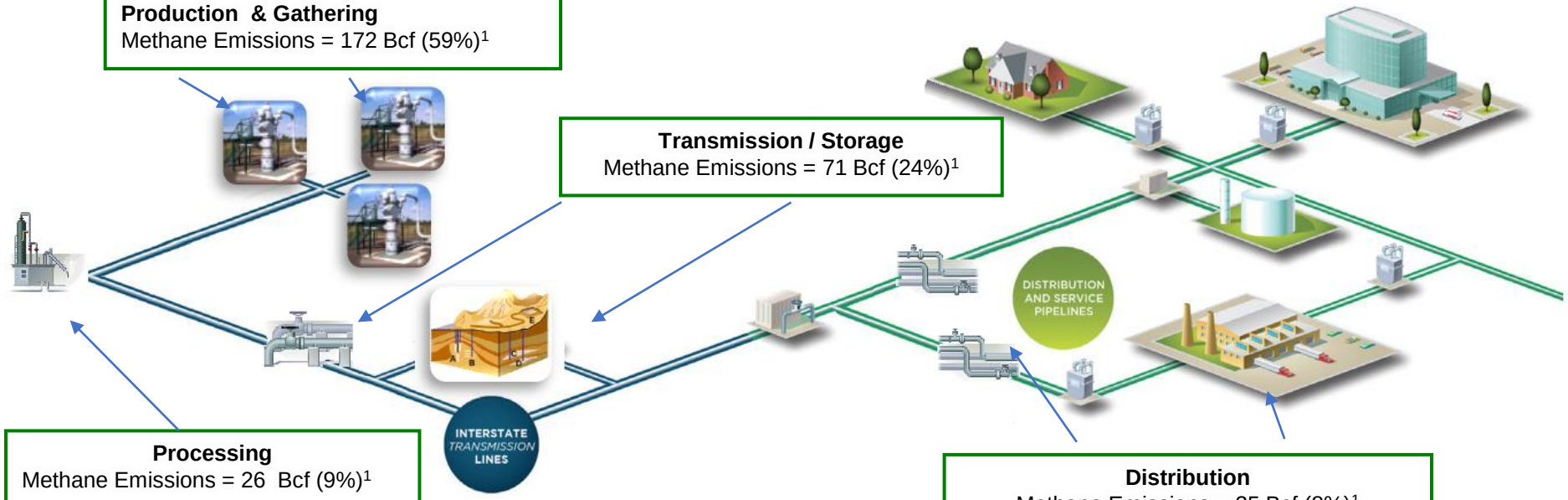
- Issued a Request for Information (RFI) in March 2022 that received thousands of pages of responses
- Conducted stakeholder workshops and webinars, including a webinar on the RFI and listening sessions with Tribal leaders and energy justice communities
- Issued a Notice of Intent on June 6, 2022 – our first major step towards getting the funding out the door and into the field
  - Provides a high-level draft plan for DOE's current vision to meet the BIL requirements for the hubs
  - Posted on OCED Exchange: https://oced-exchange.energy.gov/Default.aspx
- Funding Opportunity Announcement September 22nd, 2022: https://www.energy.gov/oced/regional-clean-hydrogen-hubs

Methane Emissions – FECM Focus on Quantification and Mitigation

22% of Total U.S. Anthropogenic Methane Emissions, 294 BCF (5,600 Gg),
~1.1% emission rate from extraction through distribution in 2018
(U.S. EPA Greenhouse Gas Inventory)

Production & Gathering
Methane Emissions = 172 Bcf (59%)[1]

Transmission / Storage
Methane Emissions = 71 Bcf (24%)[1]



Processing
Methane Emissions = 26 Bcf (9%)[1]

Distribution
Methane Emissions = 25 Bcf (8%)[1]

Infrastructure Characteristics[2]

Production
405,000 gas wells

Gathering
5,400 gathering stations
17,500 gathering compressors
381,000 miles of gathering pipe
(typically 8-5/8" or less) 500 psi

Processing
667 Natural Gas Processing Plants

Transmission & Storage
302,000 Miles of large diameter transmission pipe 24"-48"1,000 psi
2,000 compressor stations
- **7,200** engines (61 billion hp-hr)
- **2,400** turbines (15 billion hp-hr)

19,089 storage wells

Distribution
1.3 million miles of distribution

[1] EPA, 2019a. Inventory of U.S. Greenhouse Gas Emissions and Sinks.
[2] EPA, 2019b. Annex 3.6 (https://www.epa.gov/sites/production/files/2020-02/2020_ghgi_natural_gas_systems_annex36_tables.xlsx)

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