

Proponent Testimony for House Bill 170

Ohio House Natural Resources Committee

Date: April 30, 2025

Submitted by:

Andrew Duguid

Vice President, Advanced Resources International (ARI)

1840 Mackenzie Drive

Columbus, OH 43220

aduguid@adv-res.com

Chairman Don Jones, Vice Chair Monica Robb Blasdel, Ranking Member Elgin Rogers, Jr., and Members of the Committee:

Thank you for the opportunity to provide testimony in support of House Bill 170. My name is Andrew Duguid, and I serve as Vice President at Advanced Resources International, Inc (ARI) leading a group of 25 engineers in geologists based here in Columbus. ARI specializes in carbon capture and storage (CCS), enhanced oil recovery, coal bed methane and other challenging energy projects. My background includes bachelor's and master's degrees from Ohio State in Civil and Nuclear Engineering and a doctorate in Civil Engineering from Princeton University with a dissertation on the effect of CO₂ on well cements. Since 2006, I have worked on CCS projects for Schlumberger, Battelle, and now ARI.

About ARI

For over three decades, ARI has been at the forefront of CCS technology and policy, delivering technical and regulatory consulting services for CCS projects across the United States and internationally. Our team includes professionals who have drafted Class VI permit applications in both U.S. EPA and state primacy jurisdictions. This includes a current application through US EPA Region 5 for a project in Ohio.

Ohio's Opportunity – Leverage Carbon Management Expertise to Lead the Industry

Ohio possesses significant geological formations suitable for carbon dioxide (CO₂) storage. House Bill 170 establishes a regulatory framework to facilitate the deployment of CCS technologies, positioning Ohio as a leader in carbon management. This will benefit manufacturing, agricultural, and energy industries within the state. This testimony includes scientific findings from Ohio experts, including technical experts from ARI, Battelle, and the Ohio Department of Natural Resources (ODNR) to inform lawmakers on the state's CCS potential, economic implications, and the need for cohesive regulation.

Geological Storage Capacity in Ohio

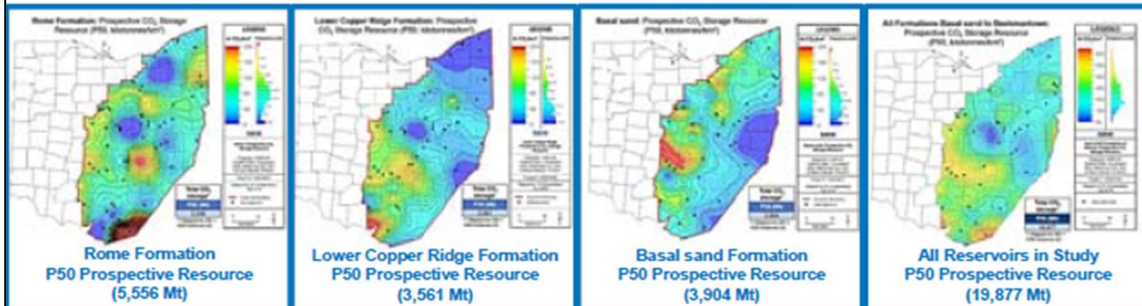
Ohio's deep saline formations provide extensive capacity for safe, long-term CO₂ storage. Projects are already being permitted through the US EPA in Lorain, Putnam, Carroll, and Pike Counties. The eastern half of the state has been studied as part of the Department of Energy's (DOE) Regional Carbon Sequestration Partnership program using with support from the state. The eastern half of the state has been extensively analyzed, mapped, and modeled to result in geologic CO₂ storage potential. The figure below is an excerpt from an Ohio-funded study presented in 2016-2017 quantifying the potential for storage in these mapped formations having a theoretical storage potential over 100 gigatons of stored CO₂ and a prospective storage of around 3.4 gigatons. To put this in perspective, the average large natural gas fueled power plant in Ohio emits about 1.7 megatons of CO₂ annually (approximately 2,000 years of storage for a single plant).

Reservoir Feasibility Assessment

- Static volumetric storage resource estimation from NETL/DOE CO₂-SCREEN calculation tool for the potential storage formations of interest
- Key inputs: reservoir thickness, porosity, temperature, pressure

Formation	Total Area (km ²)	Avg. Thickness (m)	Avg. Porosity (%)	Avg. Depth (m)	Avg. CO ₂ Density (kg/m ³)	Avg. T (°C)	Avg. P (MPa)
Beekmantown	32,470	92	4	2,194	799	53	23
Ross Run	41,031	34	3	2,122	804	52	23
Upper Copper Ridge	61,236	63	2	1,910	795	48	20
Copper Ridge B	61,236	27	2	1,974	800	49	21
Lower Copper Ridge	61,236	72	5	2,000	800	49	21
Kerbel Sandstone	37,781	10	6	1,665	799	43	18
Conasauga	61,236	27	2	2,079	799	51	22
Rome	61,236	130	4	2,106	799	51	22
Basal Sandstone	61,236	40	7	2,236	804	54	24

Above: Average formation properties calculated from the heterogeneous dataset imported into CO₂-SCREEN.



Above: CO₂ Storage Resource maps for selected formations and compilation of formations. Regional trends for both sandstones and dolomites show the highest resource estimates are in central and southern central Ohio.

