Webinars

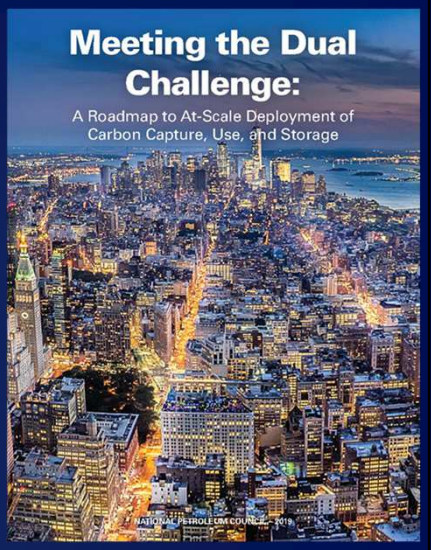
National Petroleum Council

Meeting the Dual Challenge: A Roadmap to At-Scale Deployment of Carbon Capture, Use, and Storage

https://dualchallenge.npc.org

SPE Webinar
January 29, 2020

Nigel Jenvey, Gaffney-Cline



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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

What is the National Petroleum Council (NPC)?

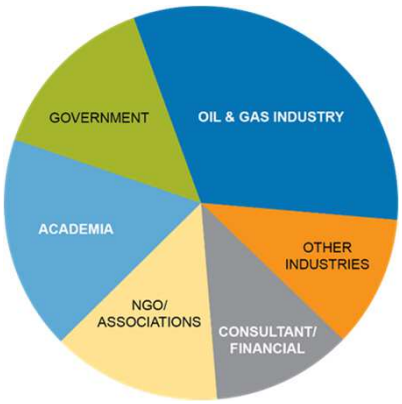
Origins	Continuation of WWII government / industry cooperation
Purpose	Sole purpose of NPC is to advise U.S. Secretary of Energy and Executive Branch by conducting studies at their request
Organization	A Federally chartered, self-funded Advisory Committee; Not an advocacy group, does not lobby
Membership	Broad and balanced. Approximately 200 members from all segments of the oil and gas industries and many outside interests
Study Participants	Diverse interests and expertise relating to the topic being addressed
Study Reports	All NPC advice is provided in reports approved by itys members and is available to the public. Reports can be viewed and downloaded at no cost from the NPC website – **www.npc.org**

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

- The Coordinating Subcommittee has membership of 22 individuals representing upstream and downstream oil & gas, LNG, biofuels, power, EPC, NGO, and state and federal governments.
- The overall study team is currently composed of over 300 participants from more than 110 different organizations and includes 17 international members.
- National Coal Council participation is represented through overlap of 21 organizations.



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

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

CCUS deployment at scale

Will mean:

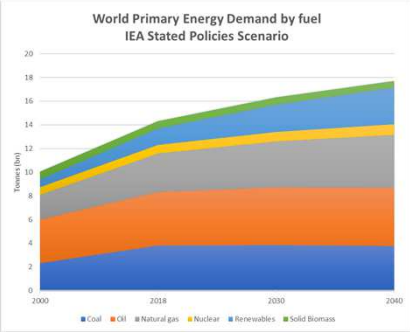
- Moving from 25 to **500 Million tonnes per annum** of CCUS capacity
- Infrastructure buildout equivalent of **13 million barrels per day** capacity
- Incremental investment of **$680 billion**
- Support for **236,000 U.S. jobs** and **GDP of $21 billion** annually

Will require:

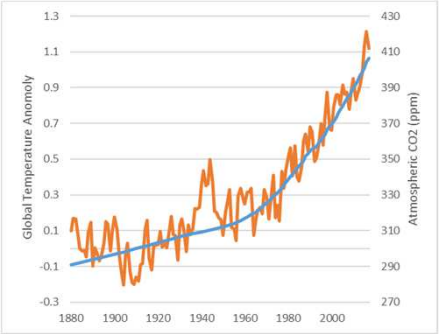
- Improved **policies**, **incentives**, **regulations** and **legislation**
- Broad-based **innovation** and **technology** development
- Strong **collaboration** between **industry** and **government**
- Increased **understanding** and **confidence** in CCUS

Understanding the dual challenge

The world faces a dual challenge of providing affordable, reliable energy while addressing the risks of climate change.



