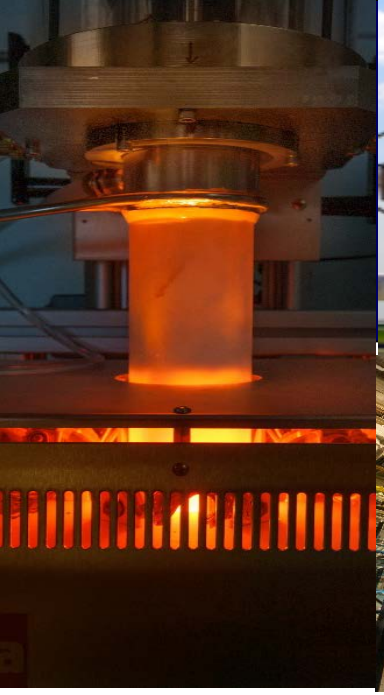
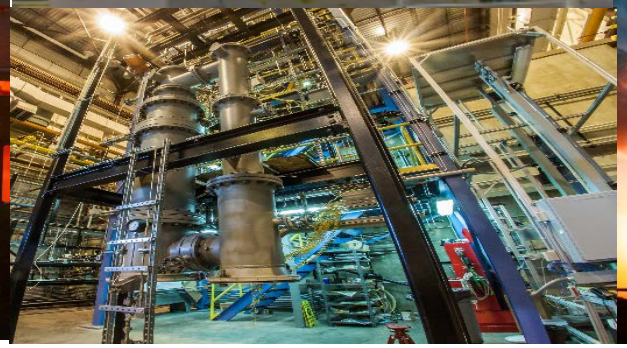
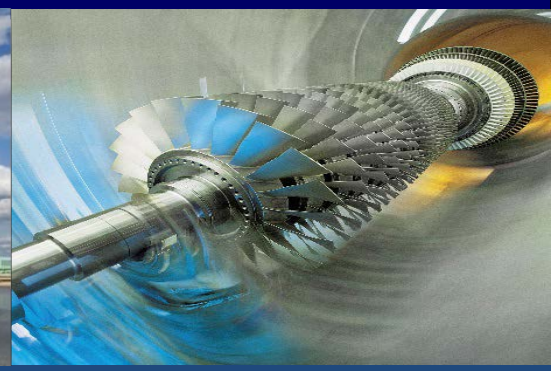




