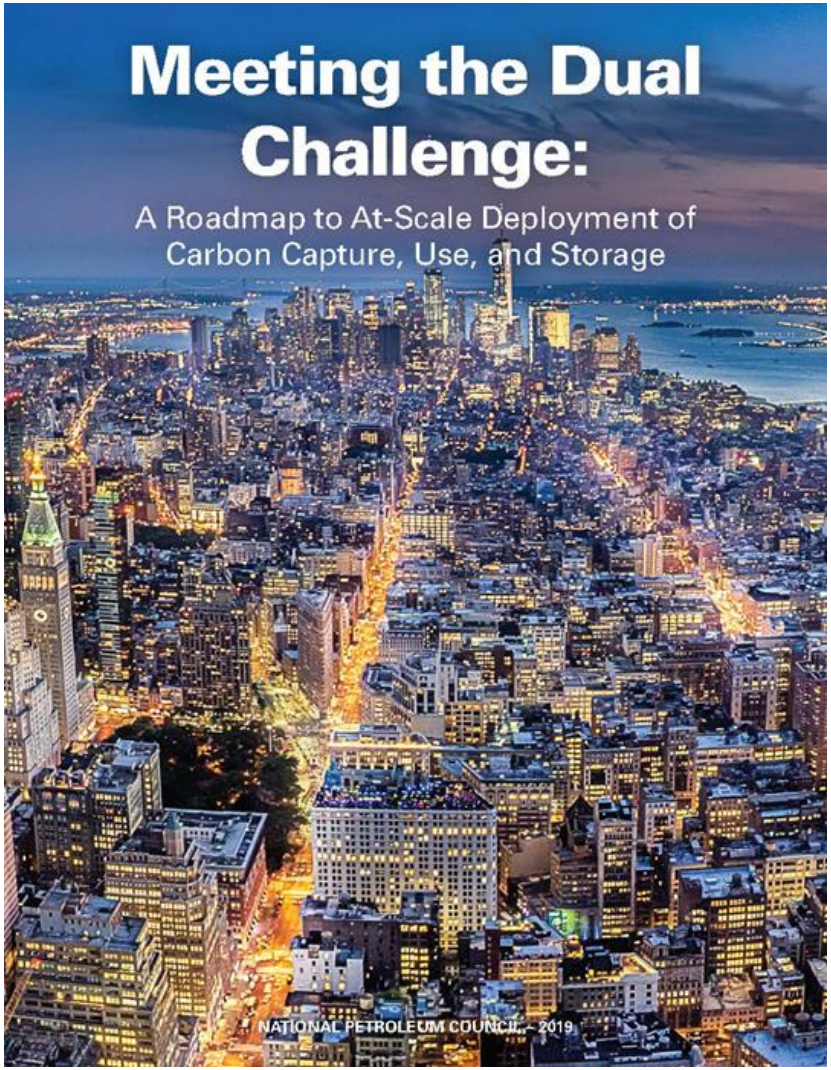
National Petroleum Council

Meeting the Dual Challenge:

A Roadmap to At-Scale Deployment of Carbon Capture, Use, and Storage

www.dualchallenge.npc.org



Department of Energy
CCUS Deployment Training Meeting
January 24, 2020

Susan Blevins, ExxonMobil
Jane Stricker, BP

In September 2017

The Secretary of Energy requested the NPC conduct a study

- Define the potential pathways for integrating CCUS at scale into the energy and industrial marketplace.
- The Secretary asked the Council to consider:
  - Technology options and readiness
  - Market dynamics, economics and financing
  - Cross-industry integration and infrastructure
  - Policy, legal and regulatory issues
  - Environmental footprint
  - Public acceptance

The request asked five key questions

1. What are **U.S. and global future energy demand outlooks**, and the environmental benefits from the application of CCUS technologies?