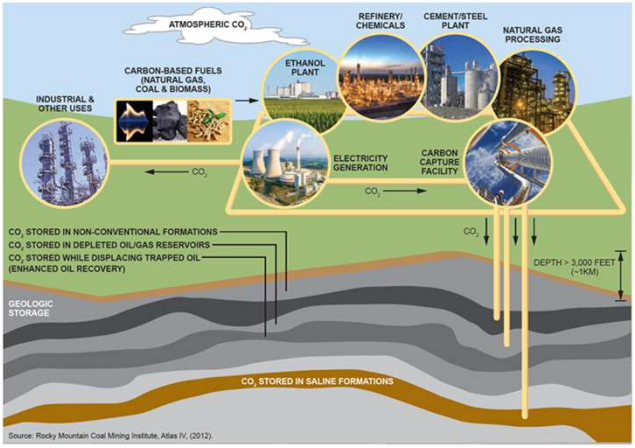
Over the next two decades, global population and GPD growth will drive continued increase in global energy demand



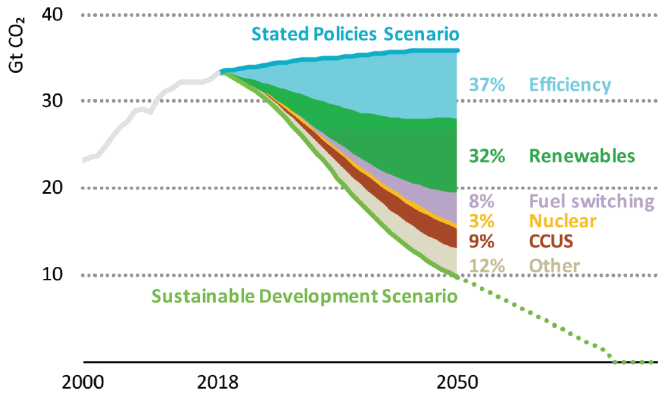
At the same time, the need to address rising carbon dioxide (CO_2) emissions continues to grow

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.



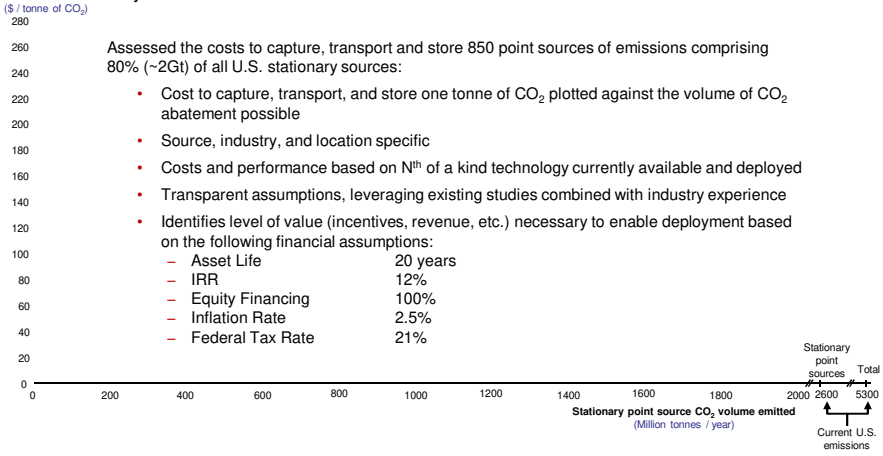
CCUS as part of a clean energy portfolio



IEA analysis demonstrates the critical role of CCUS in a clean energy technology portfolio (IEA, 2019)

CCUS cost assessment: methodology

U.S. CCUS Costs by Point Source
($ / tonne of CO_2)



Assessed the costs to capture, transport and store 850 point sources of emissions comprising 80% (~2Gt) of all U.S. stationary sources:

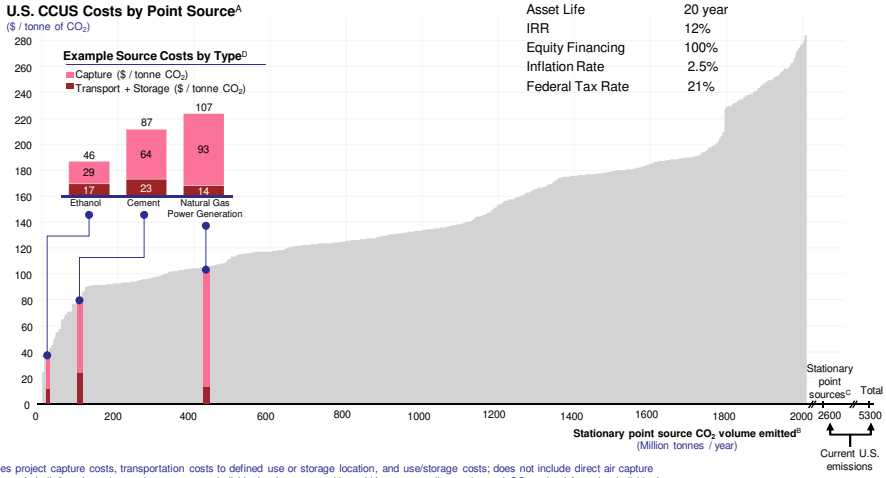
- Cost to capture, transport, and store one tonne of CO_2 plotted against the volume of CO_2 abatement possible
- Source, industry, and location specific
- Costs and performance based on N^{th} of a kind technology currently available and deployed
- Transparent assumptions, leveraging existing studies combined with industry experience
- Identifies level of value (incentives, revenue, etc.) necessary to enable deployment based on the following financial assumptions:
  - Asset Life 20 years
  - IRR 12%
  - Equity Financing 100%
  - Inflation Rate 2.5%
  - Federal Tax Rate 21%

CCUS cost assessment: methodology

U.S. CCUS Costs by Point Source[A]
($ / tonne of CO_2)

Financial Assumptions

Asset Life	20 year
IRR	12%
Equity Financing	100%
Inflation Rate	2.5%
Federal Tax Rate	21%

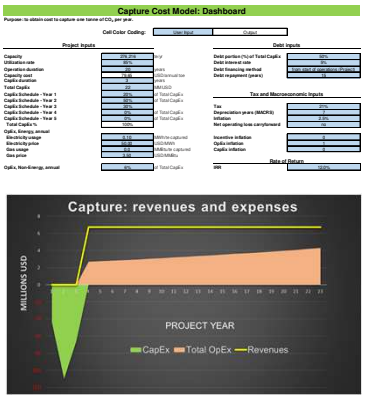


A Includes project capture costs, transportation costs to defined use or storage location, and use/storage costs; does not include direct air capture
B This curve is built from bars that each represent an individual point source with a width corresponding to the total CO_2 emitted from that individual source
C Total point sources include ~600 MTPA of point sources emissions without characterized CCUS costs
D Widths of bars are illustrative and not indicative of volumes associated with each source

CCUS cost assessment: public online tool

To provide a useful public resource and ensure transparency of the work, a cost assessment tool will be hosted by Gaffney, Cline & Associates and will be available in late January/early Fenbruary.

- **Registration page www.gaffney-cline-focus.com/npc-ccus-cost-assessment-tool**



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.

Recommendations

Agency Action & Rulemaking:

- IRS/Treasury to clarify Section 45Q
- DOI and states to establish a process for access to and use of pore space
- EPA should shorten period of Class VI permit process
- EPA to review Class VI permit process to be site-specific risk and performance-based

~60 Mtpa Cumulative annual CCUS Volume

~$50 B investment (cumulative)