U.S. DEPARTMENT OF ENERGY | Office of Fossil Energy

CCUS Developments in the United States

October 23, 2018

Steve Winberg

Assistant Secretary for Fossil Energy

U.S. Department of Energy

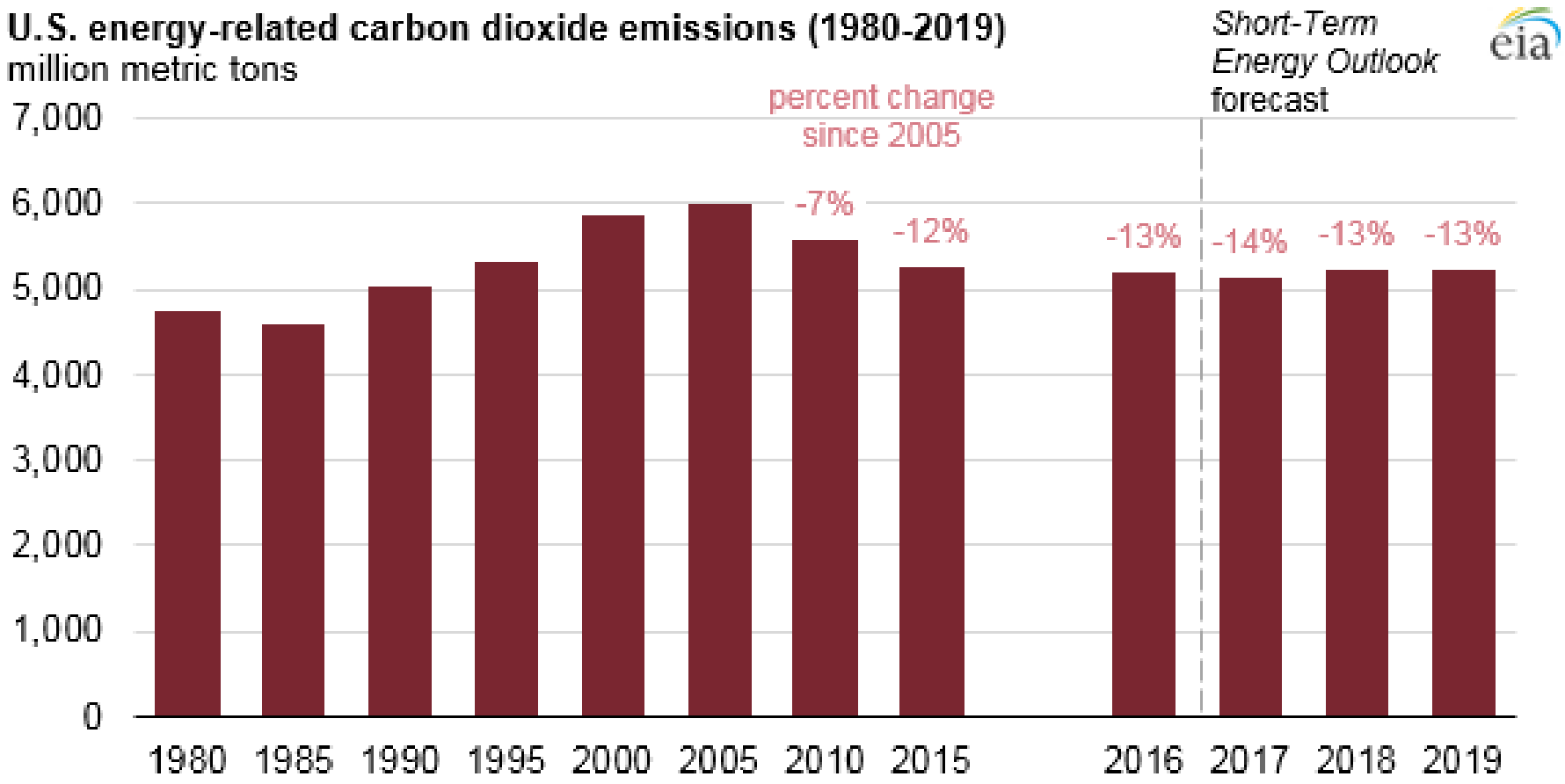
Administration Energy Priorities

- **Boosting Domestic Energy Production**
- **Grid Reliability and Resiliency**
- **Job Creation**
- **Energy Security**