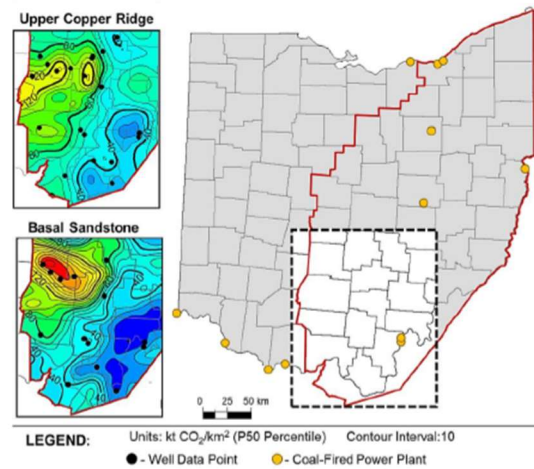
Quantification of CO₂ Storage Resource for major deep saline formations

- Theoretical Storage Resource: 111-155 Gt
- Prospective Storage Resource: 3.4 Gt (P50)
- CO₂ storage efficiency: 2.2 – 3.0% (P50)

Less than 1% difference between SEM & CO₂-SCREEN results

Generation of Storage Resource maps

- Spatial distribution of storage resource
- Help guide site selection for further analysis
- Potential for stacked storage in some areas



Support for HB 170

We support HB 170 because it provides the cohesion and certainty that developers, investors, and regulators alike need to advance CCS at scale. This bill ensures that Ohio can not only compete but lead in securing low-carbon energy infrastructure, attracting investment, and delivering long-term environmental and economic benefits.

Key Benefits of HB 170

ODNR Coordination with Subsurface Resources

The Ohio Department of Natural Resources (ODNR) is well suited to regulate Class VI wells due to their experience with other classes of injection wells. The state can ensure seamless coordination between CO₂ storage operations and other subsurface activities, including oil and gas development and waste disposal.

Alignment with Active Class VI Projects and Federal Oversight

Class VI wells are already being permitted in the state today under U.S. EPA oversight. House Bill 170 allows Ohio to build on that foundation by establishing a cohesive, unified state-level regulatory framework.

Incorporation of Best Practices from Other States

HB 170 draws upon successful frameworks from states such as Wyoming, Kansas, and Montana, which have adopted legislation clarifying CO₂ ownership and long-term liability, helping ensure responsible storage and stewardship.

Self-Funded and Sustainable Regulatory Model

HB 170 creates a regulatory model sustained by fees assessed per ton of CO₂ stored, ensuring state oversight can scale responsibly with project development.

Economic and Job Creation Potential

- **Infrastructure Development:** Implementing CCS projects will necessitate the construction of transport facilities, injection wells, and monitoring facilities, leading to job creation in engineering, construction, and maintenance sectors.
- **Attracting Investment:** A clear regulatory framework can attract private investment and federal funding, positioning Ohio as a hub for CCS technologies and related industries.

Why Ohio Must Act Now - Considerations and Recommendations

Ohio is exceptionally positioned to lead in CCS. Ohio can join North Dakota, Louisiana, and Wyoming at the forefront of the industry. HB 170 is an opportunity for Ohio to maintain its competitive edge.

All CCS regulatory and operational work is performed with transparency in regulation compliance and protection of groundwater systems. Maintaining the high level of protection standards issued by the US EPA for Class VI wells is key to Ohio's goal of primacy in issuing Class VI UIC permits. This bill will create a certain regulatory framework for developers and operators to construct and operate CCS systems in the state of Ohio will attract investment and help projects move efficiently with state regulators.

Some recommendations to increase support for this legislation are:

- **Environmental and Safety Standards:** Robust monitoring and emergency response plans are critical to address potential CO₂ leakage or seismic activity associated with injection operations.
- **Public Engagement:** Engaging local communities through public hearings and information sessions to build trust and address concerns related to CCS projects.
- **Regulatory Certainty:** Support statewide uniform CCS permitting under ODNR to institute a seamless interface between all subsurface resources and well regulations within the state.
- **Migration from Federal to State:** Engage with the current permit applicants to move regulatory processes from US EPA Region 05 UIC offices to ODNR processes; use the existing project applications to complete the regulatory framework.

Conclusion

We are confident that a responsive, science-based permitting environment is essential to success of CCS projects at the state-level. HB 170 creates the conditions needed for Ohio to support responsible CCS development while ensuring long-term safety and environmental integrity.

Thank you for your consideration.

Sincerely,

Andrew Duguid

Vice President, Advanced Resources International (ARI)

References

1. Battelle Memorial Institute. (2016). CO₂ Storage Resources and Containment Assessment in Cambrian and Ordovician Formations of Eastern Ohio: Final Summary Report. OCDO Grant OOE-D-13-22.
2. ODNR Division of Geological Survey. (2022). Open File Report 2013-2: Conducting Research to Better Define the Sequestration Options in Eastern Ohio and the Appalachian Basin.
3. Battelle Memorial Institute. (2016). Defining CO₂ Storage Options in the Upper Ohio River Valley: Advanced Characterization of Geologic Reservoirs and Caprocks. Presented: 2016 U.S. DOE Carbon Storage and Oil and Natural Gas Technologies Review Meeting.
4. Battelle Memorial Institute. (2017). CO₂ Storage Resource and Reservoir Feasibility Assessment for Deep Saline Cambrian-Ordovician Formations in Eastern Ohio. Presented: Carbon Management Technology Conference, July 2017.