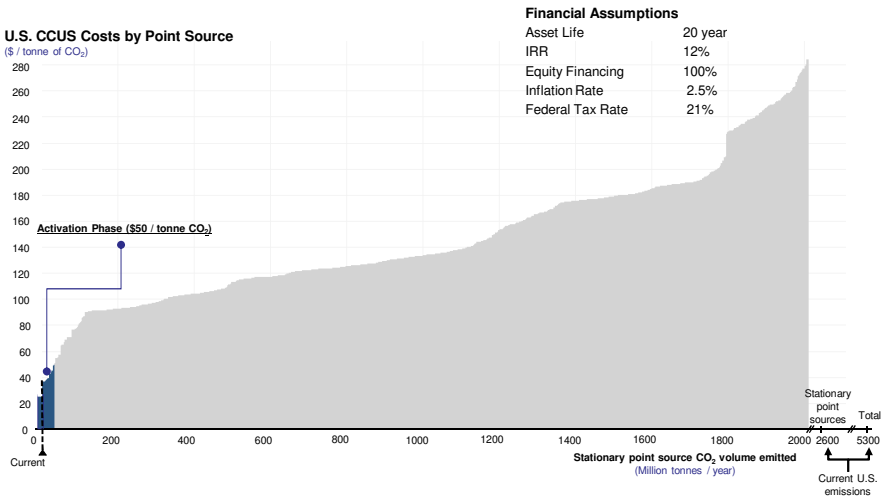
~$2 B pipeline infrastructure investment

~10K annual jobs

9% of US oil system by volume

** note: 25-40 mtpa is likely overstated based on current 12 year life of 45Q tax credit – the increase to 20 years does not come until Expansion phase*

Activation phase



Expansion phase

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.

Recommendations

Congress to:

- Amend 45Q
- Expand access to Section 48 tax credits
- Expand use of MLPs, private activity bonds, and TIFIA eligibility/funding
- Increase funding to support well permitting and timely reviews
- Allow geologic storage in federal waters from all CO_2 sources

Agencies to:

- DOE & DOI to implement process for pore space access
- DOE to create CO_2 pipeline working group for development of large scale CO_2 pipeline infrastructure
- DOE to convene stakeholder forum to address geologic storage long-term liabilities
- State policymakers enable access to pore space on private lands

~150 Mtpa Cumulative annual CCUS Volume

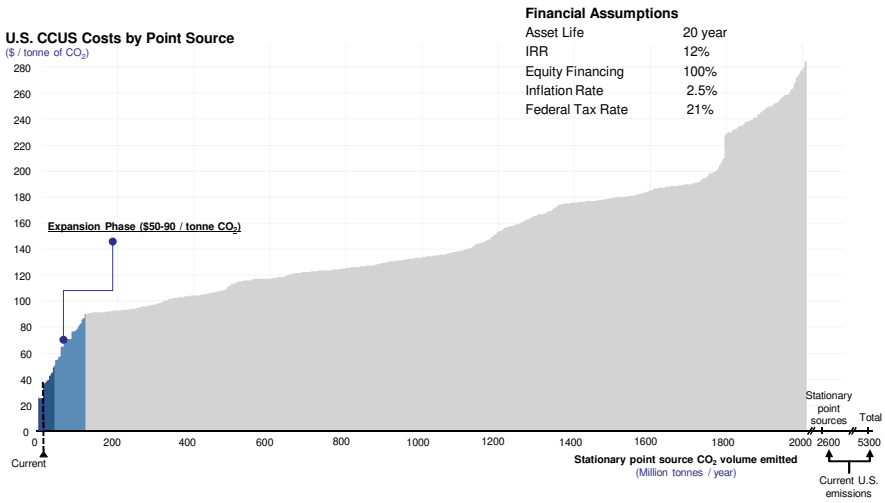
~$175 B investment (cumulative)

~$9 B pipeline infrastructure investment (cumulative)

~40K annual jobs (cumulative)

23% of US oil system by volume

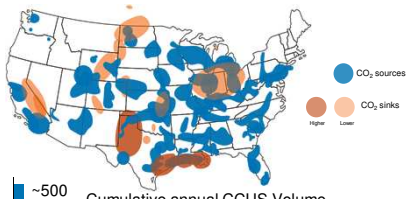
Expansion phase



At-scale deployment phase

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

Recommendation:
To achieve at-scale deployment, congressional action should be taken to implement economic policies amounting to about $110/tonne. The evaluation of those policies should occur concurrently with the expansion phase.