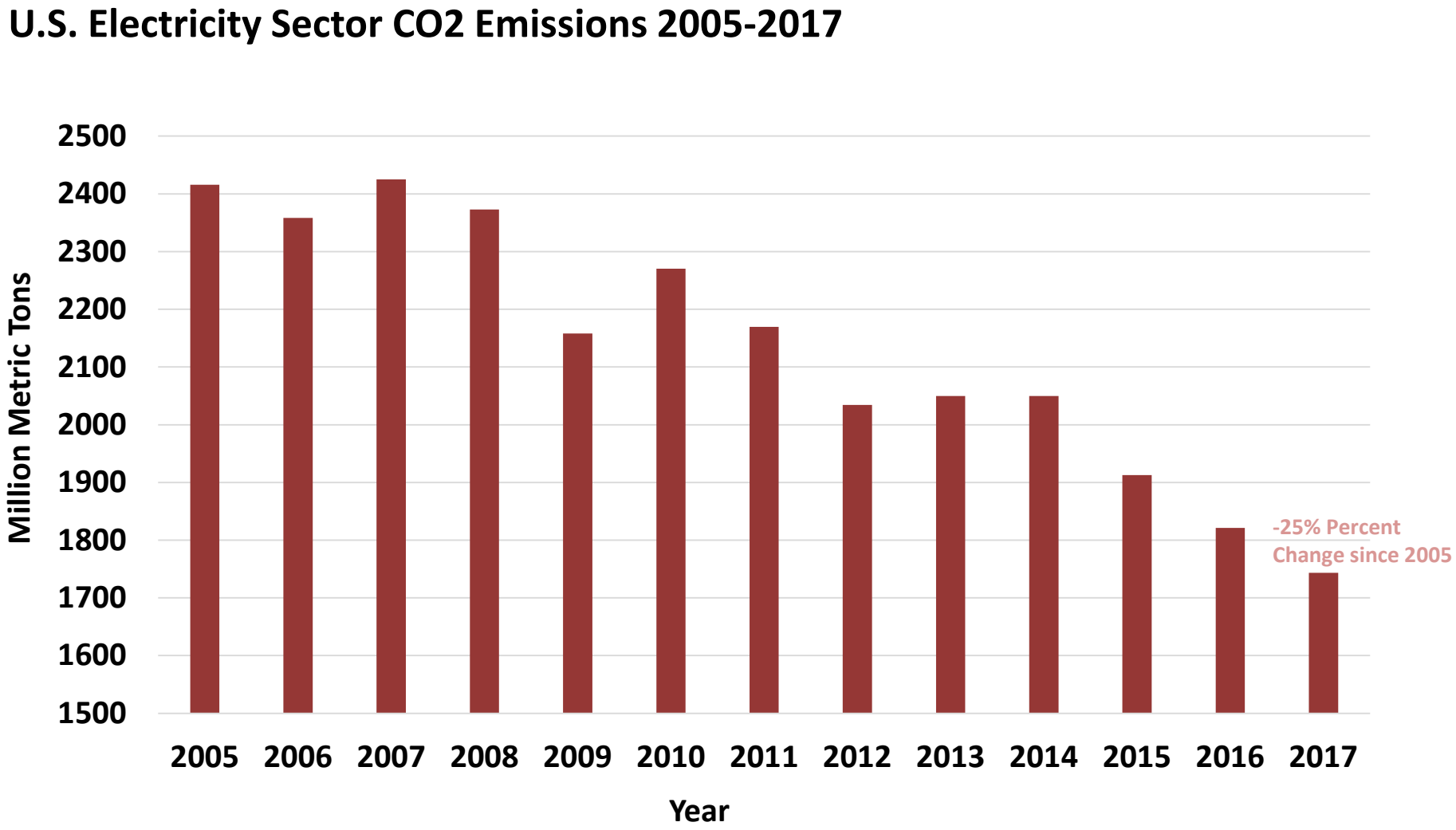
U.S. Energy-Related CO_2 Emissions

14% reduction from 2005 to 2017



Source: https://www.eia.gov/todayinenergy/detail.php?id=34872

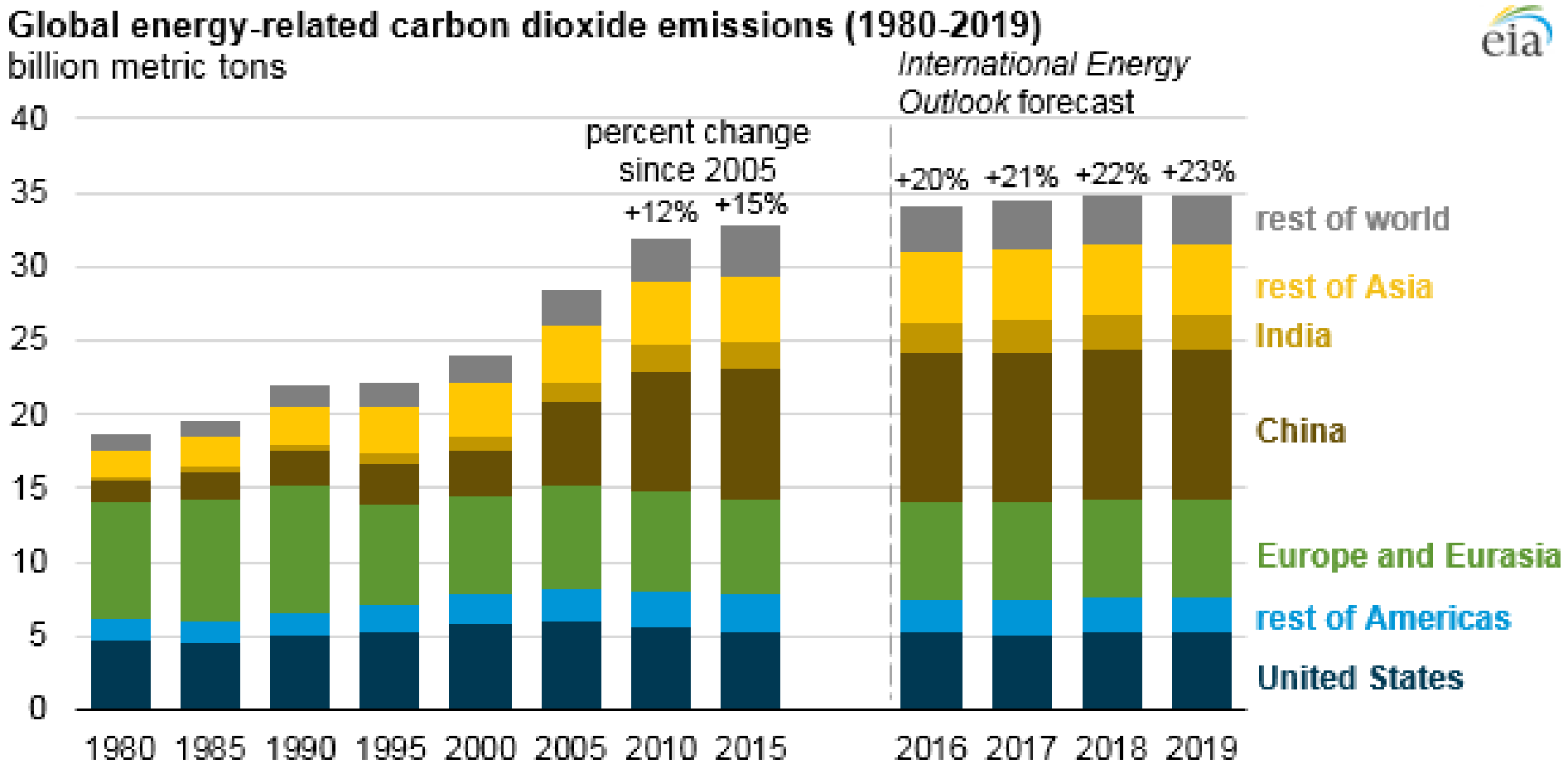
CO_2 Emissions From U.S. Electricity Sector Declined Roughly 25% from 2005-2017



Source: EIA, *U.S. Energy-Related Carbon Dioxide Emissions, 2017*

Global Energy-Related CO_2 Emissions

21% Increase Worldwide



Source: https://www.eia.gov/todayinenergy/detail.php?id=34872

Department of Energy Investments in Carbon Capture, Utilization and Storage

Major Demonstration Projects

Air Products Facility (Port Arthur, TX) – Began Operations 2013

- Built and operated by Air Products and Chemicals Inc. and located at Valero Oil Refinery in Port Arthur, TX
- State-of-the-art system to capture the CO_2 from two large steam methane reformers
- Captured gas transported via pipeline to oil fields in eastern Texas where it is used for EOR.
- Since 2013, the project has captured over three million metric tons of CO_2.