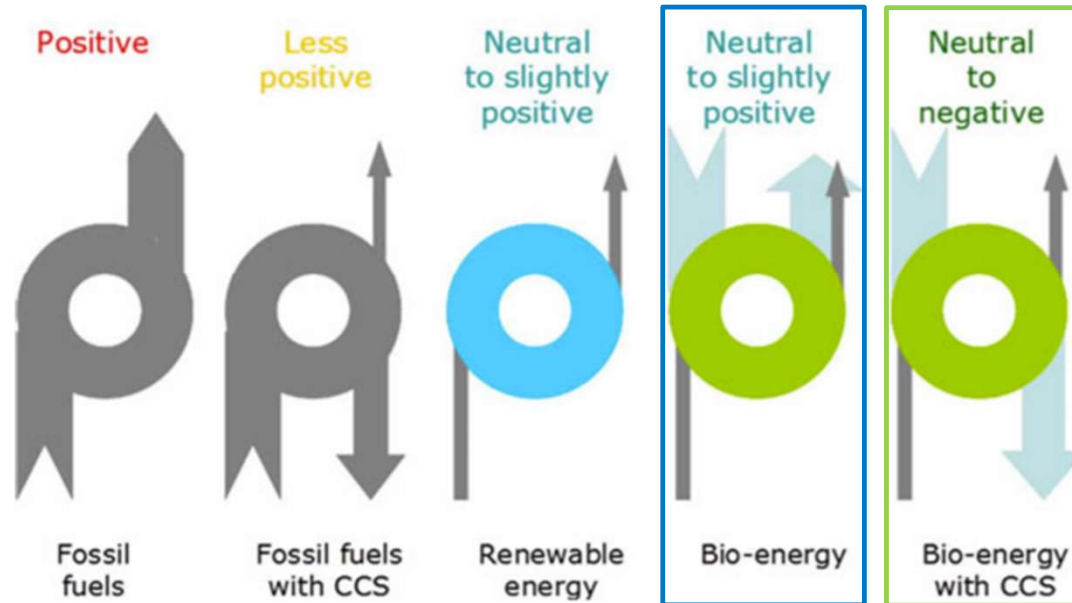
CCS Background



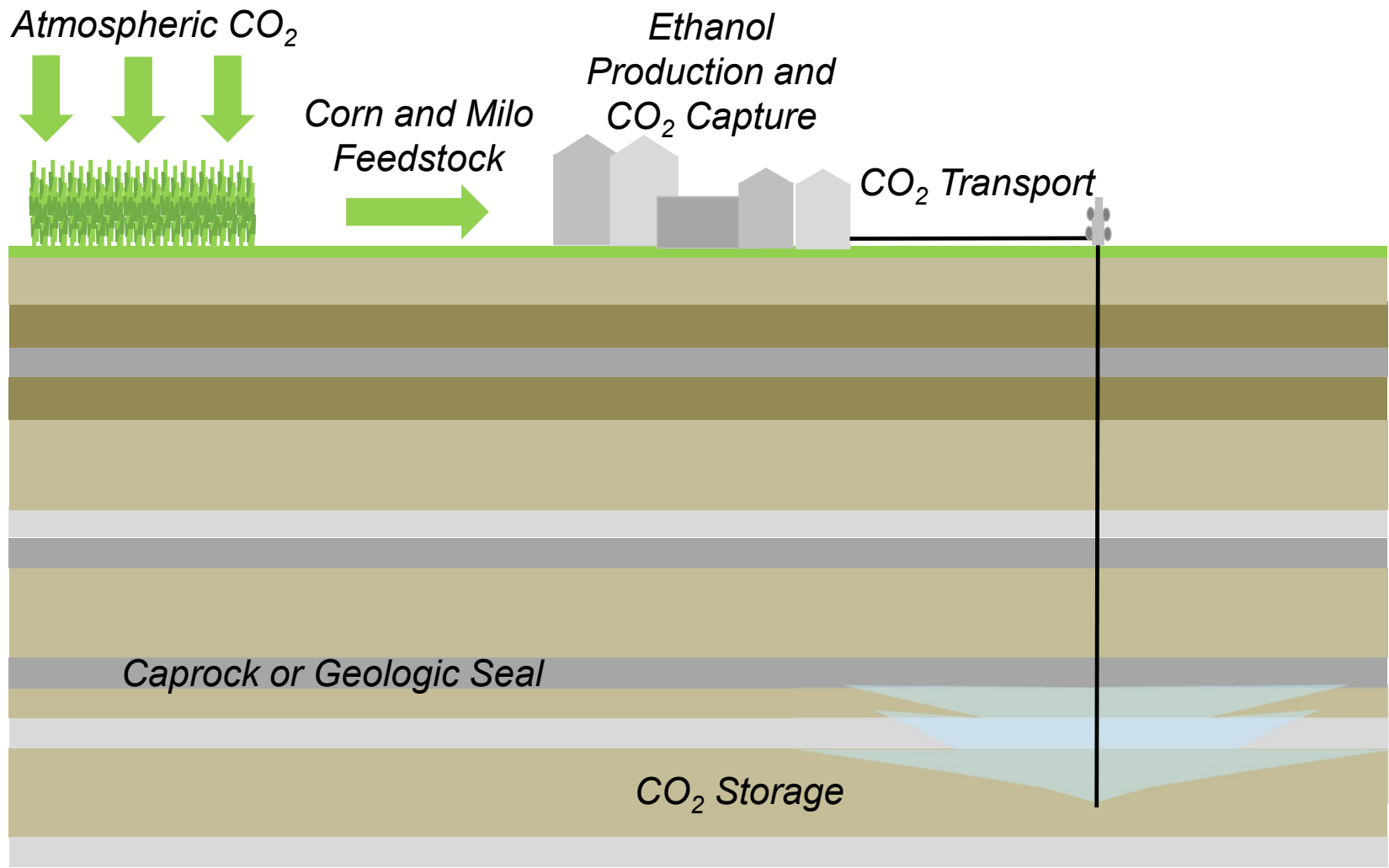
C balance of energy systems

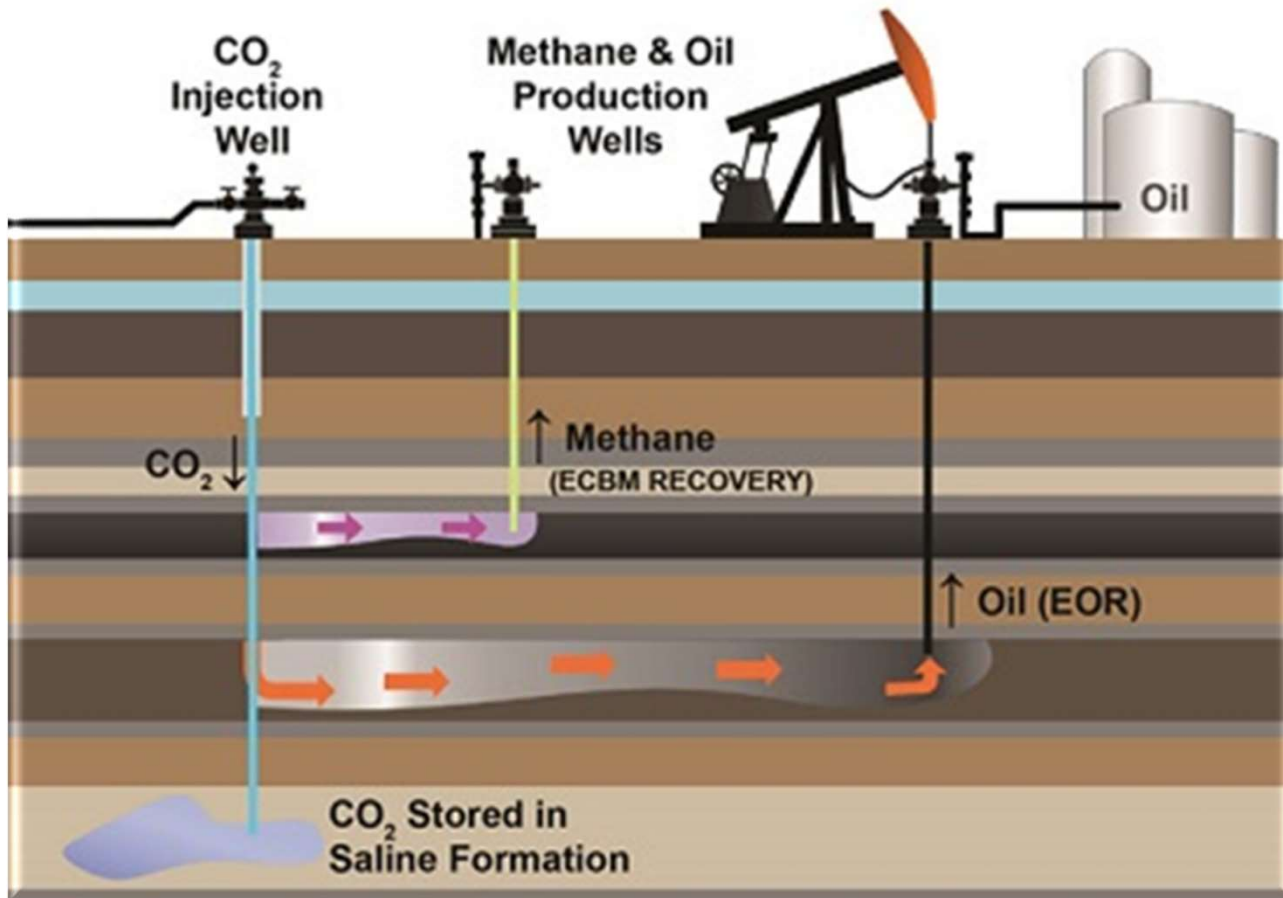


Net carbon balance



https://ieaghg.org/docs/General_Docs/IEAGHG_Presentations/2017-03-10_Bioenergy_lecture_2_Read-Only.pdf





<https://www.netl.doe.gov/coal/carbon-storage/faqs/carbon-storage-faqs>

Carbon Storage

Saline Reservoirs

- A **saline reservoir or saline aquifer** refers to a rock interval that has effective porosity and the pore space contains salty (brine) water.
- The term **saline reservoir** is meant to distinguish itself from a freshwater reservoir (or aquifer), or from reservoir units that are hydrocarbon bearing.
- CO₂ storage is not permitted in reservoirs where the dissolved solids is less than 10,000 ppm. Such reservoirs are considered potential sources of drinking water and are protected under the Safe Drinking Water Act.