2. What **R&D, technology, infrastructure, and economic barriers** must be overcome to deploy CCUS at scale?

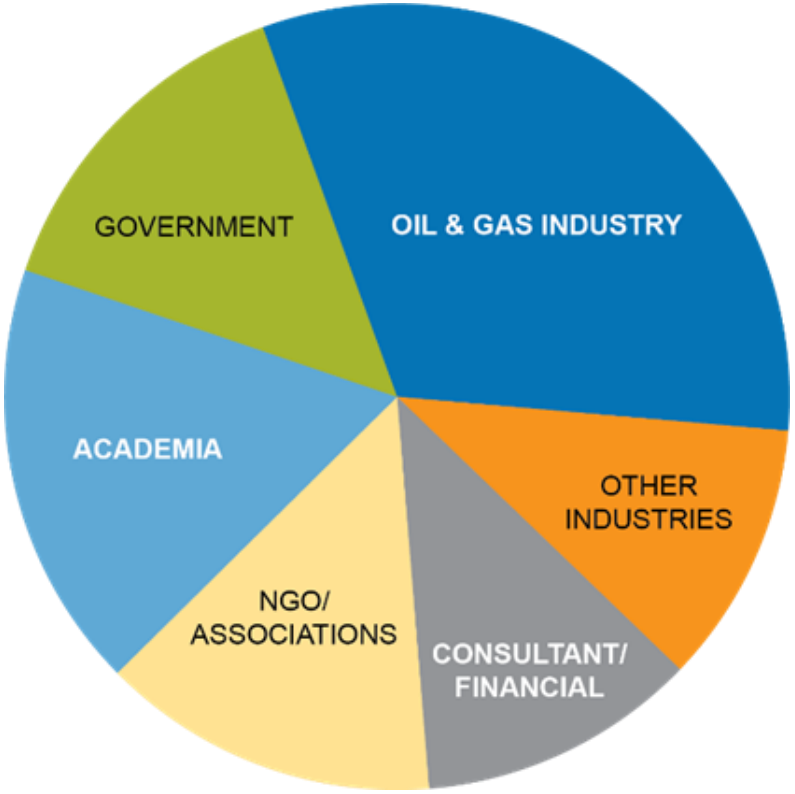
3. How should **success be defined**?

4. What actions can be taken to **establish a framework that guides public policy and stimulates private-sector investment** to advance the deployment of CCUS?

5. What **regulatory, legal, liability or other issues should be addressed** to progress CCUS investment and to enable the U.S. to be global technology leaders?

Study participation

- Over two-thirds of study participants came from outside the oil and gas industry.
- The Coordinating Subcommittee has membership of 22 individuals representing upstream and downstream oil & gas, LNG, biofuels, power, NGO, and state and federal governments.
- Overall study team included over 300 participants from more than 110 different organizations and 17 international members.
- National Coal Council participation is represented through overlap of 21 organizations.



CCUS deployment at scale

Will mean:

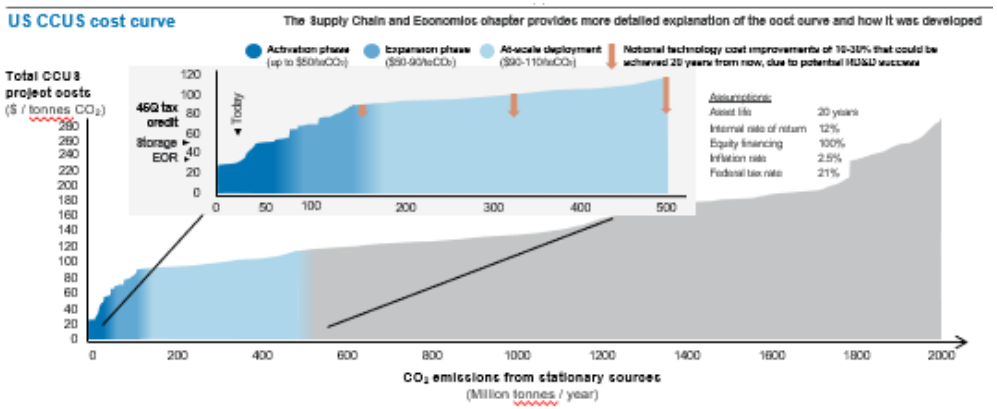
- Moving from 25 to **500 Million tonnes per annum** of CCUS capacity
- Infrastructure buildout equivalent of **13 million barrels per day** capacity
- Incremental investment of **$680 billion**
- Support for **236,000 U.S. jobs** and **GDP of $21 billion** annually

