HB 50 Carbon Capture, Utilization, and Storage

House Resources Committee

Presented by:
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February 10, 2023

CCUS: Introduction

What is it?

- Carbon Capture, Utilization, and Storage (CCUS) is a process to capture carbon dioxide (CO_2), either from industrial processes or directly from the atmosphere, for the purpose of utilizing it for other activities or storing it underground in geologic formations

Why Now?

- The CCUS market is rapidly expanding, both within the U.S. and worldwide
- Federal legislation in the prior 18 months has included direct grants and tax incentives for CCUS, increasing industry interest, including outreach to the Department of Natural Resources (DNR)
- Federal funds are available for states seeking Class VI well permitting, showing federal support for state primacy
- Protracted project timelines and milestone requirements in the tax credit structure necessitate prompt action
- Sets the stage for potentiating continued development of Alaska's oil resources, and potential major gas development

What is the potential in Alaska?

- Alaska's depleted oil & gas fields, saline aquifers, and deep coal seams have significant CO_2 storage potential
- Alaska has important competitive advantages – we own the pore space & we know the reservoirs
- Fifteen other states have passed CCUS omnibus legislation that we have learned from

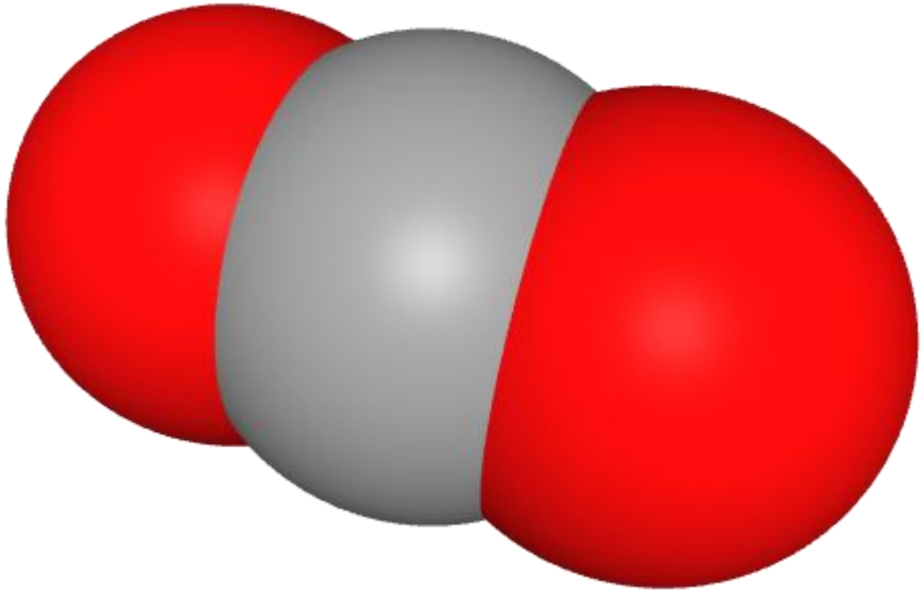
OUTLINE

1. What is CCUS?
2. Why is CCUS good for Alaska?
3. Can CCUS Work in Alaska?
4. How Was This Legislation Developed?
5. What Does This Legislation Do?

WHAT IS CCUS?

What is CCUS?

- **C**arbon
- **C**apture
- **U**tilization
- **S**torage

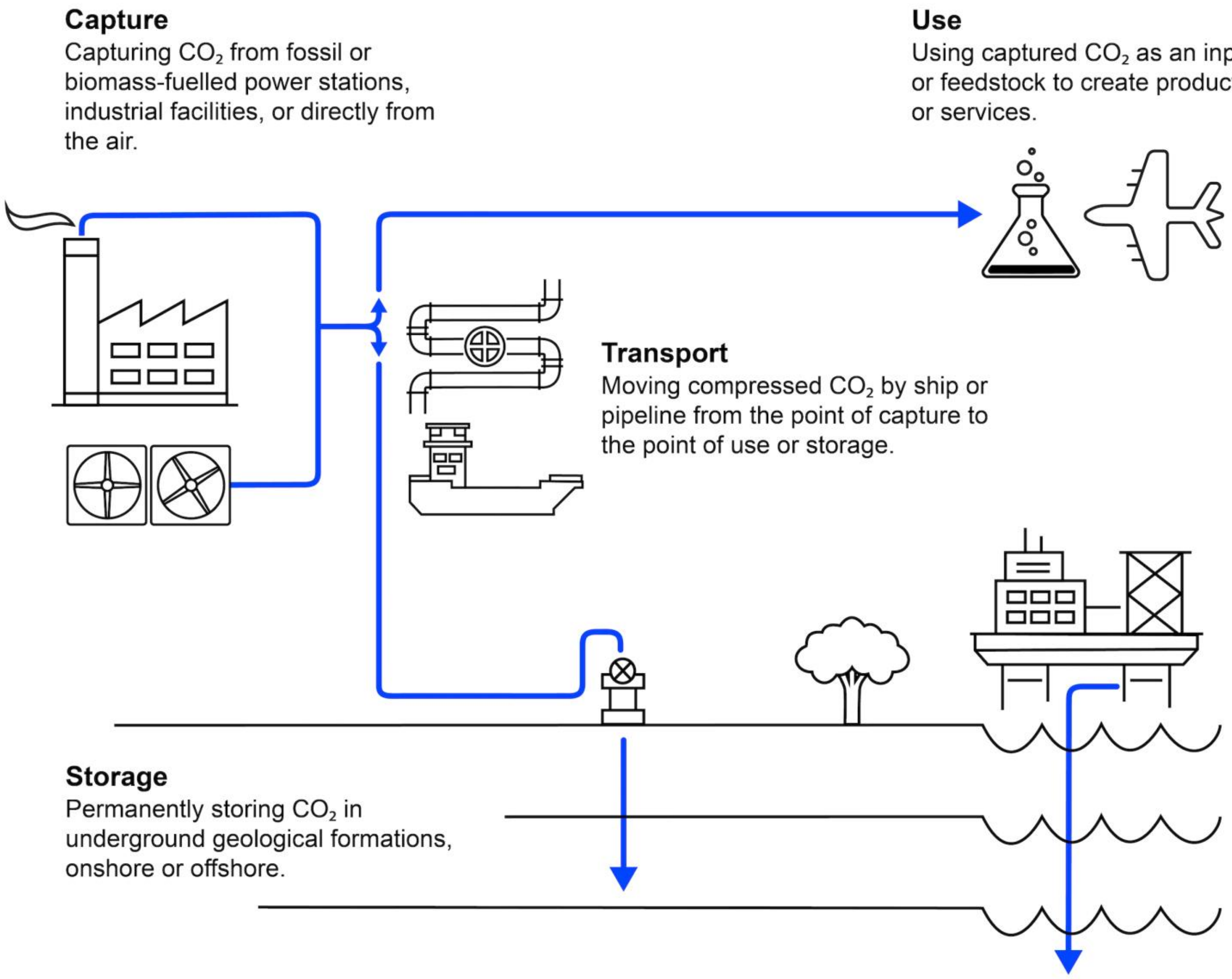


What is CCUS?

Carbon capture, utilization and storage (CCUS) is a process that captures carbon dioxide emissions from industrial processes, point sources like coal-fired power plants, or from the air and either reuses or stores it so it will not enter the atmosphere.

Carbon dioxide storage in geologic formations includes oil and gas reservoirs, unmineable coal seams and deep saline reservoirs -- structures that have stored crude oil, natural gas, brine and carbon dioxide over millions of years.

What is CCUS?



Capture
Capturing CO_2 from fossil or biomass-fuelled power stations, industrial facilities, or directly from the air.
Use
Using captured CO_2 as an input or feedstock to create products or services.
Transport
Moving compressed CO_2 by ship or pipeline from the point of capture to the point of use or storage.
Storage
Permanently storing CO_2 in underground geological formations, onshore or offshore.

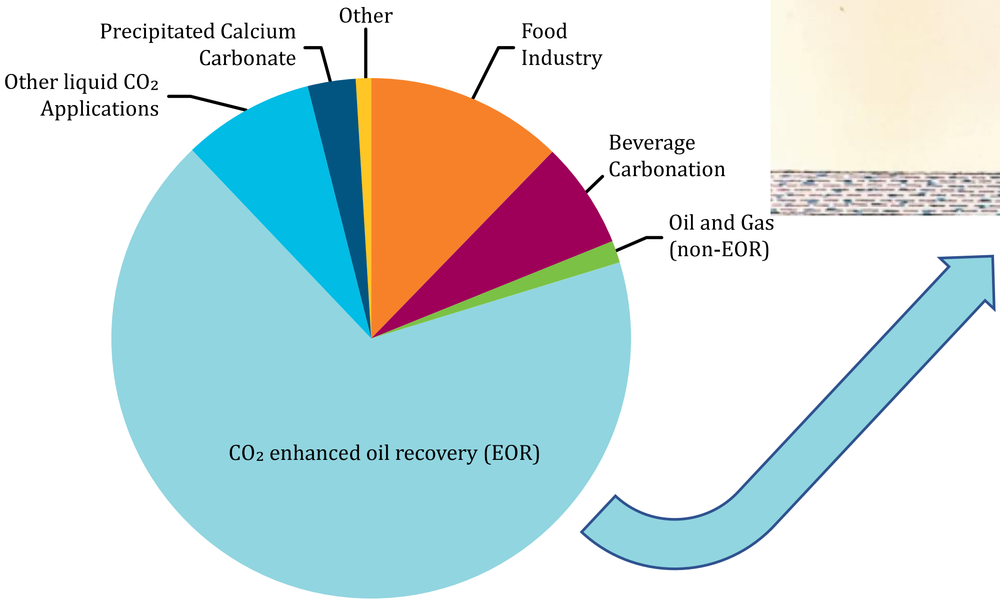
Capture

Myriad technologies in various stages of commercial development:

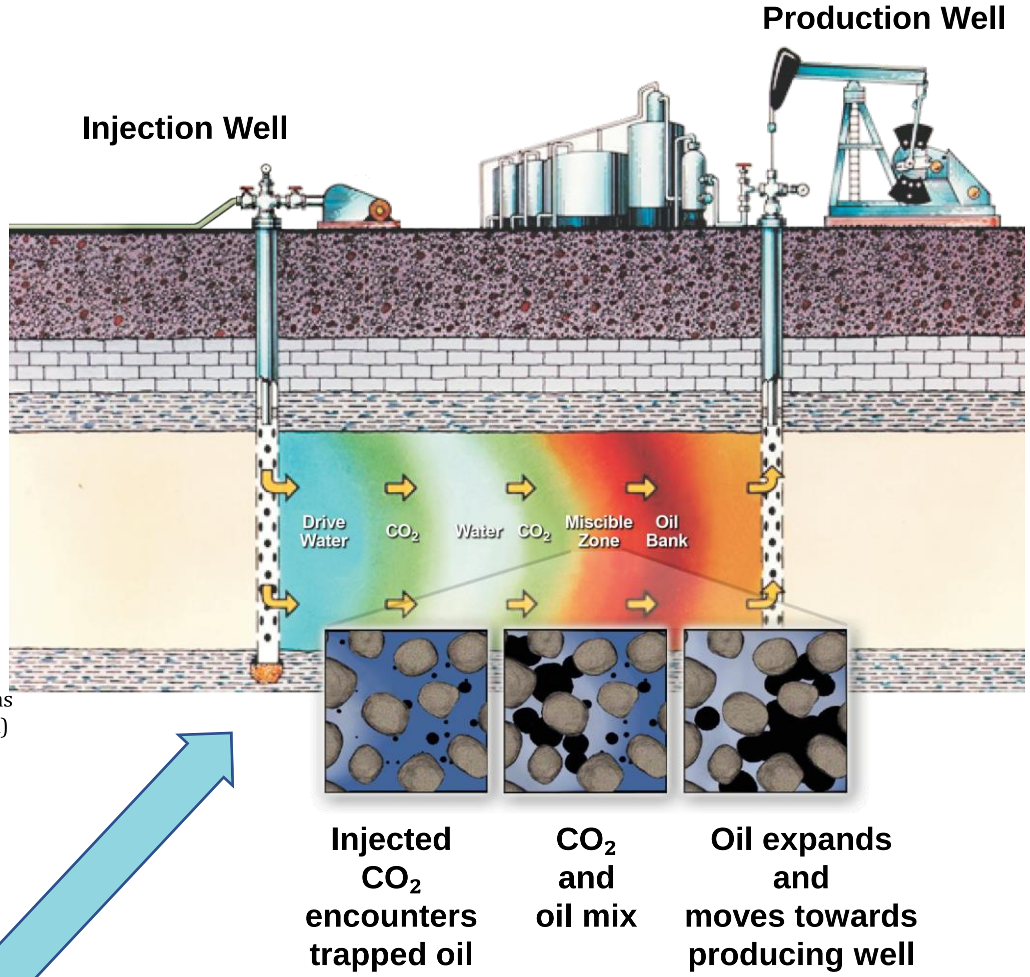
1. Pure stream carbon capture from certain industrial processes such as the production of methanol or ammonia or removing naturally-occurring carbon from natural gas
2. Capturing carbon dioxide following the combustion of fossil fuels, such as from a coal-fired power plant
3. Capturing carbon dioxide directly from the atmosphere

Utilization – Enhanced Oil Recovery

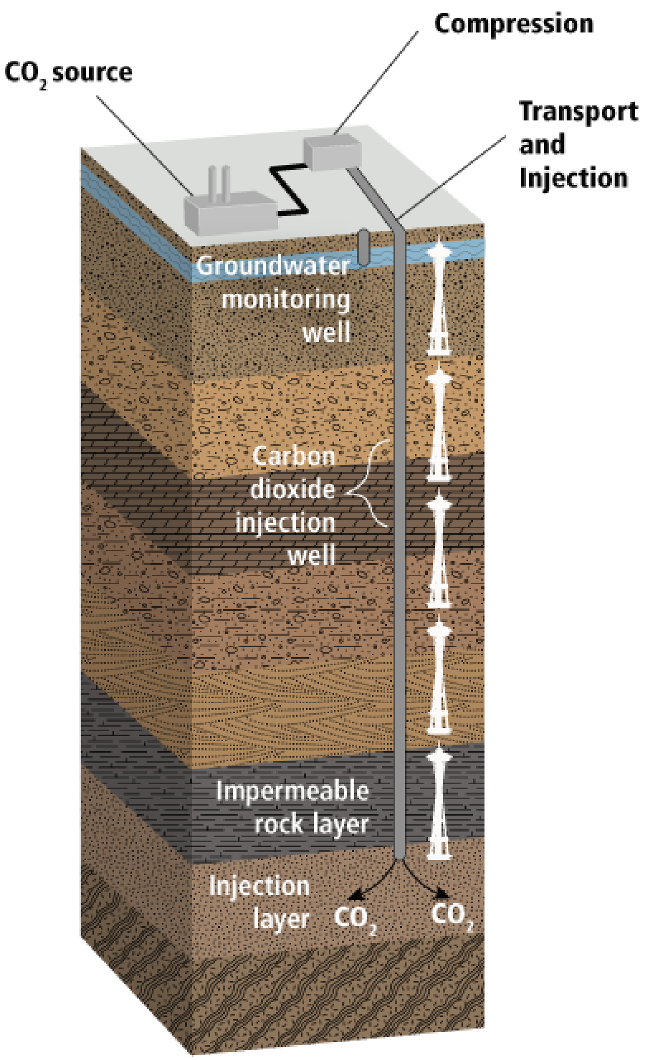
Enhanced Oil Recovery is allowed under existing authorities and lease agreements.



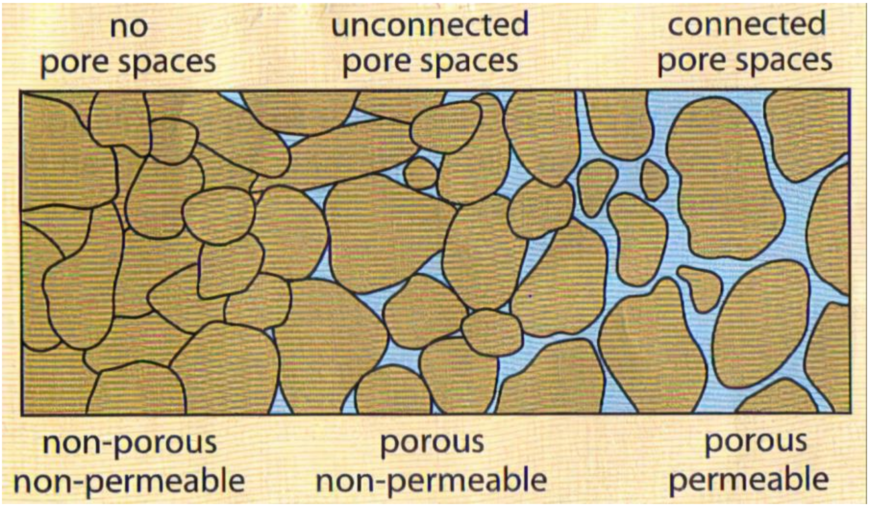
Approximate proportion of current CO_2 demand by end use



Storage – the primary focus of the bill



1. Depleted oil and gas reservoirs
2. Saline aquifers
3. Unmineable coal seams



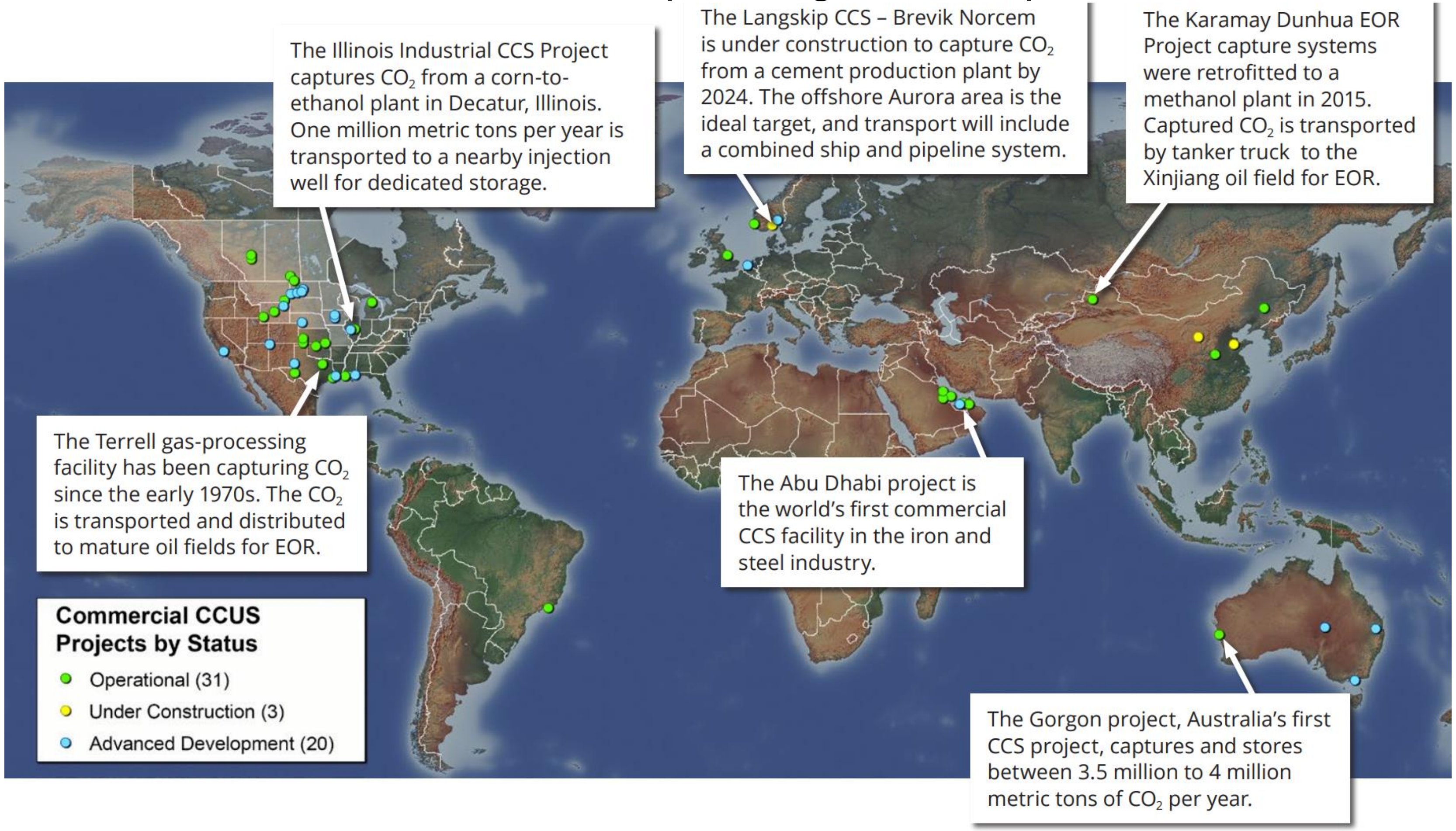
Why is CCUS Good for Alaska?