Underground Source of Drinking Water (USDW)

*An **USDW** as defined in Title 40, Code of Federal Regulations (40 CFR), Section 144.3 is an aquifer or part of an aquifer which:*

•supplies any public water system, or contains a sufficient quantity of ground water to supply a public water system and currently supplies drinking water for human consumption or contains fewer than 10,000 milligrams/liter of Total Dissolved Solids (TDS)

<https://www3.epa.gov/region1/eco/drinkwater/terms.html>

Geologic CO₂ storage

Caprock

- Composed of tiny particles or is fully cemented. Considered tight or impermeable to fluid flow.
- Commonly shale.

Reservoir Rock

- Pore space between grains.
- Permeable: communication between pore spaces.
- Commonly sandstone and limestone.

http://climatewarmingcentral.com/nat_gas_page.html
<http://geologylearn.blogspot.com/2015/03/sandstone.html>

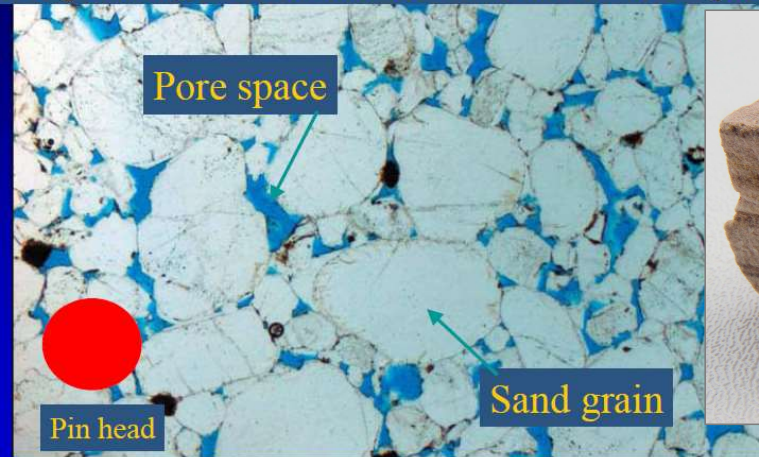
Magnified views of rock



Shale examples



CO₂ Storage in Sandstone Reservoir Pore Space

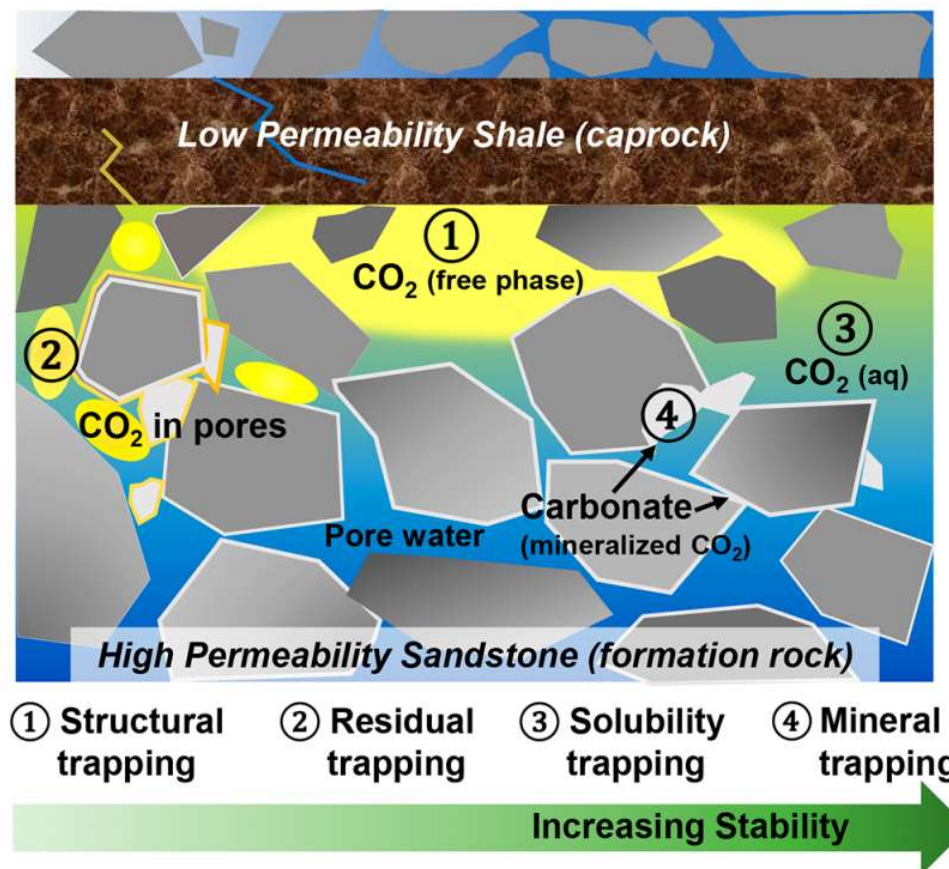


Sandstone



Trapping Mechanisms

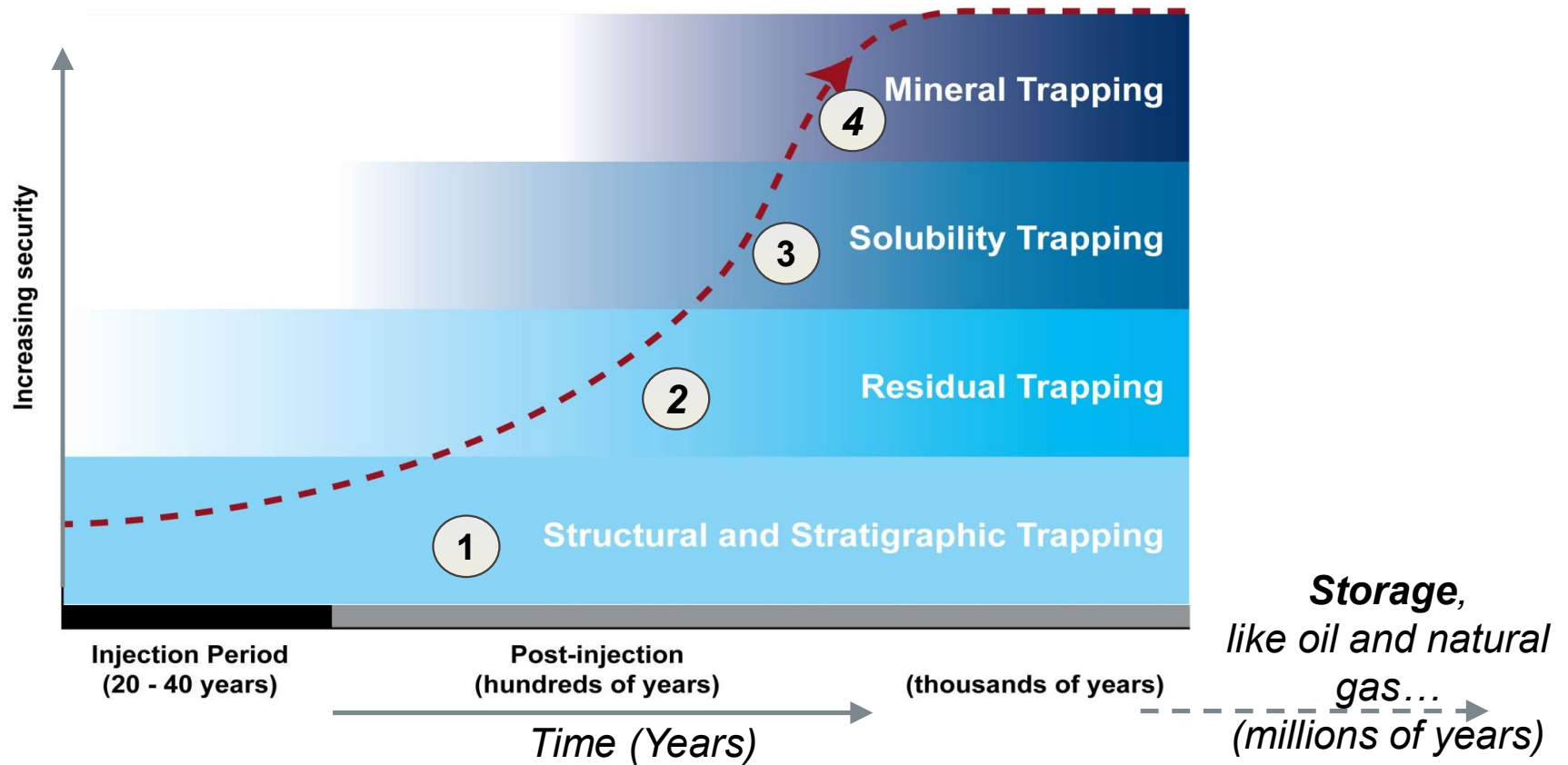
- 1) Physical Trapping, free phase
- 2) Residual Trapping, in pores
- 3) Solubility Trapping, dissolve into the brine water
- 4) Mineral Trapping, becomes a solid carbonate mineral



<https://pubs.acs.org/doi/pdf/10.1021/acs.accounts.6b00654>

Nanoscale Chemical Processes Affecting Storage Capacities and Seals during Geologic CO₂ Sequestration