Petra Nova CCS (Thompsons, TX) – Began Operations 2017

- Joint venture by NRG Energy, Inc. and JX Nippon Oil and Gas Exploration
- Demonstrate the Mitsubishi Heavy Industries CO_2 capture technology ability to capture 90% of the CO_2 emitted from a 240-megawatt flue gas stream. (designed to capture/store 1.4 million tonnes of CO_2 per year)
- Captured CO_2 used for EOR at the West Ranch Oil Field in Jackson County, Texas, where it will remain sequestered underground

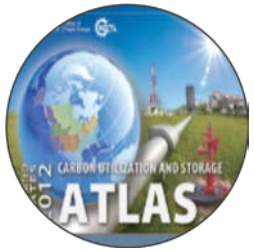
ADM Ethanol Facility (Decatur, IL) – Began Operations 2017

- Built and operated by Archer Daniels Midland (ADM) at their existing biofuel plant located in Decatur, IL
- Planned to **capture 1 million metric tons of CO_2** as a by-product of the ethanol biofuels production process and store it in a deep saline reservoir
- First ever CCS project to use the EPA Underground Injection Class VI well permit in the United States that is specifically designed for CO_2 storage

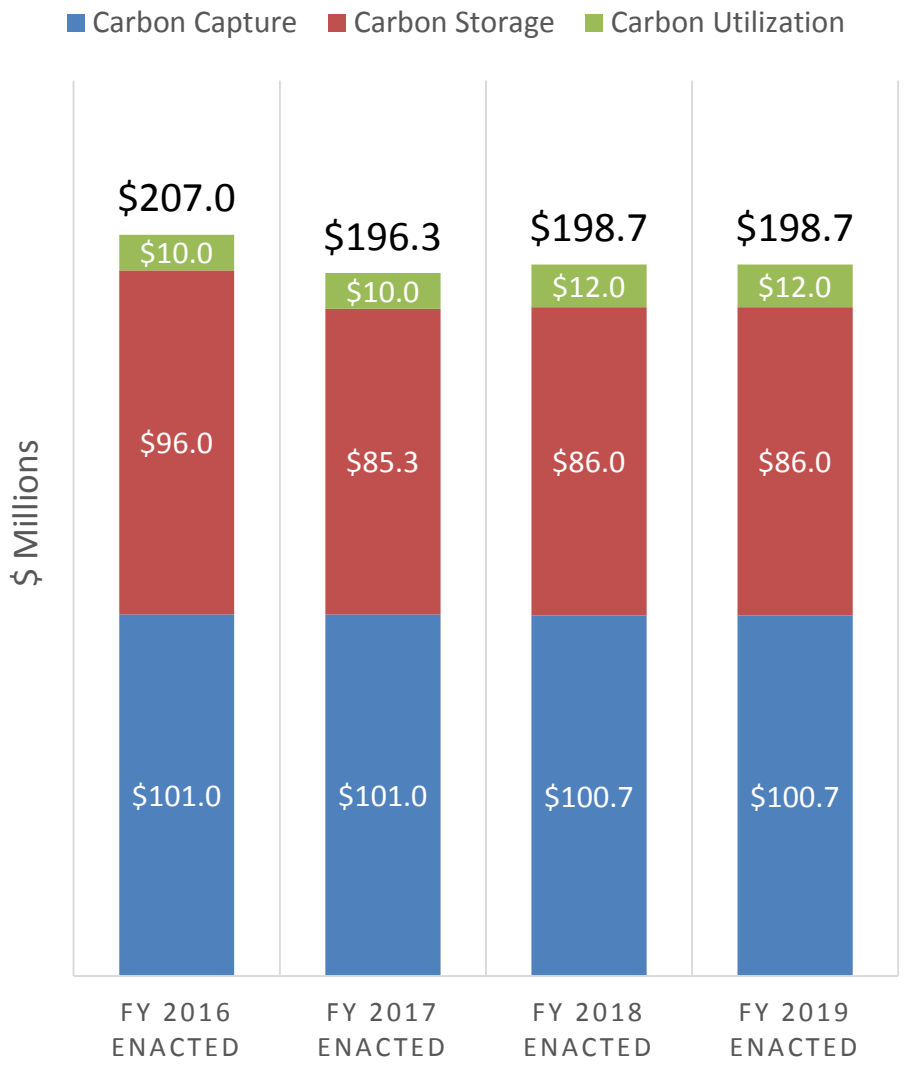
Federal Investment in Carbon Capture, Utilization and Storage R&D

Carbon Capture
R&D and scale-up technologies for capturing CO_2 from new and existing industrial and power-producing plants