Why is CCUS Good for Alaska?

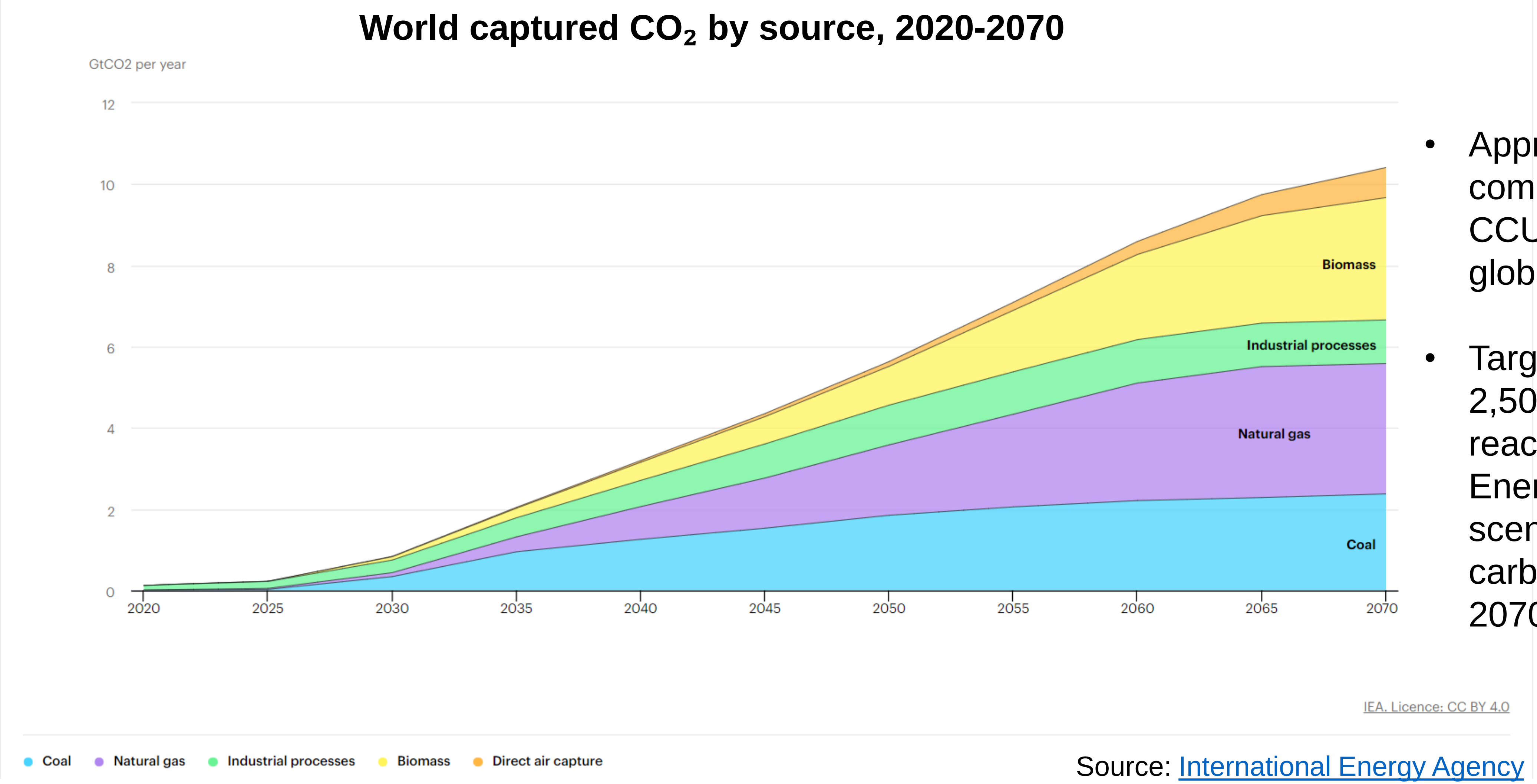
- **Bolster development of Alaska’s abundant oil and gas**
- **Federal incentives are driving investment in peer states**
- **Environmental, Social, and Governance (ESG) concerns driving capital to projects with carbon management options**
- **Alaska should participate in global uptick in CCUS projects**
- **Project timelines require the state to act promptly because of the federal incentives' deadlines**
- **Additional state revenue**

Global CCUS Projects

There is a growing trend of CCUS projects around the world as companies compete to provide oil and gas to competitive markets in foreign jurisdictions that have implemented carbon taxation and include "ESG" measurements in their corporate goals and performance



Market Potential



- Approximately 35 commercial CCUS facilities today globally
- Targeted growth: 2,500 facilities to reach International Energy Agency (IEA) scenario of net zero carbon emissions by 2070

Source: International Energy Agency

Federal Incentives

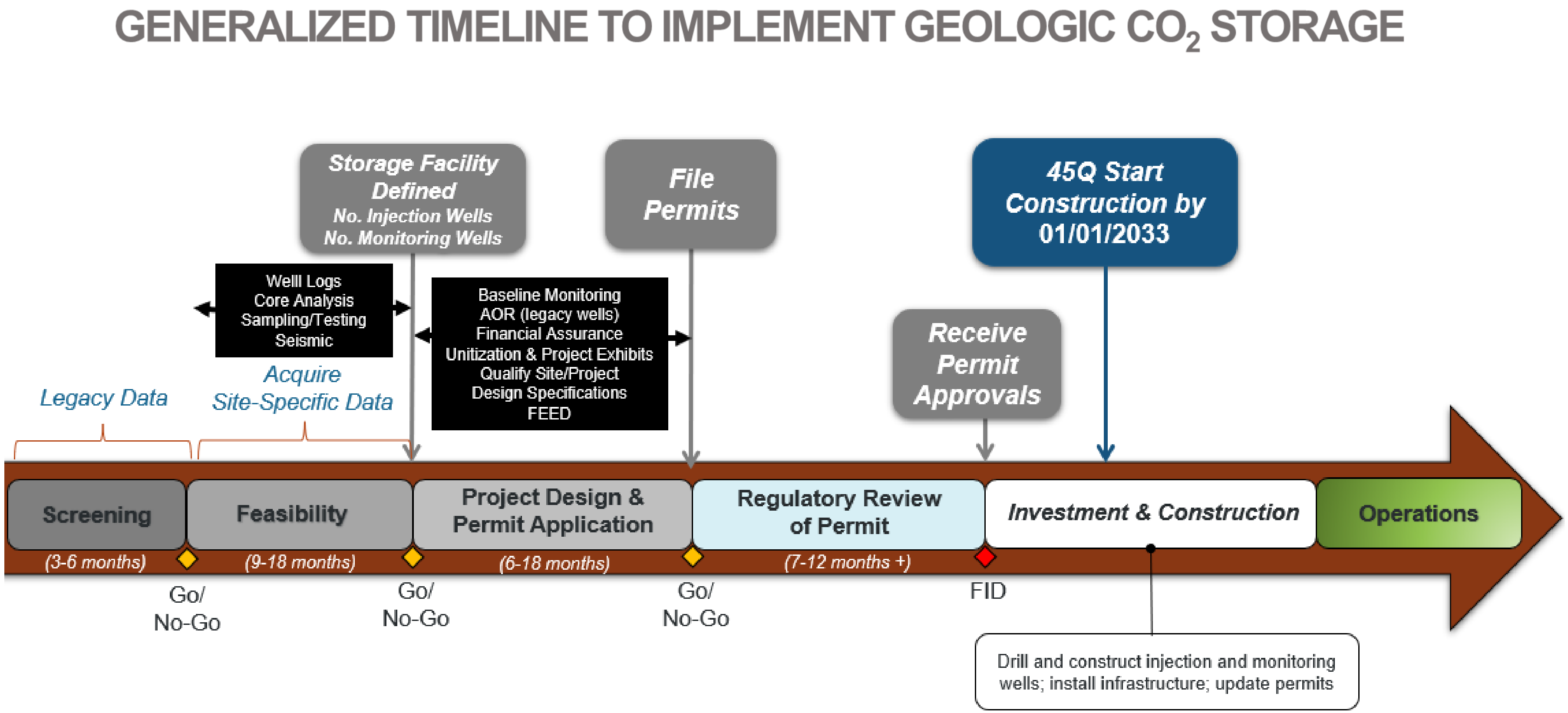
45Q (CCS) Tax Credit - Inflation Reduction Act Enhancements

- Deadline to start construction 1/1/2033
- $85/ton for CCUS from industrial facilities and power plants stored in geologic formations
- $60/ton for utilization of captured CO_2/CO for enhanced oil recovery (EOR) or to produce low and zero-carbon fuels, chemicals, and building materials
- $180/ton for direct air capture (DAC) carbon stored in geologic formations and $130/ton for DAC carbon used in EOR

TIMING

Critical timing elements:

- Projects can take 5 years or more to start construction
- DNR and AOGCC would have regulations to promulgate following legislative approval
- Federal funding now available to support Class VI well primacy



NET ZERO GREENHOUSE GAS (GHG) INITIATIVES OF NORTH SLOPE COMPANIES

ConocoPhillips Emissions Reductions Targets and Performance

- Reduce methane intensity by 10% and routine flaring to zero by 2025
- Reduce Scope 1 and Scope 2 Greenhouse Gas (GHG) intensity by 40–50% (gross operated and net equity) by 2030
- Net zero Scope 1 and Scope 2 emissions by 2050

Emissions Reduction Targets | ConocoPhillips

ENI's Strategy Against Climate Change

- 35% reduction in net Scope 1, 2, and 3 emissions by 2030
- 55% reduction in net Scope 1, 2, and 3 emissions by 2035
- 80% reduction in net Scope 1, 2, and 3 emissions by 2040
- Net zero Scope 1, 2, and 3 emissions by 2050

Net Zero al 2050 | Eni

Exxon 2030 Greenhouse Gas (GHG) Emission Reduction Plans:

(Relative to 2016 level and apply to Scope 1 and Scope 2 GHG emissions from operated assets)

- 20–30% reduction in corporate-wide GHG intensity
- 40–50% reduction in upstream GHG intensity
- 70–80% reduction in corporate-wide methane intensity
- 60–70% reduction in corporate-wide flaring intensity

Advancing climate solutions | ExxonMobil

Hilcorp

"We have to operate to the same high standards as everyone else. We may be private, but we have capital providers, we have partners, we have lots of other people involved in business with us. They're feeling those pressures (i.e. ESG, emissions reductions), and we have to be responsive to those as well." — Greg Lalicker, Hilcorp CEO

How America's Biggest Privately Owned Oil Company Takes A Divergent Approach To The Energy Transition (forbes.com)

Repsol Path Towards Decarbonization

- 55% reduction in scope 1 and scope 2 emissions in operated assets by 2025
- 30% reduction in scope 1, 2, and 3 net emissions by 2030
- Net zero by 2050

Net zero emissions by 2050 commitment | Repsol

Santos Path to Net Zero

- 26–30% reduction in scope 1 and scope 2 absolute emissions (from 2020 baseline) by 2030
- Actively work with customers to reduce scope 1 and scope 2 emissions by > 1 million tons of carbon dioxide per year by 2030
- Scope 1 and scope 2 absolute emissions at net zero by 2040
- **Santos has committed to net-zero emissions (scope 1 and scope 2) for the Pikka Project**

Santos to be net-zero emissions by 2040 | Santos

Santos Announces Pikka FID | Santos

GREENHOUSE GAS (GHG) IMPACTS ON PROJECT APPROVALS UNDER NEPA

Recent challenges to NEPA analyses of Alaska project have focused on GHG impacts — a significant obstacle to project progress in Alaska.