Geologic CO₂ Storage Trapping Mechanisms

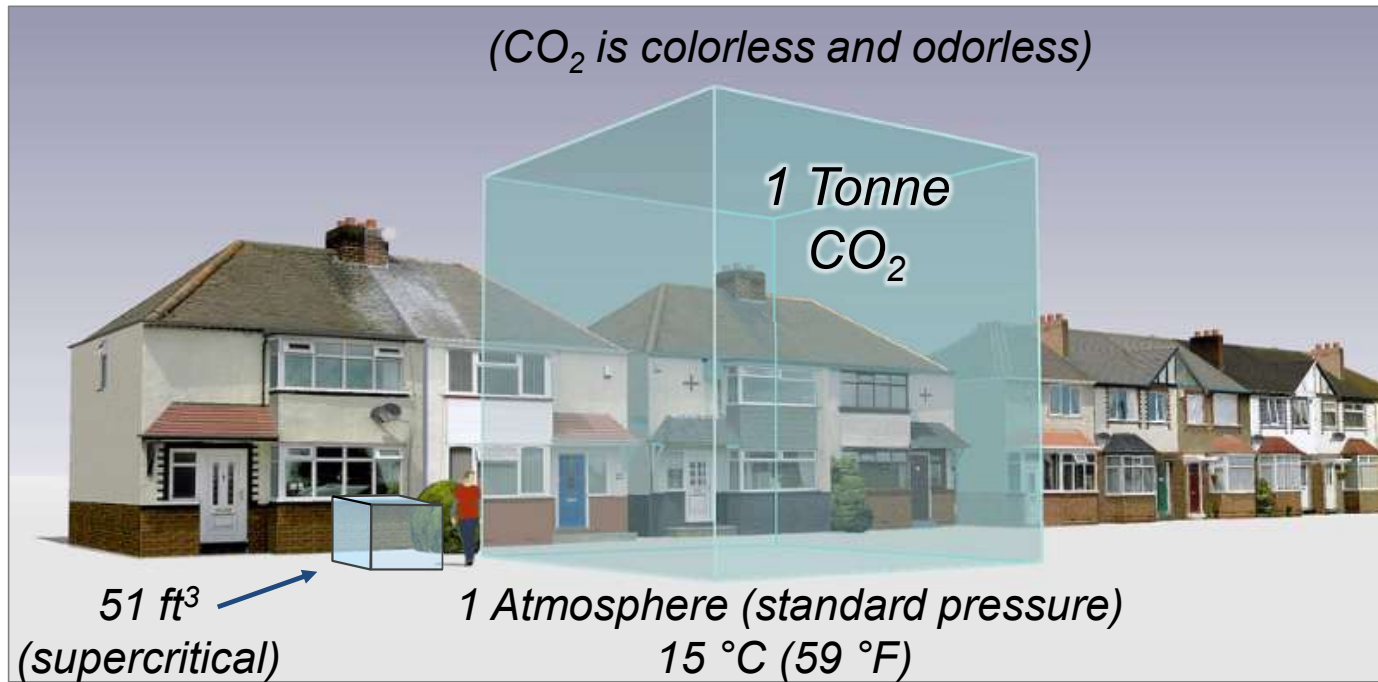


<http://www.co2crc.com.au>

CO₂ Properties



How big is a tonne of CO₂?

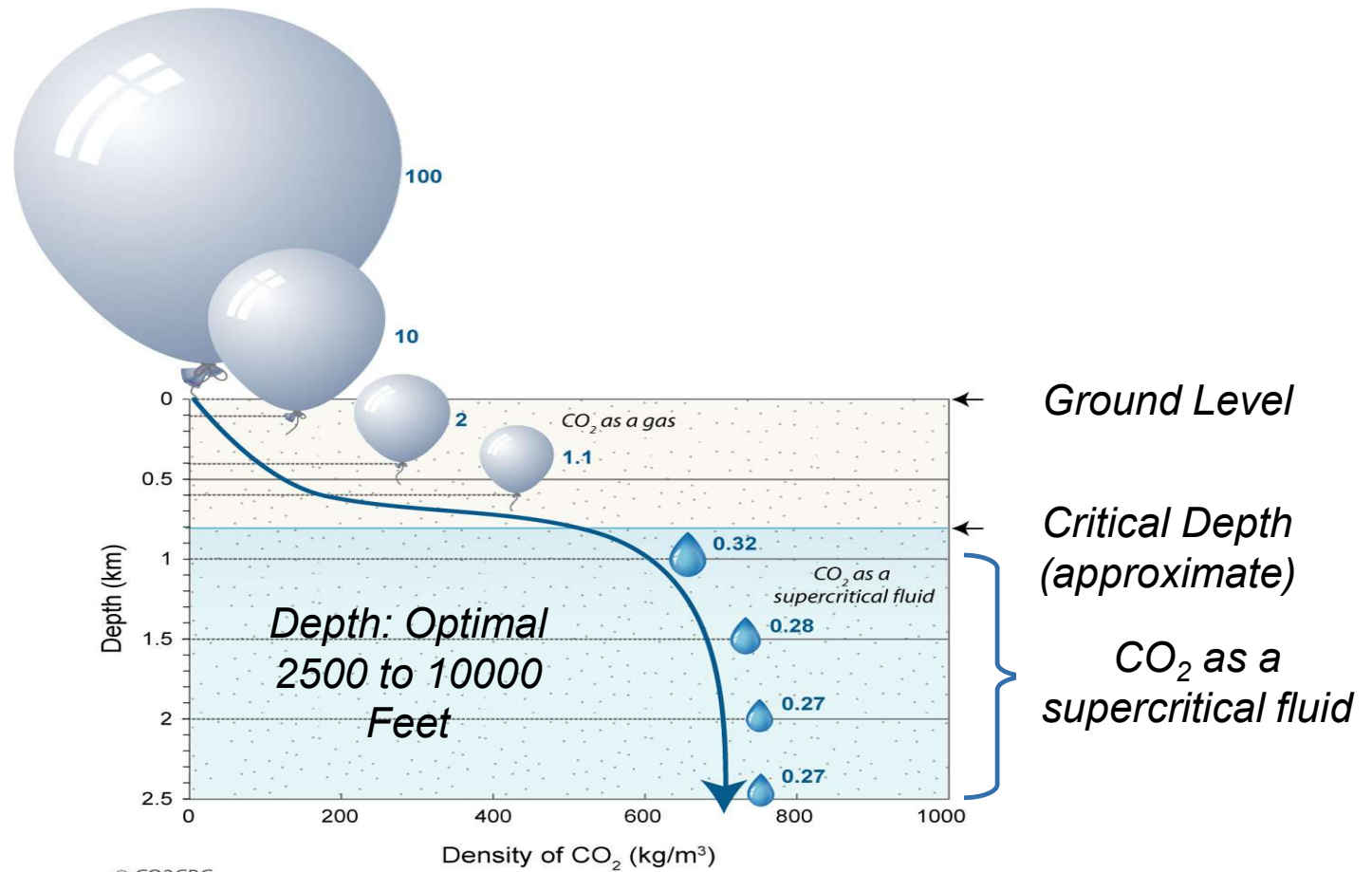


- 1 Tonne = 1,000 kg
- At standard pressure and 15 °C (59 °F) the density of carbon dioxide gas is 1.87 kg/m³ (0.1167 lb/ft³).
- One metric ton (2,205 lb) of carbon dioxide gas occupies 534.8 m³ (18,885 ft³, 117,631 US gallons).
- It would fill a cube 8.12 meters high (26' 8") or a sphere 10.07 meters across (33').