CO_2 Utilization
R&D and technologies to convert CO_2 to value-added products

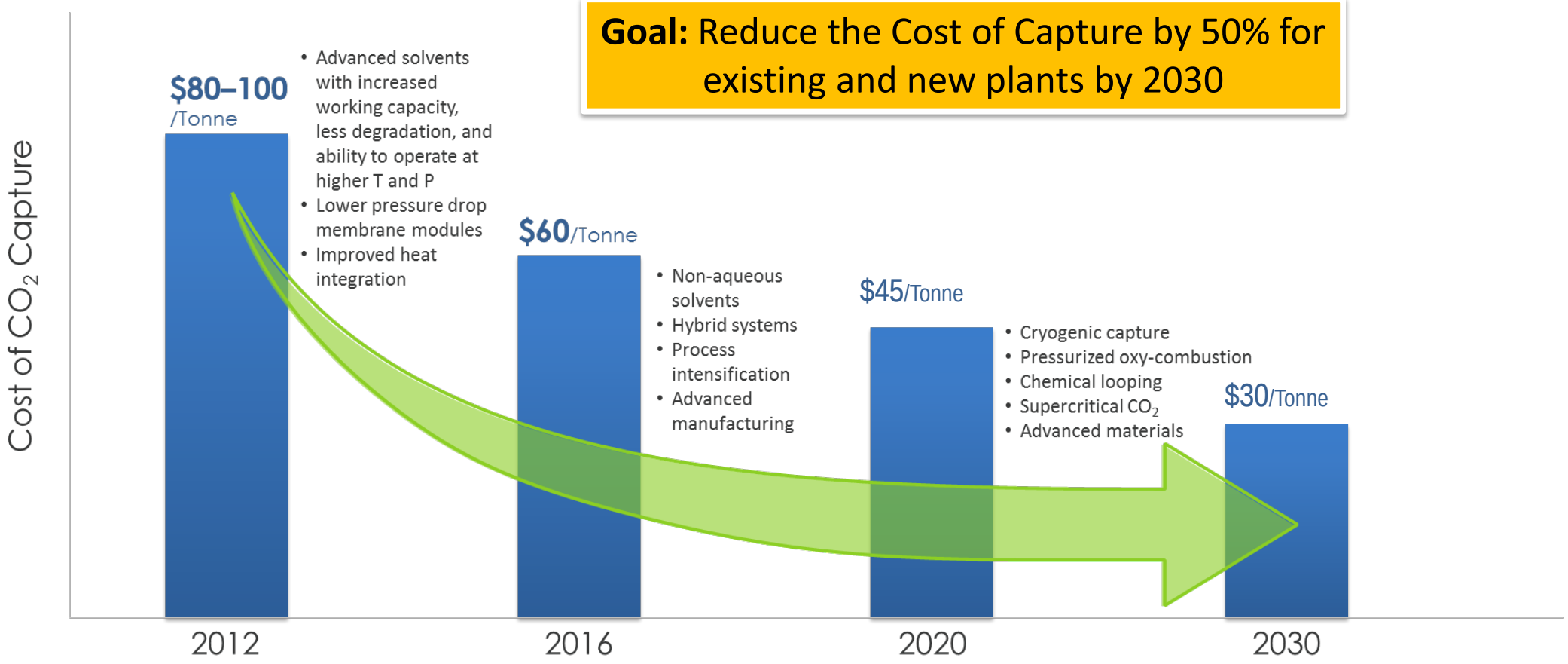


Carbon Storage
Safe, cost- effective, and permanent geologic storage of CO_2

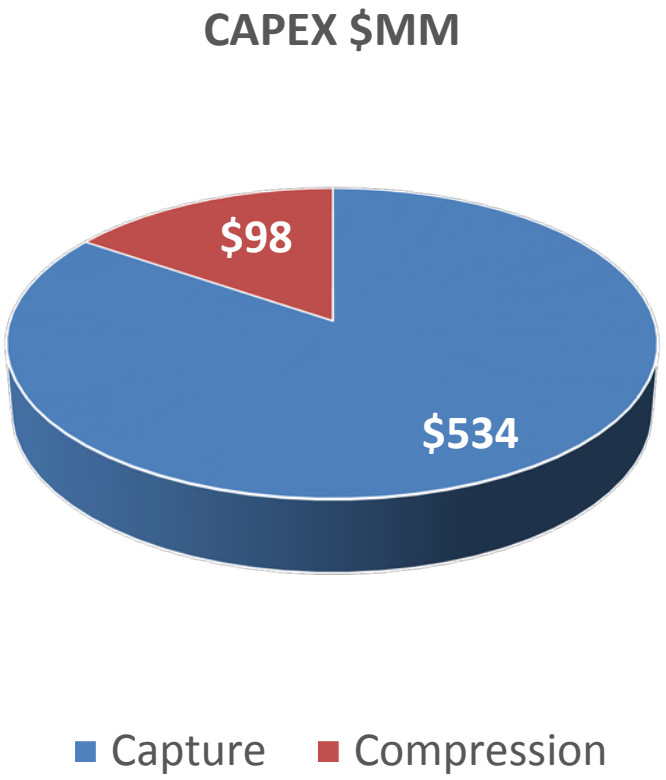


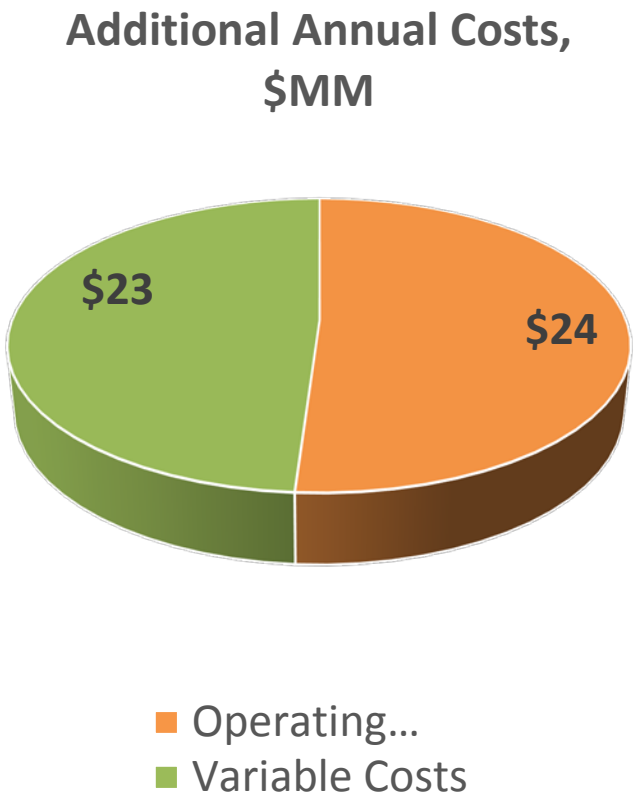
Carbon Capture Program Goals

Goal: Reduce the Cost of Capture by 50% for existing and new plants by 2030

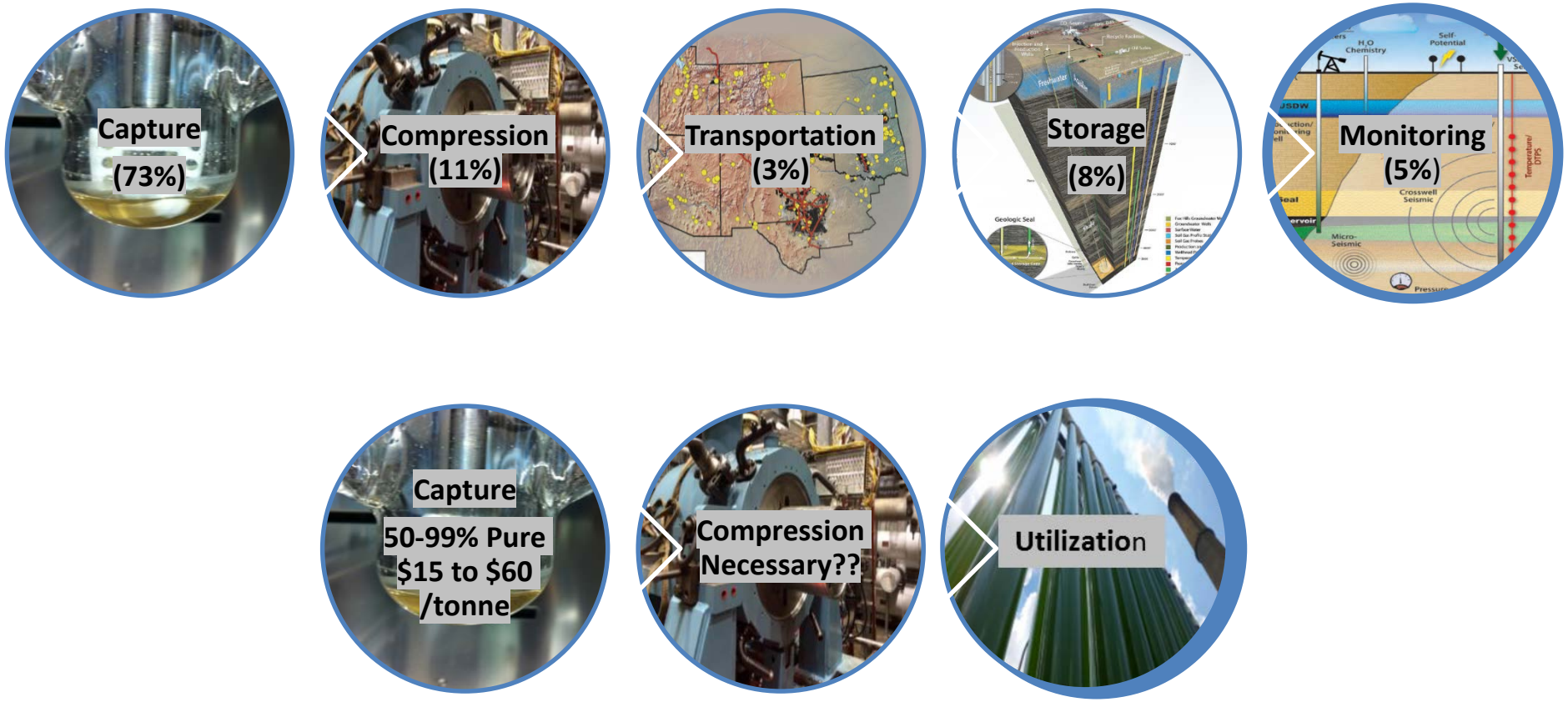


Cost of Capture and Compression





CCS and CCU Value Chains



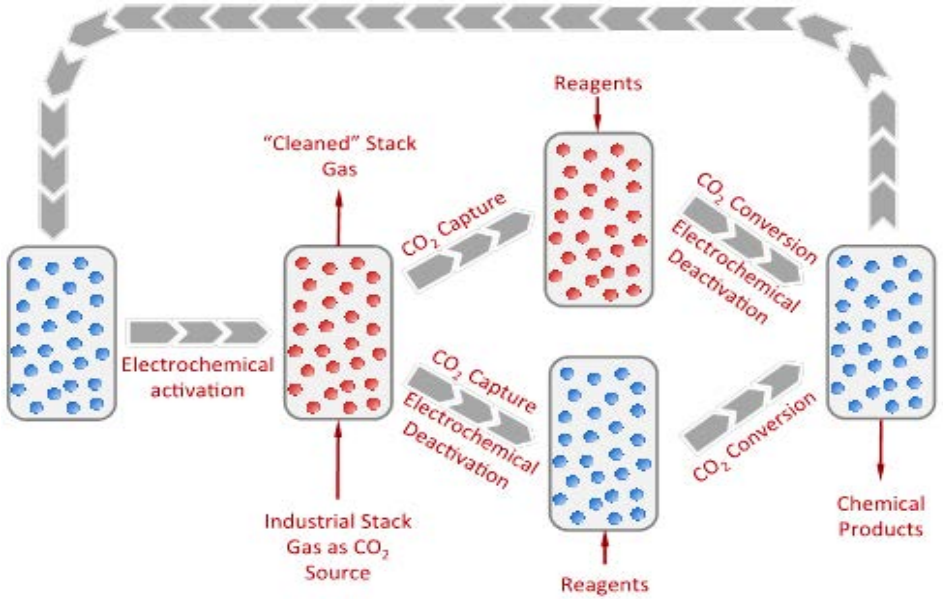
Source: NETL, Cost and Performance Baseline for Fossil Energy Plants, Revision 3, July 2015