Enabling carbon storage in Alaska gives project developers (oil and gas, mining) options for mitigating carbon emissions and addressing these NEPA challenges before they are litigated.

Liberty Project

Alaska Journal of Commerce: 9th Circuit rules against federal permit for Liberty project

Willow Project

New York Times: Court Blocks a Vast Alaskan Drilling Project, Citing Climate Dangers

Outside: The Alaska Oil Willow Project Could Destroy Biden's Climate Legacy

ANWR Coastal Plain Leasing

ADN: Biden blocks drilling in ANWR, among his first acts as president

Peregrine

Petroleum News: Suit against Peregrine: Enviros say BLM's approval didn't adequately consider climate change impacts

Reuters: Greens target new oil exploration in Alaska National Reserve

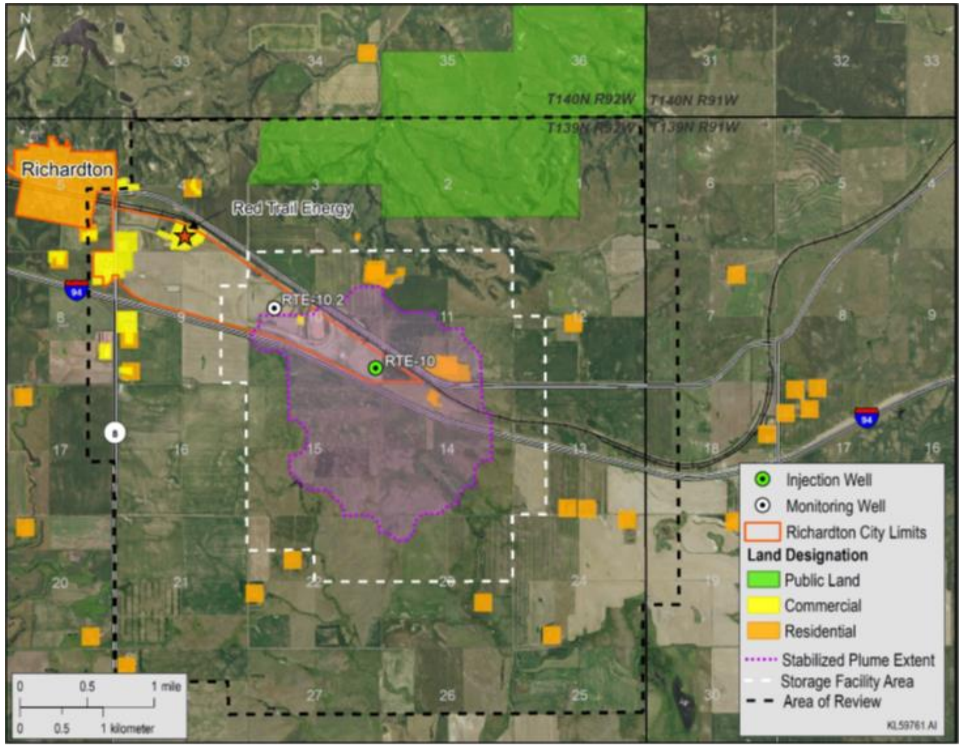
BOEM Cook Inlet lease sales

S&P Global: Environmental groups file lawsuit to halt Cook Inlet offshore oil, gas lease sale

ADN: Hotly debated federal Cook Inlet oil and gas lease sale draws only 1 bid

REVENUE

Hypothetical 10-year gross revenue to State of Alaska due under storage lease.



Red Trail Energy, LLC –Actively injecting in North Dakota

Project surface acreage: 3,480 acres (white outline)
Emissions: 180,000 metric ton/yr (~200,000 ton/yr)

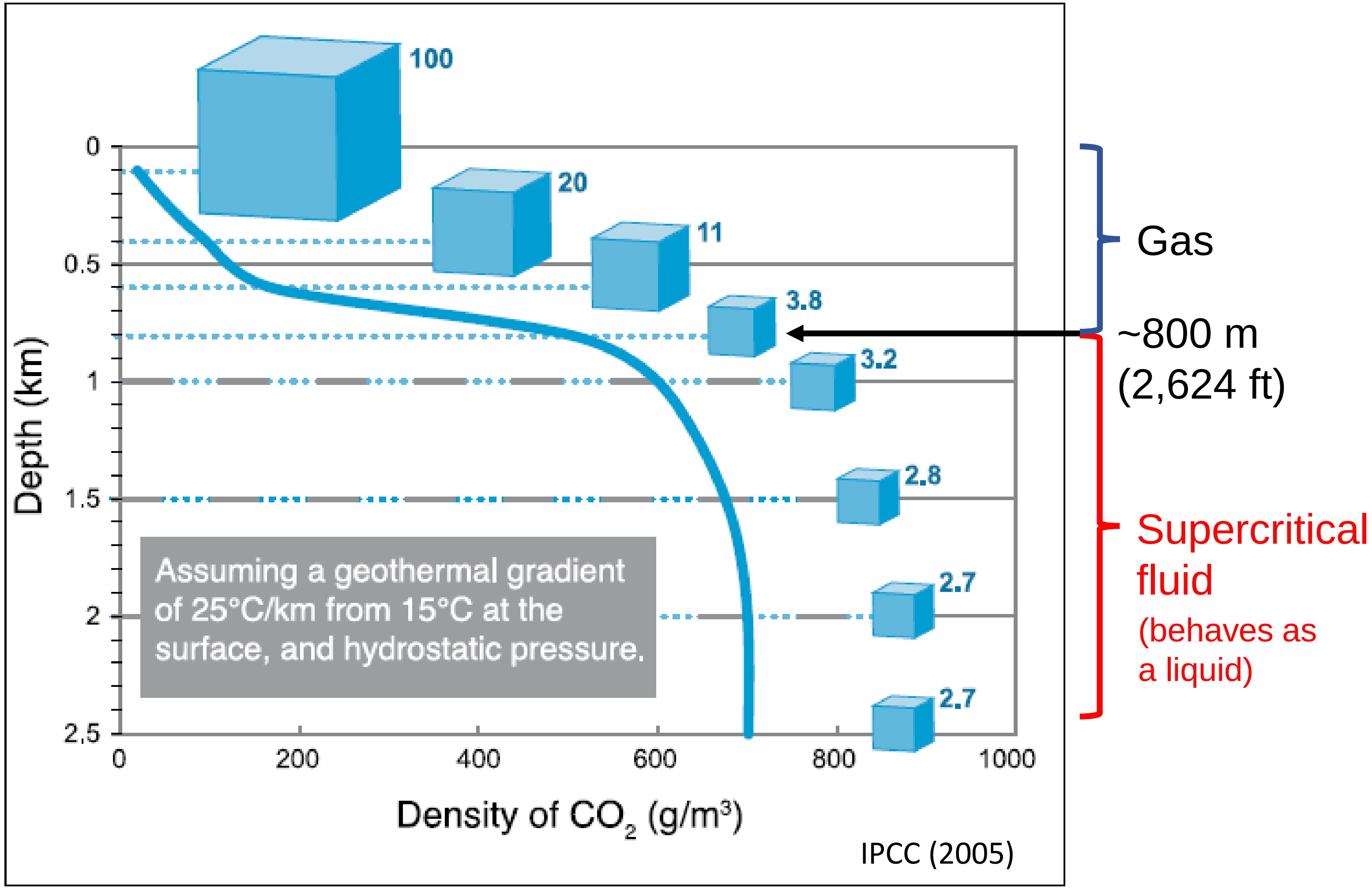
Initial Rent:	$20
Initial Injection Fee:	$2.50
Statutory 5yr Escalation:	5%
Acreage:	3,480
Yearly Injection (tons):	200,000

	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10	*Totals*
Rent	$69,600	$69,600	$69,600								$208,800
Injection Fee				$500,000	$500,000	$525,000	$525,000	$525,000	$525,000	$525,000	$3,625,000
											$3,833,800

Can CCUS Work in Alaska?