<http://groups.ischool.berkeley.edu/uconserve/>

<https://www.flickr.com/photos/carbonquilt/8801363368/in/photostream/>

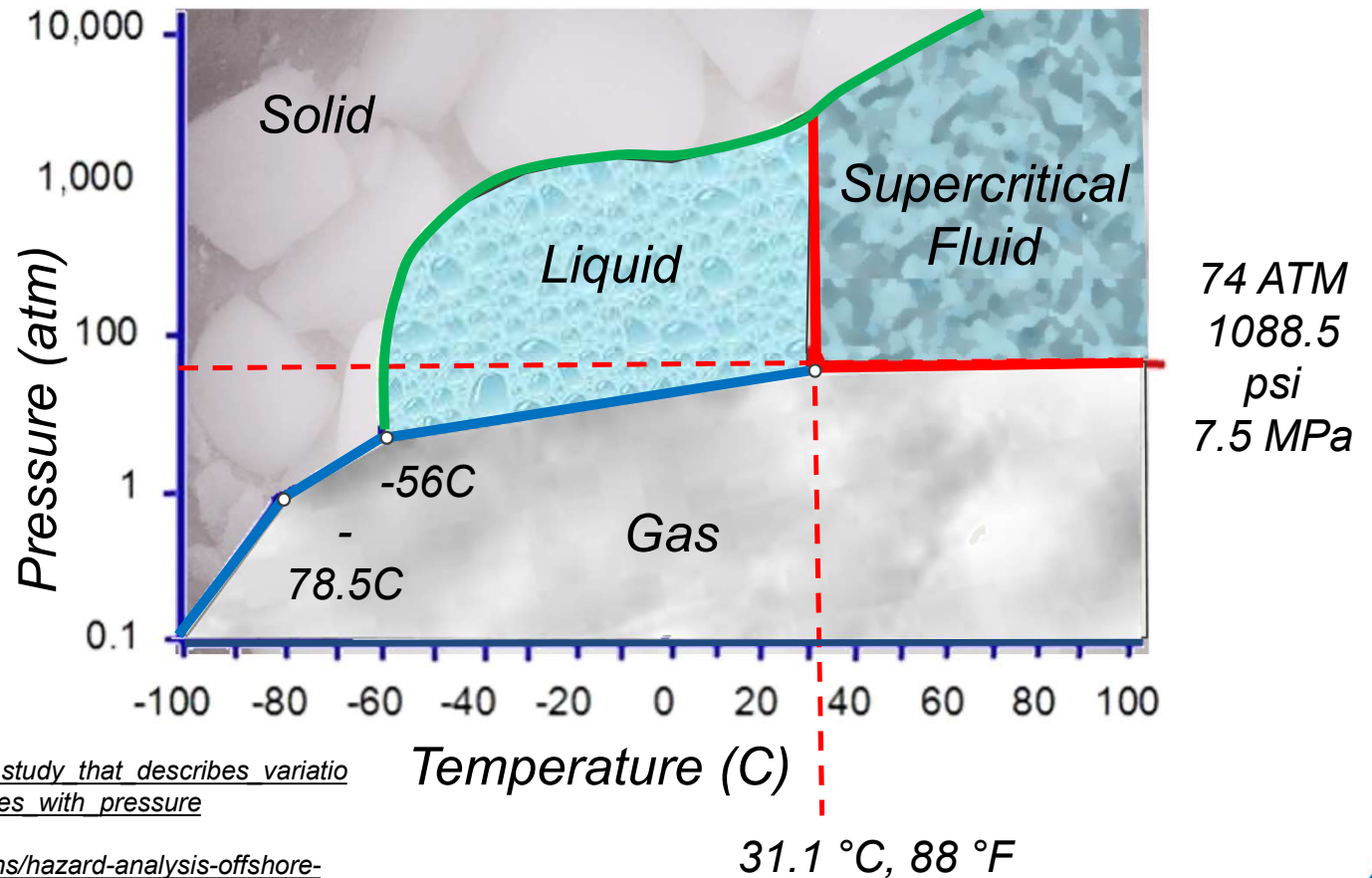
CO₂ storage efficiency increases with depth



<http://www.co2crc.com.au/dls/external/geostoragesafe-IEA.pdf>

CO₂ Phases

- Supercritical CO₂ is just a fourth phase where CO₂ has the density of a liquid, but the viscosity of a gas.
- This state occurs at pressures and temperatures commonly found in deep, geologic formations.



[https://www.researchgate.net/post/Is there a study that describes variation of supercritical CO₂s properties with pressure](https://www.researchgate.net/post/Is_there_a_study_that_describes_variation_of_supercritical_CO2s_properties_with_pressure)

https://hub.globalccsinstitute.com/publications/hazard-analysis-offshore-carbon-capture-platforms-and-offshore-pipelines/21-properties-co2#fig_2.1