Carbon Use & Reuse

Offset CO_2 capture costs + Fix CO_2 in stable products

Biological Capture & Conversion

Fuels & Chemicals



Mineralization & Cements

Policy Incentives for CCUS - 45Q tax credits

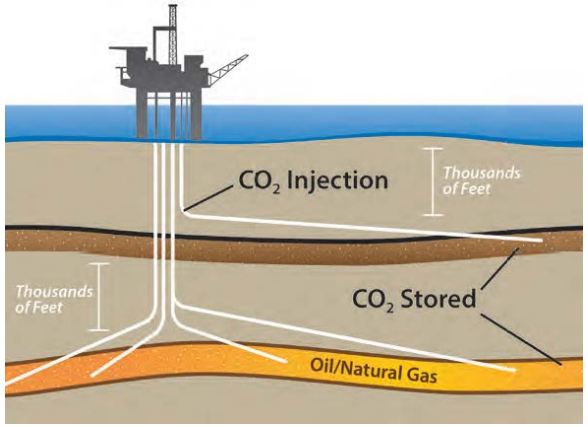
"Technology push" through R&D is matched with "market pull" through financial incentives

- Tax benefits defined in "45Q" for qualified CCUS projects have been available since 2008
- The February 2018 "Bipartisan Budget Act of 2018" extended and significantly expanded the tax benefits:
  - **Increased the credit amount**:
    $20/ton → up to $50/ton for saline storage, 10/ton → up to $35/ton for EOR
  - **Expanded the qualified carbon oxides** to include carbon monoxide (CO)
  - **Expanded qualified uses** to include CO_2 utilization other than enhanced oil or natural gas recovery
  - **Lowered the qualifying threshold** for the amount of CO_2 captured to allow more industries to participate in the program
  - **Increased the flexibility** to allow credit assignment to capture or disposal facility
  - **Removed the program cap**

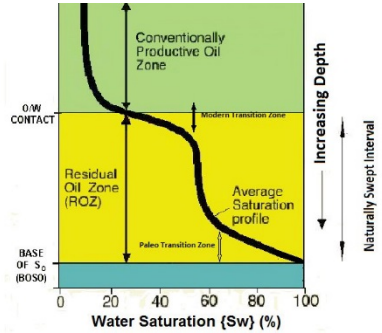
Regional Carbon Sequestration Partnerships (RCSPs)