PHYSICAL AND CHEMICAL PROPERTIES OF CO_2

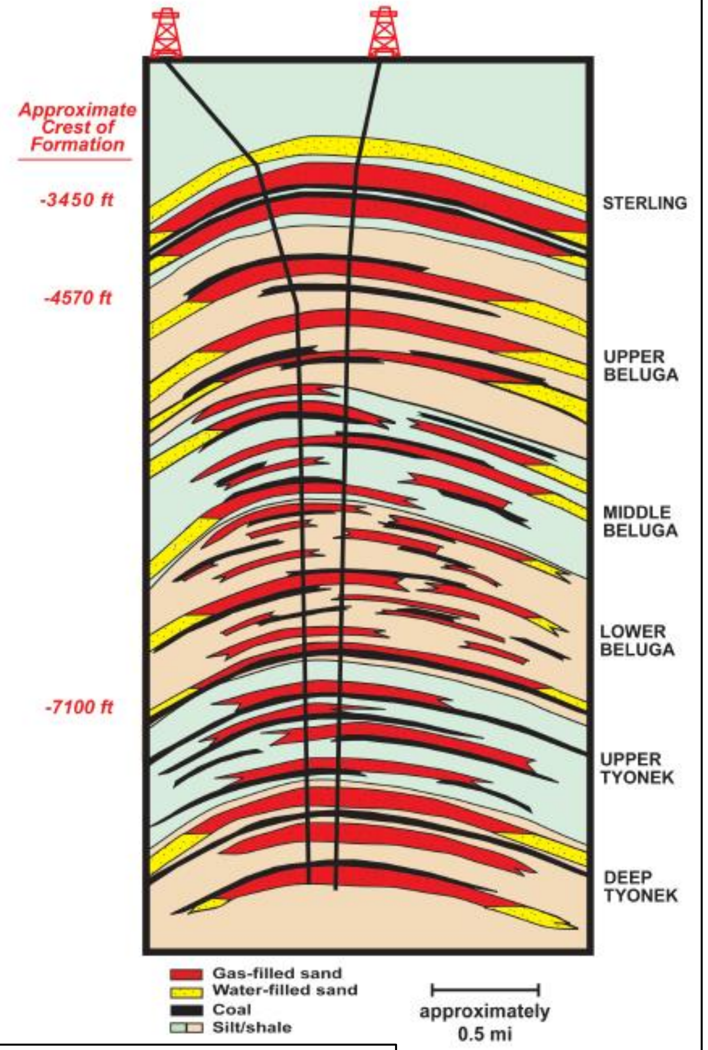
- Physical state varies with temperature and pressure
- Pressure increases with depth
- When supercritical – can store more CO_2 for a given reservoir volume
- CO_2 displaces pore fluids when injected
- Supercritical CO_2 is less dense than H_2O
- Buoyant
- Subsurface formations must meet certain criteria for storage



Hydrostatic gradient (fresh water) = 0.433 psi/ft; in deep subsurface, pore fluids are saline and gradient is slightly higher - 0.45-0.465 psi/ft

REQUIREMENTS FOR GEOLOGIC CO_2 STORAGE

Kenai Gas field



Enos and Maier (2013)

Sandstone, Tyonek Formation (blue is pore space)

Helmold (2013)

500 µm = 0.5 mm
200 µm = 0.2 mm

Porosity – void space

Permeability – interconnected voids

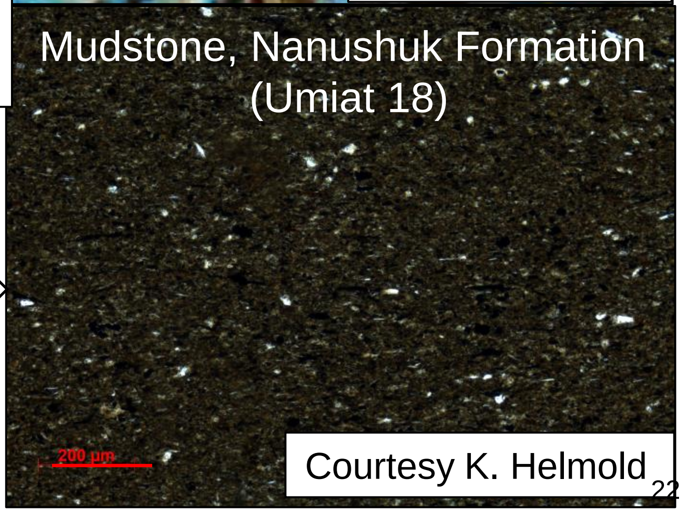
Trap

Seal

Depth >~2,600 ft

Impermeable mudstone (no blue space)

Mudstone, Nanushuk Formation (Umiat 18)



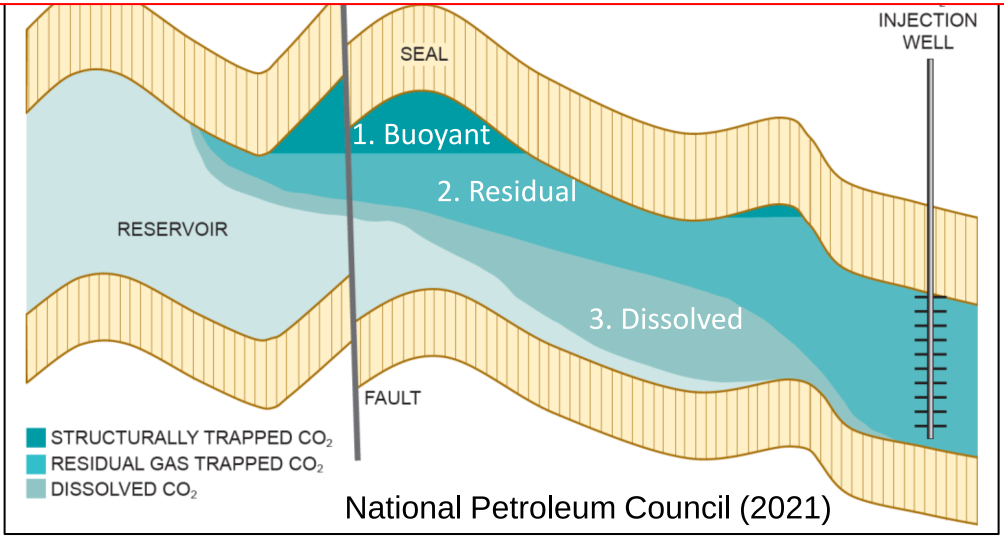
Courtesy K. Helmold

CO_2 Storage Mechanisms in Porous and Permeable Formations

Storage Mechanisms

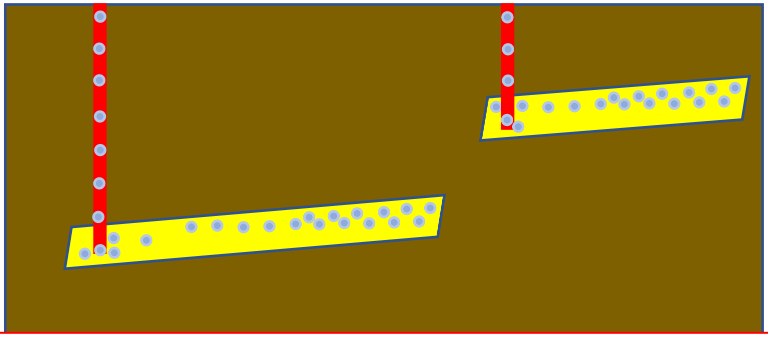
1. Buoyant trapping
2. Residual trapping
3. Solubility trapping
4. Mineral trapping

1 - Buoyant trapping in geologic structures

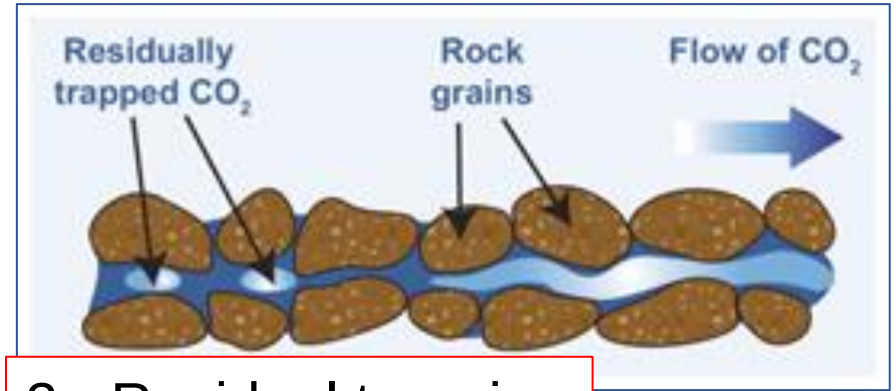


National Petroleum Council (2021)

CO_2 Injection Wells

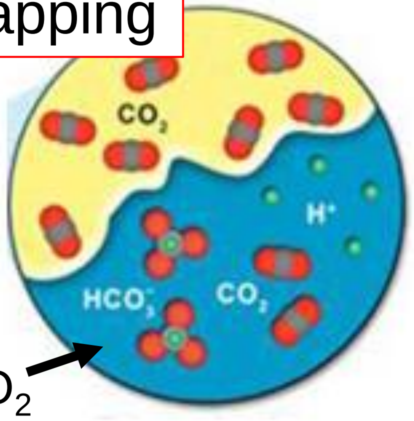


1 – Buoyant trapping related to stratigraphic pinch-out

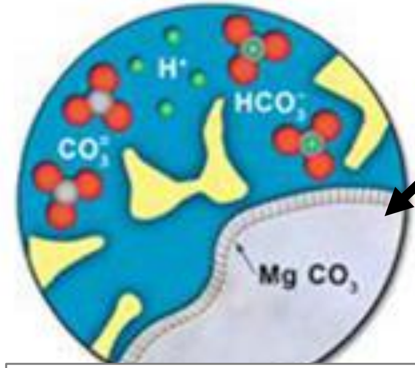


2 - Residual trapping

3 - Solubility trapping



Dissolved CO_2



Mineral precipitates

4 – Mineral carbonation

Depleted Oil Fields and Saline Formations

- Depleted oil and gas fields have:
  - proven reservoir, trap, and seal
  - extensive datasets that characterize reservoir properties, temperature, pressure, and water salinities
  - sandstone body geometries and associated pore volumes are well-characterized
  - know original oil in-place (OOIP) and production history
  - existing infrastructure
- Declining oil fields – CO_2 for EOR

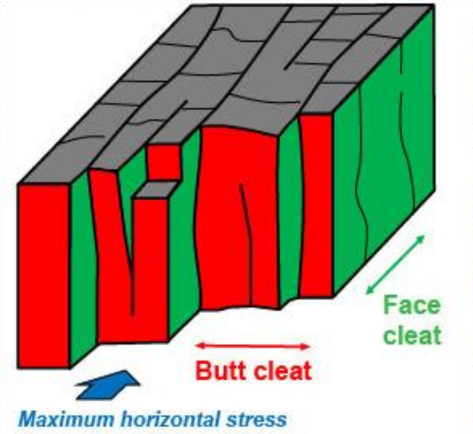
- Saline formations:
  - total dissolved solids >10,000 parts per million
  - Non-potable water
  - Isolated from potable water sources – saline aquifers deeper and separated from aquifers by seals
  - Depositional environment of sedimentary formation influences depth to non-potable water
    - Marine – shallower
    - Nonmarine – deeper
  - Data may be lacking - not as well known as depleted oil fields

Storage in Unmineable Coal Seams

- CO_2 in coal is stored in naturally occurring fractures (cleats) and micropores in coal
- Cleats provide permeability and access to larger surface area (micropores)
- Methane (CH_4) and CO_2 are strongly attracted to coal particles
- CO_2 molecules are attracted more strongly to coal particles than methane – displaces methane
- Coal rank influences storage capacity (IPCC, 2005)