~500 Mtpa Cumulative annual CCUS Volume

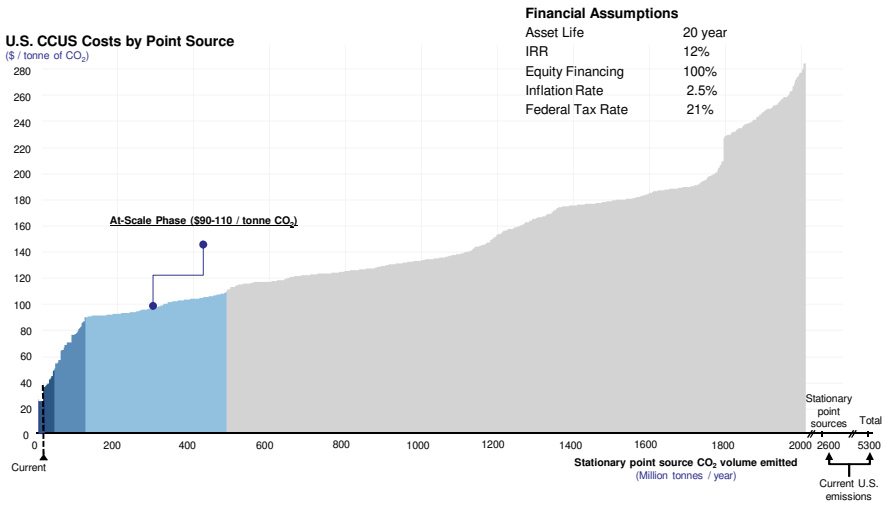
~$680 B investment (cumulative)

~$28 B pipeline infrastructure investment (cumulative)

~230K annual jobs (cumulative)

76% of US oil system by volume

At-scale deployment phase



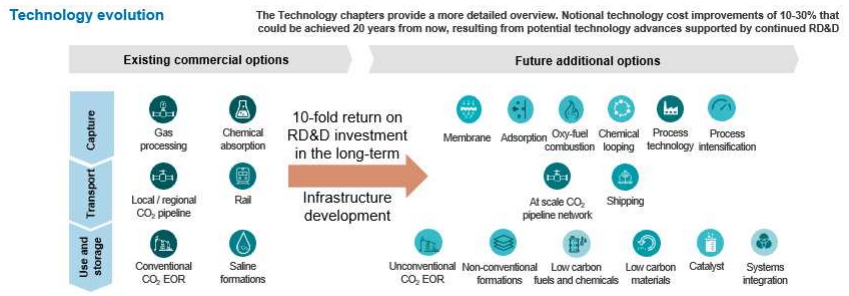
CCUS technologies

Title	Lead Authors	Key Sections
CO_2 Capture	John Northington Jennifer Wilcox	• Capture process • Technology types and maturity • Opportunities by sector • Capture cost drivers • Research and development priorities
CO_2 Transport	Dan Cole	• Current transport technologies • Existing U.S. CO_2 pipeline network • Role of transport in widespread CCUS deployment
CO_2 Geologic Storage	Richard Esposito Sally Benson	• Description of CO_2 geologic storage • Commercial scale experience and enablers • Options for CO_2 storage and capacity potential • Research and development priorities
CO_2 Enhanced Oil Recovery	William Barrett	• EOR technology experience and maturity • Conventional vs. non-conventional EOR • EOR capacity potential, near- and long-term • Research and development priorities
CO_2 Use	Will Morris Alissa Park	• CO_2 use technologies, pathways and products • Relative experience and maturity • Opportunities and challenges • Research and development priorities