CarbonSAFE

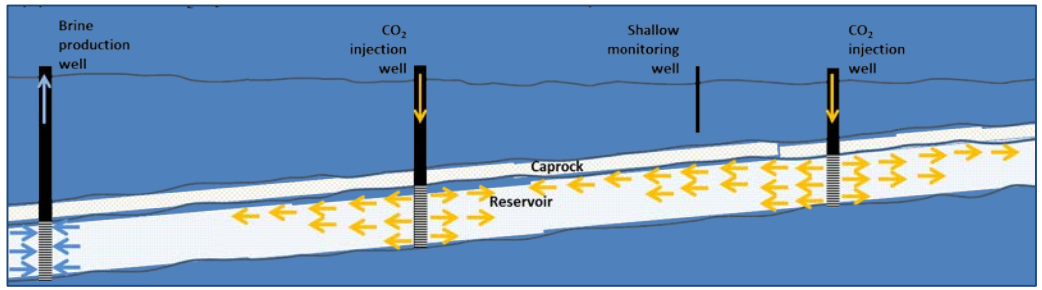
Offshore Storage



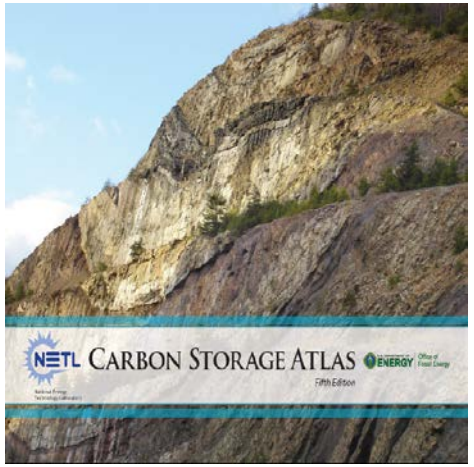
Unconventional EOR

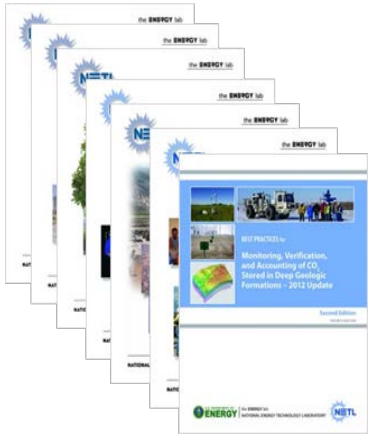


Brine Extraction Storage Tests (BEST)



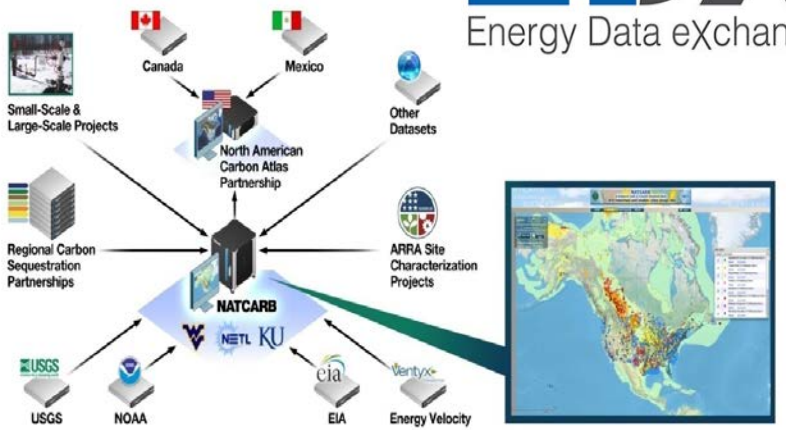
Knowledge Sharing Products





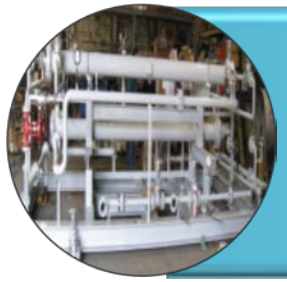
EDX
Energy Data eXchange

Worldwide CCS Project Database

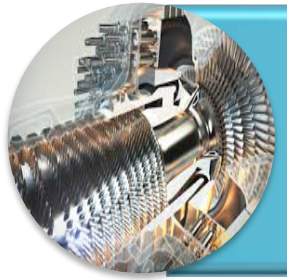


Products and resources publically available at: https://www.netl.doe.gov/research/coal/carbon-storage

Office of Clean Coal and Carbon Management – What we do



Carbon Capture, Utilization and Storage
R&D and scale-up technologies for capturing and using or storing CO_2 from new and existing industrial and power-producing plants



Advanced Energy Systems
Technologies that improve plant efficiency and performance, increase plant availability, and maintain the highest environmental standards

Cross Cutting Research and Systems Integration
Materials, sensors, and advanced computer systems for future power plants and energy systems, as well as testing and validating technologies into integrated systems

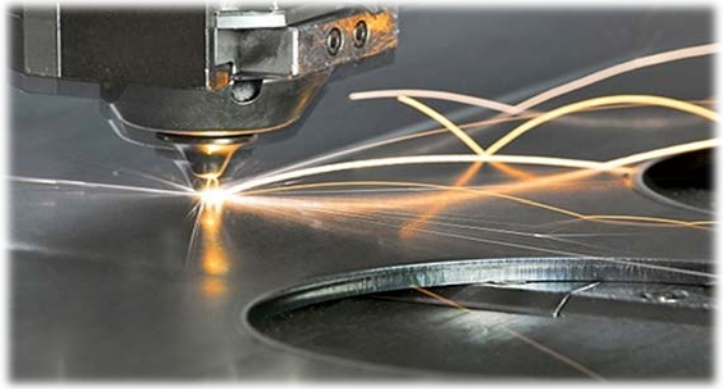
Improving the Existing and Future Coal Fleet

Upgrading the Existing Coal Fleet

- Advances and demonstrates technologies, such as topping cycles that can improved plant efficiencies (5%) and cycling capability—making the coal fleet more economical to operate
- Uses advanced materials and processes to maximize its efficiency and minimize emissions

Advancing the Coal Plant of the Future

- Small-scale (50 - 350 MW), modular capable of distributed generation
- Near-zero emissions
- High efficiency (40+%)
- Provides stable power that can also be flexibly dispatched to meet the needs of the grid



Elevating CCUS Internationally

Clean Energy Ministerial CCUS Initiative

Expand the spectrum of clean energy technologies under CEM to include CCUS

Create a sustained platform for the private sector, governments, and the investment community to engage and accelerate CCUS deployment

Facilitate identification of both near and longer-term investment opportunities to improve the business case for CCUS

Disseminate emerging CCUS policy, regulatory, and investment best practices as part of integrated clean energy systems


Thank you