Will require:

- Improved **policies**, **incentives**, **regulations** and **legislation**
- Broad-based **innovation** and **technology** development
- Strong **collaboration** between **industry** and **government**
- Increased **understanding** and **confidence** in CCUS

Roadmap for CCUS deployment

- The letter from the Secretary included a request for a roadmap of actions needed to drive widespread deployment of CCUS in the U.S. over the next 25 years
- To develop the roadmap, a CCUS cost curve was developed:
  - Assessed the costs to capture, transport and store the largest 80% of U.S. stationary source CO_2 emissions – source, industry, and location specific and use transparent assumptions
  - Plotted the cost to capture, store and transport one tonne of CO2 against the volume of CO2 abatement possible – identifies the level of value (incentives, revenue, etc.) needed to enable deployment.



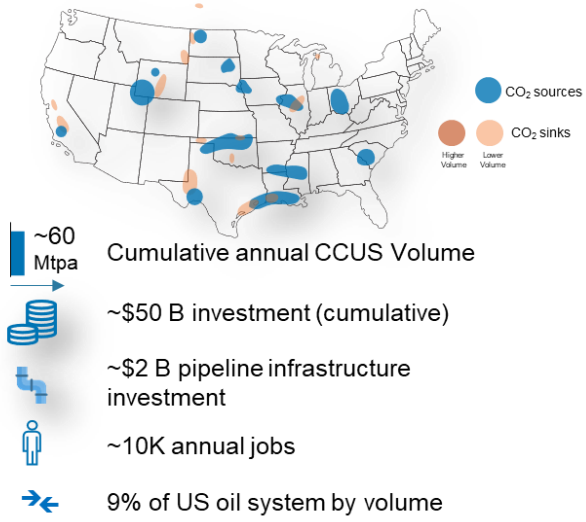
- The roadmap details recommendations in four pathways – financial incentives, regulatory frameworks, technology and capability, and stakeholder engagement and across three phases – activation, expansion and at-scale, designed to achieve widespread deployment.

Activation phase

Clarifying existing tax policy and regulations could activate an additional 25 to 40 million tons per annum (Mtpa) of CCUS, doubling existing U.S. capacity within the next 5 to 7 years. (No congressional action required)

Recommendations

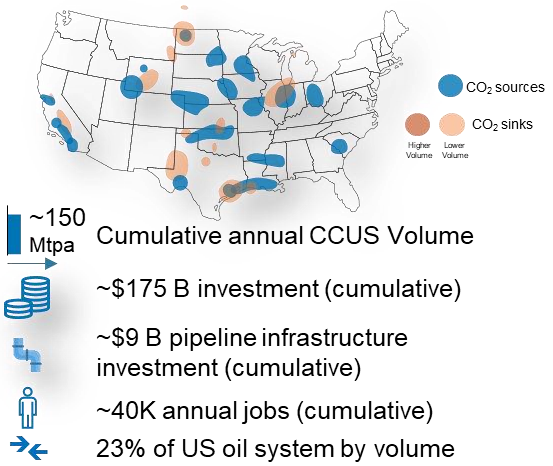
- IRS to clarify Section 45Q requirements for transferability, secure geologic storage, construction start date, and credit recapture
- DOI and states to establish a process for access to and use of pore space for geologic storage on federal and state lands
- EPA should issue a Class VI permit to drill within six months
- EPA, upon receipt of a completed well report, should review and make any necessary modifications, and issue a Class VI permit to inject within six months
- EPA to undertake planned periodic review of Class VI wells to align with site-specific risk and performance-based approach