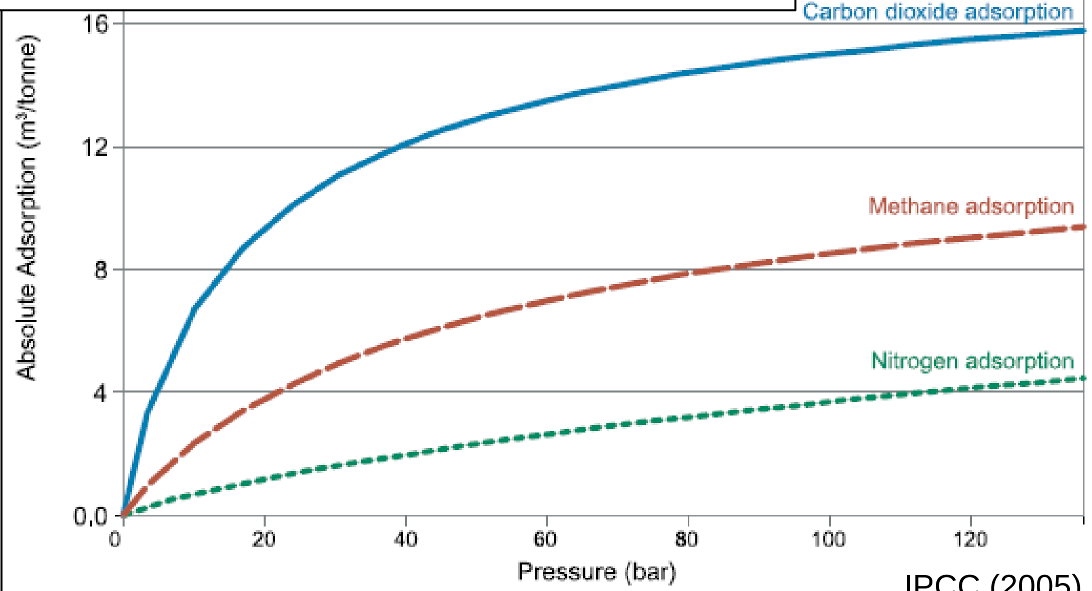
  -Low rank coal – lignite – CO_2 storage capacity >10x methane

  -Anthracite – CO_2 storage capacity = methane



U. Kentucky KGS

Sub-bituminous to bituminous Tiffany coal, Fruitland Formation, San Juan Basin, CO



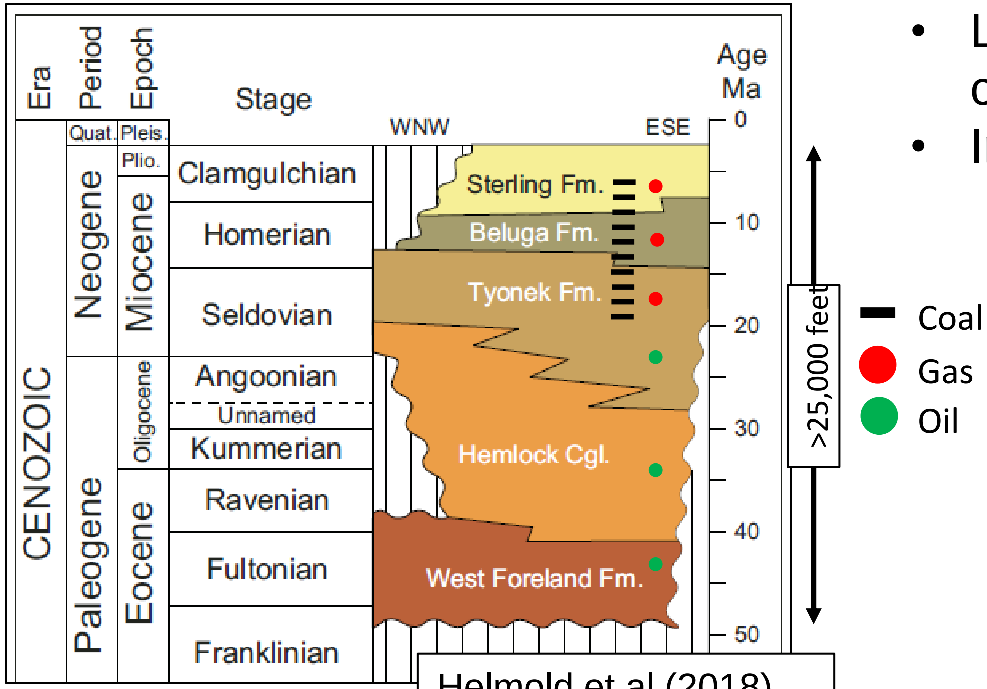
IPCC (2005)

Geologic Carbon Storage Summary

- Geologic storage options include: depleted and declining oil and gas fields; saline formations; unmineable coal seams
- Subsurface formations must be deeper than approximately 2,600 ft
- Formations must have porosity and permeability
- Formations must include traps (folds, faults, stratigraphic pinchout)
- Formations must be overlain by effectively zero permeability formations – seals
- Monitoring during and after CO_2 injection is important

Cook Inlet CO_2 Storage Potential

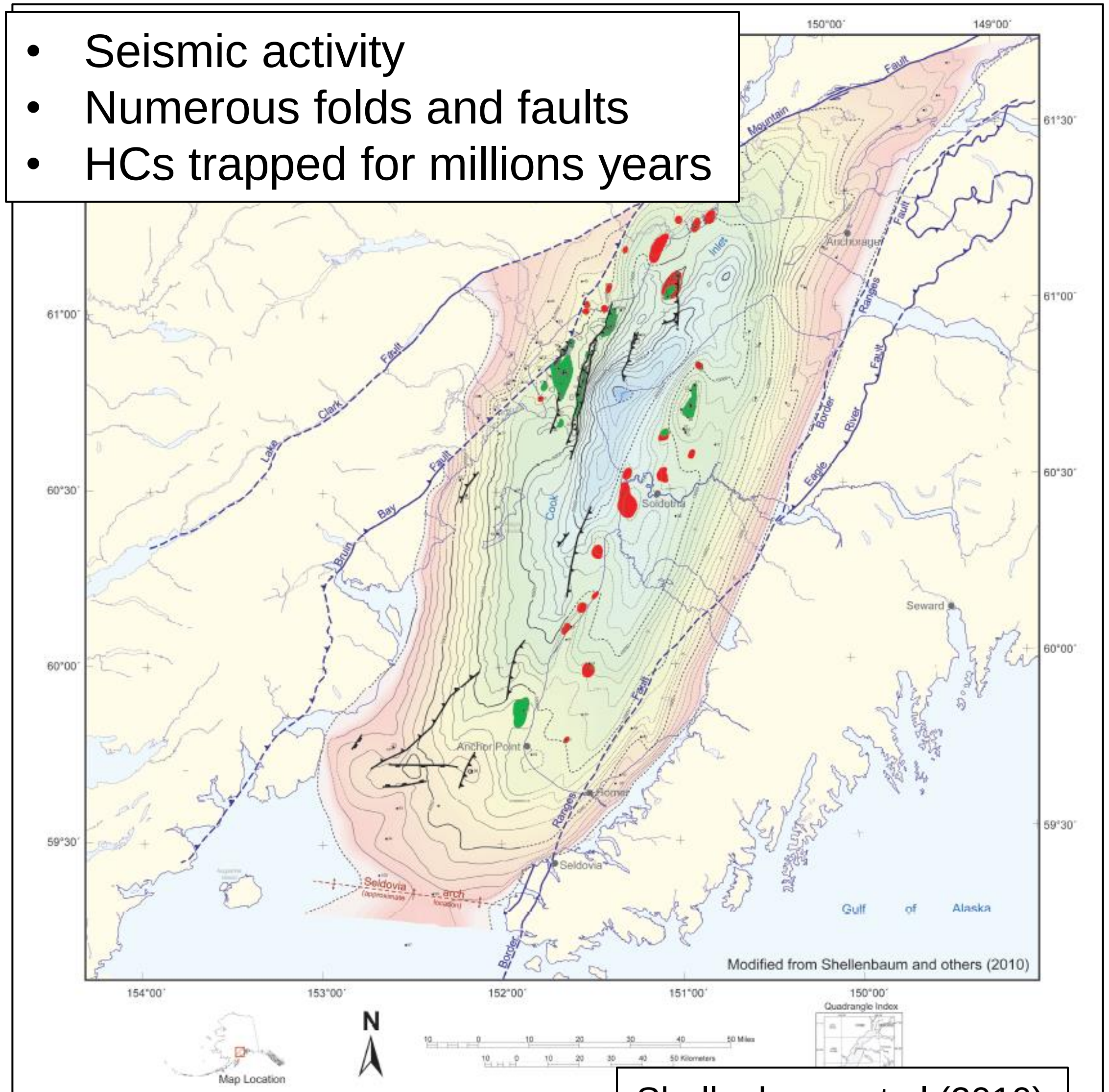
- Thousands of feet of interbedded sandstone, mudstone, coal
- 10 oil fields – 5 relatively large *(data rich)*
- 38 gas fields *(data rich)*
- Proven reservoirs and traps
- 1.4 billion barrels of oil produced
- 8.9 trillion cubic feet of gas produced
- Saline formations
- Large volume of pore space potentially available for CO_2



Helmold et al (2018)

- Large volume of coal
- Infrastructure

- Seismic activity
- Numerous folds and faults
- HCs trapped for millions years



Shellenbaum et al (2010)

Summary of CO_2 Storage Potential in Cook Inlet

CO_2 storage in depleted and declining oil fields

- Proven reservoir (porosity, permeability), trap, and seal
- Existing infrastructure
- 1.4 billion barrels of cumulative oil production as of end November 2022 (AOGCC)
- Field sizes and cumulative production volumes provide a measure of CO_2 storage potential in existing oil and gas fields
- Seismic activity - trapped hydrocarbons prove seal capacity of mudstones not impacted