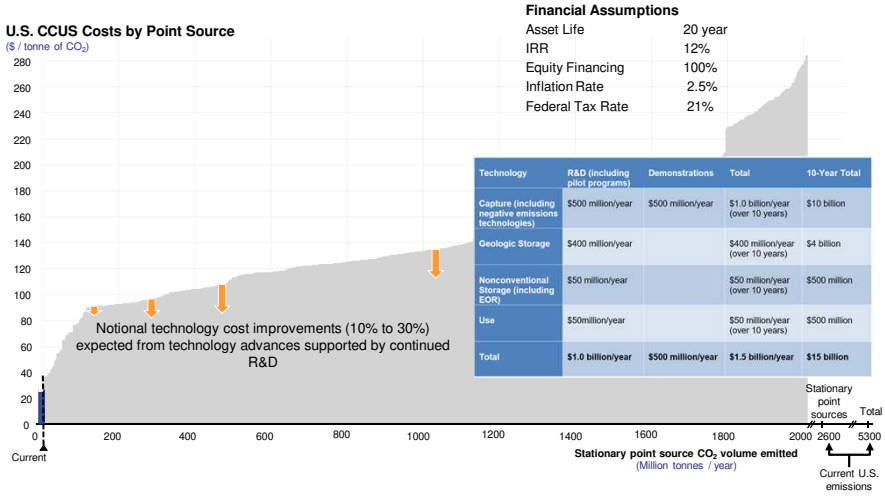
Critical role of RD&D investment

Study describes the evolution of CCUS technologies across the supply chain and builds the case for continued investment in RD&D to achieve long-term cost and performance improvements and advance alternatives beyond currently deployed technology.

Recommendation: Congress should appropriate $15 billion of RD&D funding over the next 10 years to enable the continued development of new and emerging CCUS technologies and demonstration of existing technologies.



CCUS cost assessment: role of RD&D



Financial Assumptions

Asset Life	20 year
IRR	12%
Equity Financing	100%
Inflation Rate	2.5%
Federal Tax Rate	21%

Technology	R&D (including pilot programs)	Demonstrations	Total	10-Year Total
Capture (including negative emissions technologies)	$500 million/year	$500 million/year	$1.0 billion/year (over 10 years)	$10 billion
Geologic Storage	$400 million/year		$400 million/year (over 10 years)	$4 billion
Nonconventional Storage (including EOR)	$50 million/year		$50 million/year (over 10 years)	$500 million
Use	$50million/year		$50 million/year (over 10 years)	$500 million
Total	**$1.0 billion/year**	**$500 million/year**	**$1.5 billion/year**	**$15 billion**

Public and industry engagement

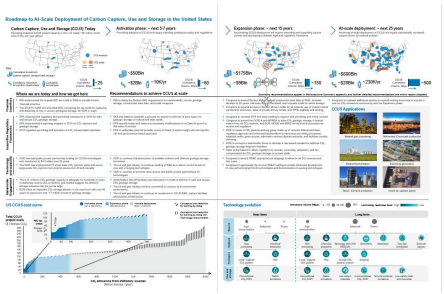
Increasing understanding and confidence in CCUS as a safe and reliable technology is essential for public and policy stakeholder support. The oil and natural gas industry is uniquely positioned to lead CCUS deployment due to its relevant expertise, capability, and resources.

Recommendations:

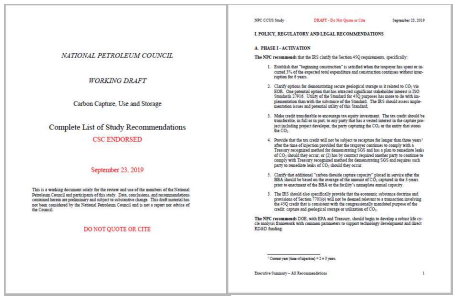
- Industry, governments and NGOs should work together to build confidence that CCUS is safe, secure, and critical to managing emissions.
- The oil and natural gas industry should remain committed to improving its environmental performance.
- The oil and natural gas industry should continue to investment in CCUS, specifically:
  - Current and next generation capture facilities
  - Development of new technologies
  - CO_2 pipeline infrastructure needed for EOR and saline storage
  - R&D for advancing CCUS technologies

Roadmap and full list of recommendations

Roadmap to At-Scale CCUS Deployment



All Study Recommendations



NATIONAL PETROLEUM COUNCIL

WORKING DRAFT

Carbon Capture, Use and Storage

Complete List of Study Recommendations

CSC ENDORSED

September 23, 2019

This is a working document solely for the review and use of the members of the National Petroleum Council and participants of its study. Data, conclusions, and recommendations contained herein are preliminary and subject to substantive change. This draft material has not been considered by the National Petroleum Council and is not a report nor advice of the Council.

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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.

Questions?

Webinars

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