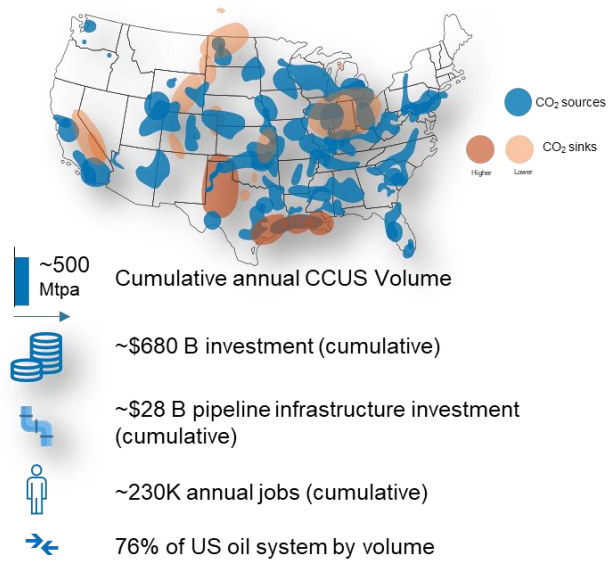
** note: 35mtpa is likely overstated based on current 12 year life of 45Q tax credit – the increase to 20 years does not come until Expansion phase*

Expansion and at-scale deployment phases

Extending and expanding current policies and developing a durable legal and regulatory framework could enable the next phase of CCUS projects (an additional 75-85 Mtpa) within the next 15 years.



Achieving CCUS deployment at scale, an additional 350-400 Mtpa, in the next 25 years will require substantially increased support driven by national policies.



Key messages

- CCUS refers to the complete supply chain needed to capture, transport and permanently use or store CO_2, eliminating it from the atmosphere.
- All credible future energy scenarios recognize that fossil fuels will remain part of the total energy mix for the next several decades.
- CCUS is essential to addressing the dual challenge of providing affordable, reliable energy to meet the world's growing demand while addressing the risks of climate change.
- The United States is the world leader in CCUS and uniquely positioned to deploy the technologies at scale.
- To achieve CCUS deployment at scale, the U.S. government will need to reduce uncertainty on existing incentives, establish adequate additional incentives, and implement a durable regulatory and legal environment that drives industry investment.
- A commitment to CCUS must include a commitment to continued research, development, and demonstration.
- At-scale CCUS deployment could create a new industry, driving job creation and economic growth across the nation.
- Increasing understanding and confidence in CCUS as safe and reliable is essential for public and policy stakeholder support.

Back-up

NPC study report

Executive Summary (Volume 1)

- Transmittal letter
- Report outline
- Preface
- Executive Summary, Roadmap and Recommendations

Appendices

A. Request Letter and NPC Description

B. Study Group Rosters

CCUS Deployment At-Scale (Volume 2)

- **Chapter 1:** The Role of CCUS in Future Energy Mix
- **Chapter 2:** CCUS Supply Chains & Economics
- **Chapter 3:** Policy, Regulatory & Legal Enablers
- **Chapter 4:** Stakeholder Engagement

Appendices

C. CCUS Project Summaries

D. Integrated Economic Analysis (ERM Memo)

CCUS Technologies (Volume 3)

- **Technology Introduction**
- **Chapter 5:** CO_2 Capture
- **Chapter 6:** CO_2 Transport
- **Chapter 7:** CO_2 Geologic Storage
- **Chapter 8:** Enhanced Oil Recovery
- **Chapter 9:** CO_2 Use

Appendices

E. Mature CO_2 Capture Technologies

F. Emerging CO_2 Capture Technologies

G. CO_2 EOR Case Studies

H. CO_2 EOR Economic Factors and Considerations

List of Topic Papers
Abbreviations, Units, Glossary

Findings and Recommendations

Full Report

The CCUS supply chain

CCUS technologies combine to reduce the level of CO_2 emitted to or remove CO_2 from the atmosphere to be transported to and converted into useful products or injected underground for safe, secure and permanent storage.