CO_2 Storage in saline formations

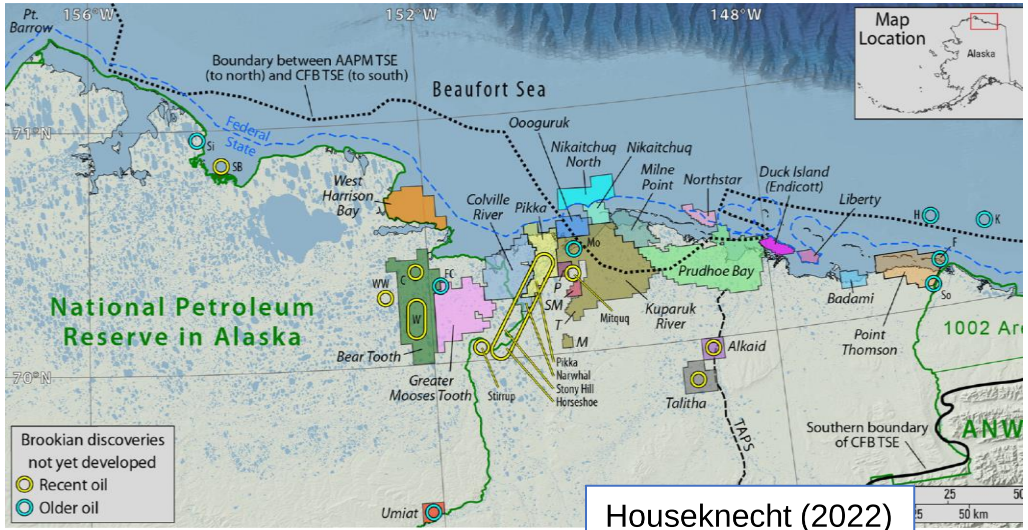
- Large pore volume – huge potential
- Uncharacterized

Unmineable coal seams

- Huge coal resource in basin
- Estimated storage potential – 43 billion tons (Shellenbaum and Clough, 2010)

NORTH SLOPE CO_2 STORAGE POTENTIAL

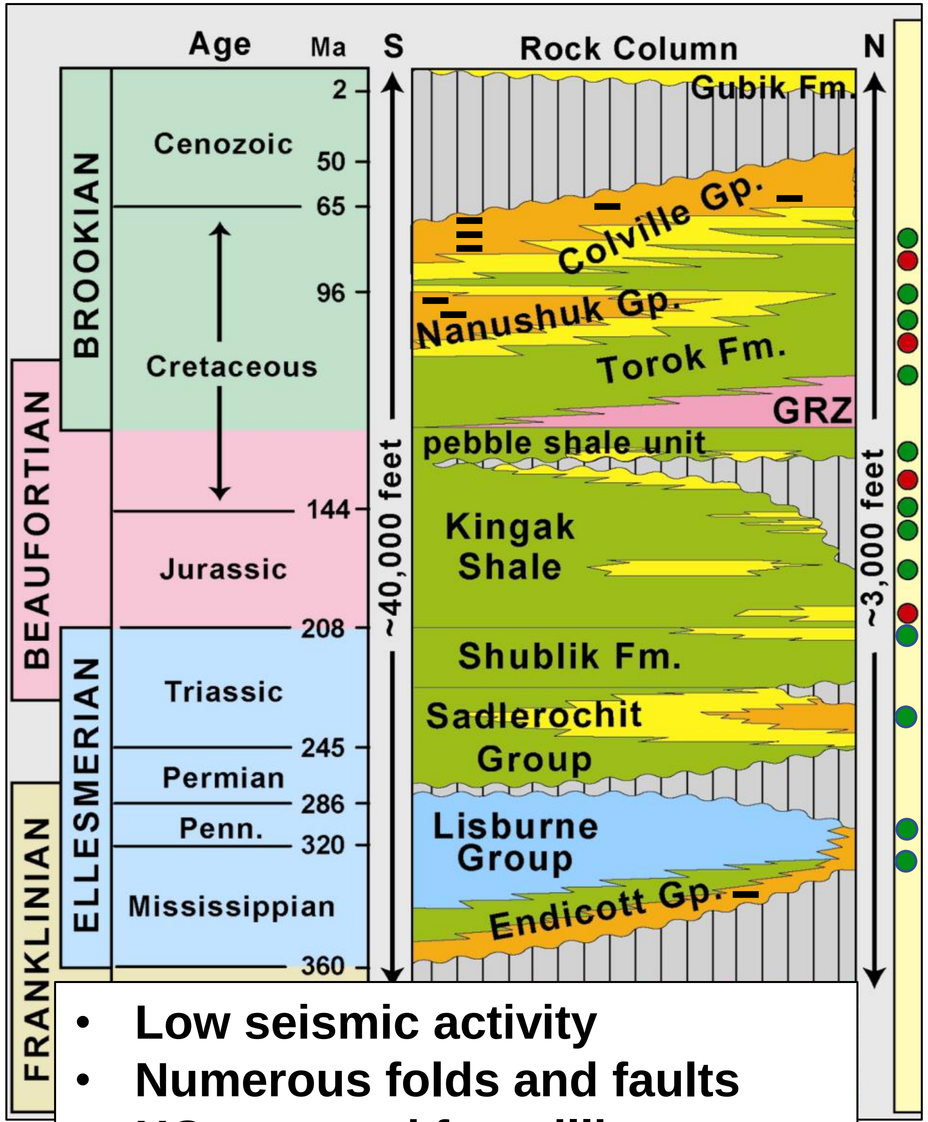
- 1000s feet of interbedded sandstone and mudstone
- Abundant coal west of Umiat (Federal and Native land)
- More than 70 oil accumulations and several gas accumulations discovered since 1944 – several with OOIP >1 billion barrels oil
- 18.7 billion barrels produced through September 2022 (AOGCC)
- Proven reservoirs and traps – many large fields in decline
- Saline formations are extensive
- Large volume of pore space potentially available for CO_2 storage



Houseknecht (2022)

- Coal
- Infrastructure

Coal
Gas
Oil



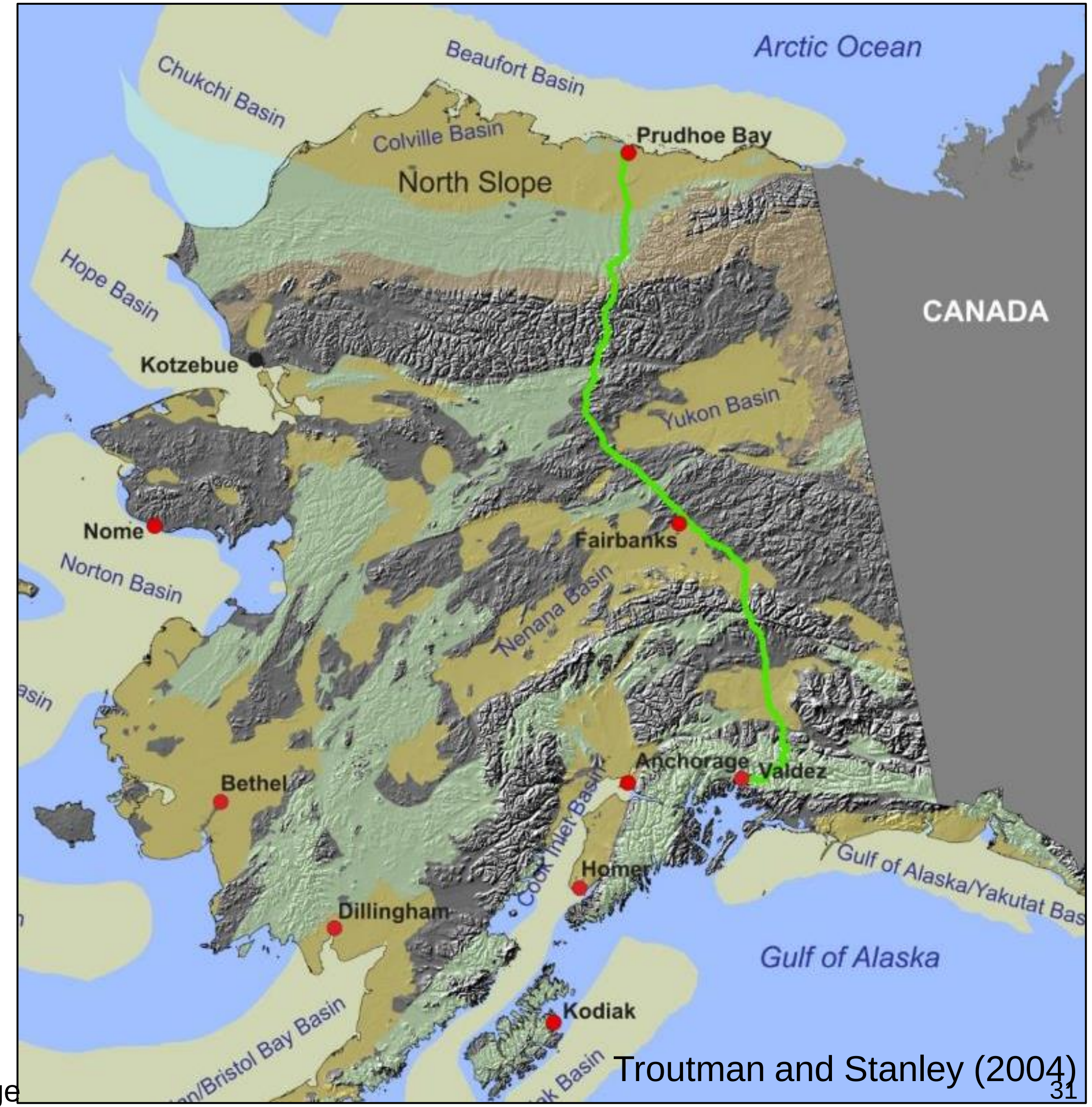
- **Low seismic activity**
- **Numerous folds and faults**
- **HCs trapped for millions years**

Summary of CO_2 Storage Potential on North Slope

- Many fields with original oil in place with an estimated >1 billion barrels of oil and a recoverable oil volume >300 million barrels of oil
- Large legacy fields have been in decline for decades – EOR potential
- Field sizes and cumulative production volumes provide measure of CO_2 storage potential in declining fields – **USGS estimates 0.9 billion metric tons mean recovery replacement storage**
- U.S. Geological Survey estimates mean total CO_2 storage potential at 270 billion metric tons (USGS Circular 1386; includes only deep saline formations and existing oil fields)
- Storage in unmineable coal seams estimated at 5.83 billion tons (Shellenbaum and Clough, 2010)

Interior Sedimentary Basins

- All basins are data poor
- Best known are Susitna, Nenana, and Yukon Flats
- Sedimentary rocks filling basins are nonmarine (river, coal swamp, flood plain, and lake deposits)
- Potable water extends to greater depths
- Nonmarine settings also suggest laterally discontinuous reservoir seals
- No infrastructure



Troutman and Stanley (2004)

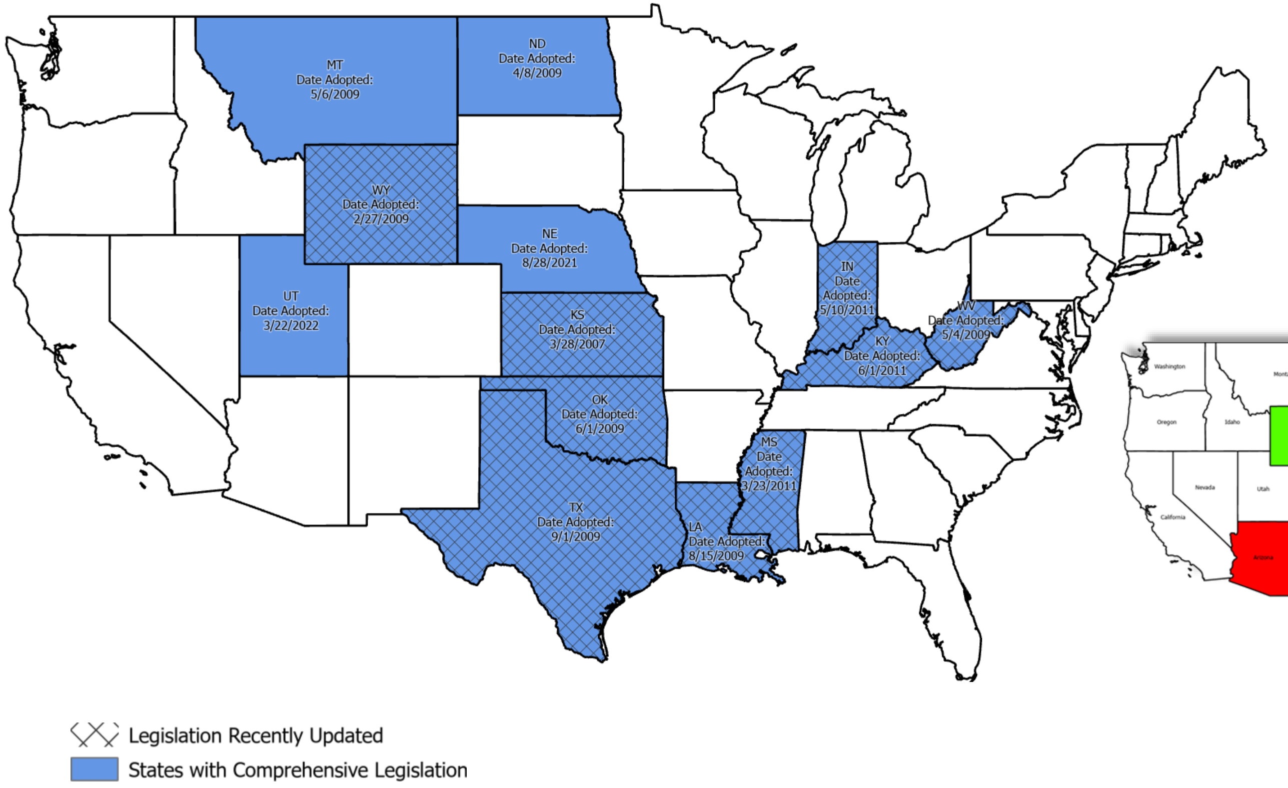
How Was This Legislation Developed?

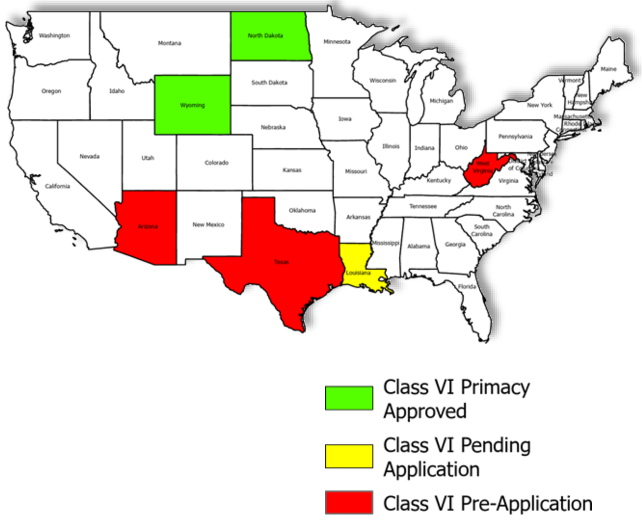
How was this Legislation developed?

- Review of peer state legislation
- Coordination with other State of Alaska agencies
- Statewide CCUS stakeholder workgroup

States Advancing CCUS Programs

Stantec peer state review





How Was This Legislation Developed?

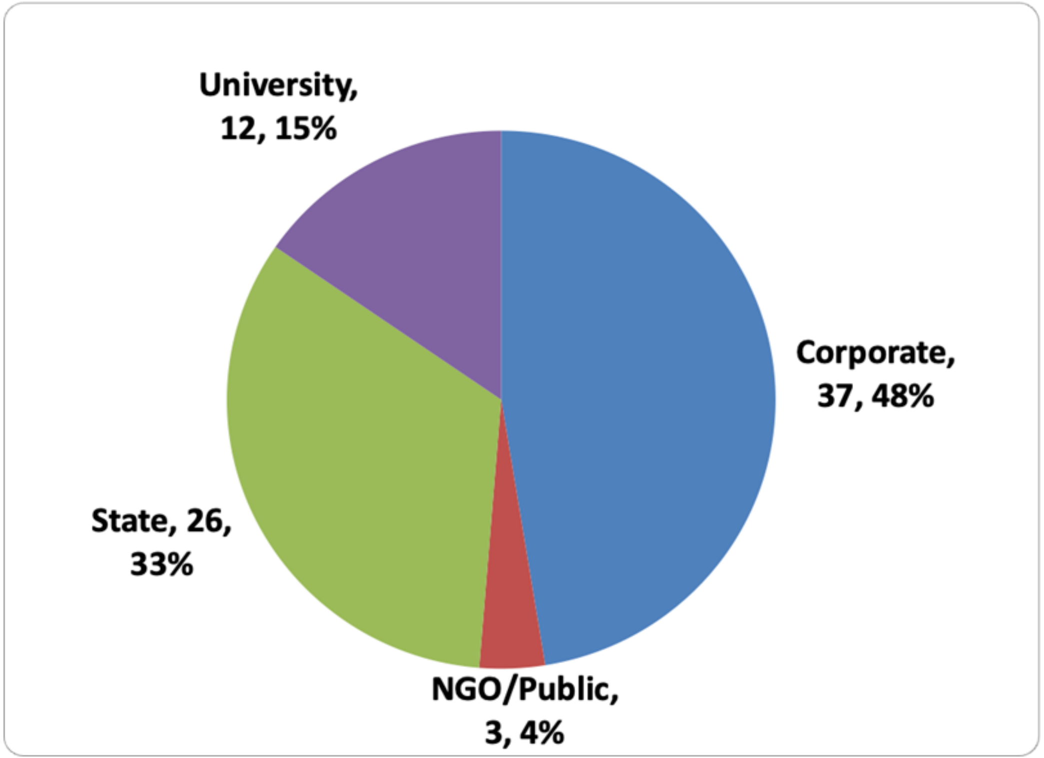
State Agencies Involved

How Was This Legislation Developed?

Statewide CCUS Workgroup

Workgroup Committees

1. Regulatory framework.
    1. Stakeholder white paper
2. Government engagement and funding opportunities
3. CCUS Roadmap
4. Public outreach and education



INE

UAF Institute of Northern Engineering
University of Alaska Fairbanks

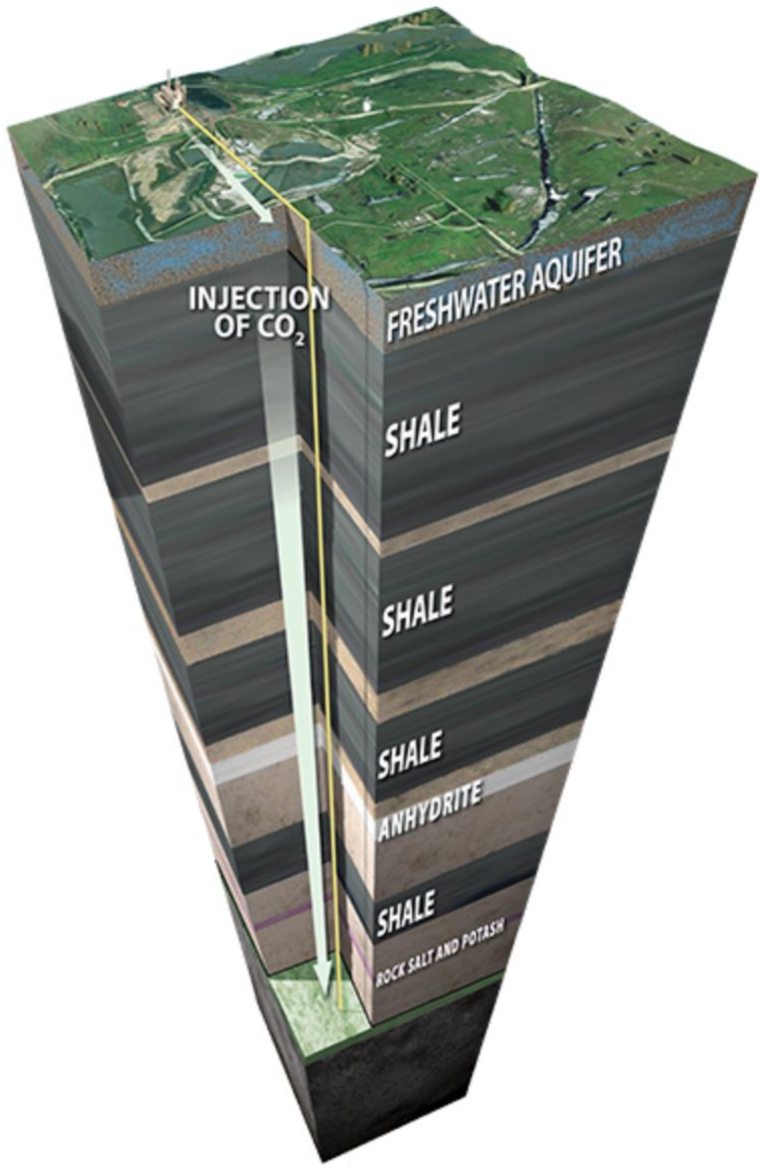
PCO2R Partnership

What Does This Legislation Do?

Regulatory Framework

How HB 50 enables carbon storage:

- Provides for the use of public lands for CCUS
- Accounts for the amalgamation of property interests and protection of correlative rights
- Outlines relationship between other commercial minerals and reservoirs to be used for storage
- Enables permitting for CO_2 pipelines
- Defines ownership of carbon dioxide and ascription of liability
- Addresses authority for SDWA Class VI well primacy



QUESTIONS?

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