House Committee on Natural Resources
Subcommittee on Energy and Mineral Resources
"The Opportunities and Risks of Offshore Carbon Storage in the Gulf of Mexico"

Invited Testimony

Dr. Timothy A. 'Tip' Meckel
April 28, 2022

Subcommittee Chair Alan Lowenthal, Ranking Member Pete Stauber, and Subcommittee Members:

Thank you for inviting me today to provide testimony to the House Subcommittee on Energy and Mineral Resources oversight hearing titled: *"The Opportunities and Risks of Offshore Carbon Storage in the Gulf of Mexico."*

I serve as a Senior Research Scientist at the **Gulf Coast Carbon Center** at the **Texas Bureau of Economic Geology** at **The University of Texas at Austin**. My expertise is in geology and geophysics, with a specialty in carbon dioxide storage.

During my 15 years working full time on Carbon Capture and Geologic Storage (CCS), I have worked closely with the **U.S. Department of Energy** – **National Energy Technology Laboratory** under the **Office of Fossil Energy and Carbon Management**. My colleagues and I have led a half dozen CCS demonstration projects utilizing over $70 million dollars in Federal funding. Our Center has also interacted with many companies that are actively developing CCS projects, including offshore, both in the United States and internationally.

Beginning in 2010, I initiated a research program to evaluate the offshore **Gulf of Mexico** for CCS. I have completed three multi-year offshore CCS storage research projects to date, with one ongoing for the western Gulf of Mexico. We now have the first example of a successful State lease for offshore CO_2 storage, indicating commercial market interest and viability of IRS Section 45Q tax credits for accelerating project deployment.

Lastly, my colleagues and I at the Center are currently in regular dialog with the **Bureau of Ocean Energy Management** (BOEM) and the **Bureau of Safety and Environmental Enforcement** (BSEE) on topics related to offshore CCS.

In the United States, and globally, we are faced with the unprecedented challenge of providing abundant affordable and reliable energy, while simultaneously mitigating the effects of climate change associated with industrial emissions.

Both the **International Panel on Climate Change** (IPCC) and the **International Energy Agency** (IEA) have stated repeatedly over the last decade that trying to address our energy needs and associated industrial emissions will be both more expensive and less effective without carbon capture and geologic storage. Simply put, CCS is not a 'want', it is a 'need'.

It is important for the subcommittee to recognize that while CCS is a relatively new topic for the offshore, there are over 20 years of experience in developing and deploying CCS technology in the United States, a recognized leader in CCS. Multiple examples of successful industrial projects exist. The primary technology components needed are at a very high Technology Readiness Level (TRL), and projects can proceed safely and effectively today.

With regard to subsurface storage capacity, the **Offshore Continental Shelves** (OCS) represent the **national end-game for effective CCS deployment** at the scale needed to mitigate existing

and future emissions. In particular, the Gulf of Mexico basin is one of the most studied geologic regions in the world. Currently available subsurface data are sufficient to initiate storage projects today. Multiple technical studies identify **hundreds of gigatons of storage capable of addressing national emissions for decades**.

Considering the **opportunities** that offshore CCS affords, it is important to recognize the following:

- An offshore CCS industry would facilitate the **mitigation of significant quantities of CO_2 emissions** from industrial point sources, and would increase the nation's ability to reach stated greenhouse gas emissions reduction targets.
- The development of a successful offshore CCS industry will both retain and create significant long-term, diverse, and high-paying **jobs.**
- Development of offshore CCS will lead to **international competitiveness** in a rapidly evolving global energy transition.
- Offshore CCS can be an important part of addressing **environmental justice** issues related to the energy transition.
- The opportunity exists to **re-purpose existing infrastructure** nearing the end of its production cycle for CCS and avoid decommissioning costs.

Considering the **risks** that CCS presents, the following points are critical to understand:

- **CCS science is mature** and subsurface injection of CO_2 for emissions abatement is demonstrably safe and effective.
- Primary risks include **migration of buoyant fluids** toward the surface and marine environment via legacy wellbores or geologic pathways.
- The management of **induced pressure** in the subsurface associated with CO_2 injection is important for understanding project location and adjacent proximity, while minimizing potential for induced seismicity.
- The technologies needed for **effective monitoring** of subsurface CO_2 injection projects are mature.
- The **costs** of CCS are currently quite high. Current IRS tax credits (similar in structure to those for solar and wind development) valued at $39/ton are capable of initiating some projects, but tax credit values closer to $85/ton would generate a significant additional increase in project deployment.
- **Public perception** of CCS is uneven, although many become more supportive once they are provided additional information on the benefits and risks.

In conclusion, I believe the Gulf of Mexico represents the **single best opportunity for developing a U.S. CCS industry that can effectively address national emission reduction strategies at the required scale**. The opportunities are economically impactful, can significantly mitigate emissions for reaching our national targets, and the risks are manageable and monitoring is mature. We are ready to proceed.

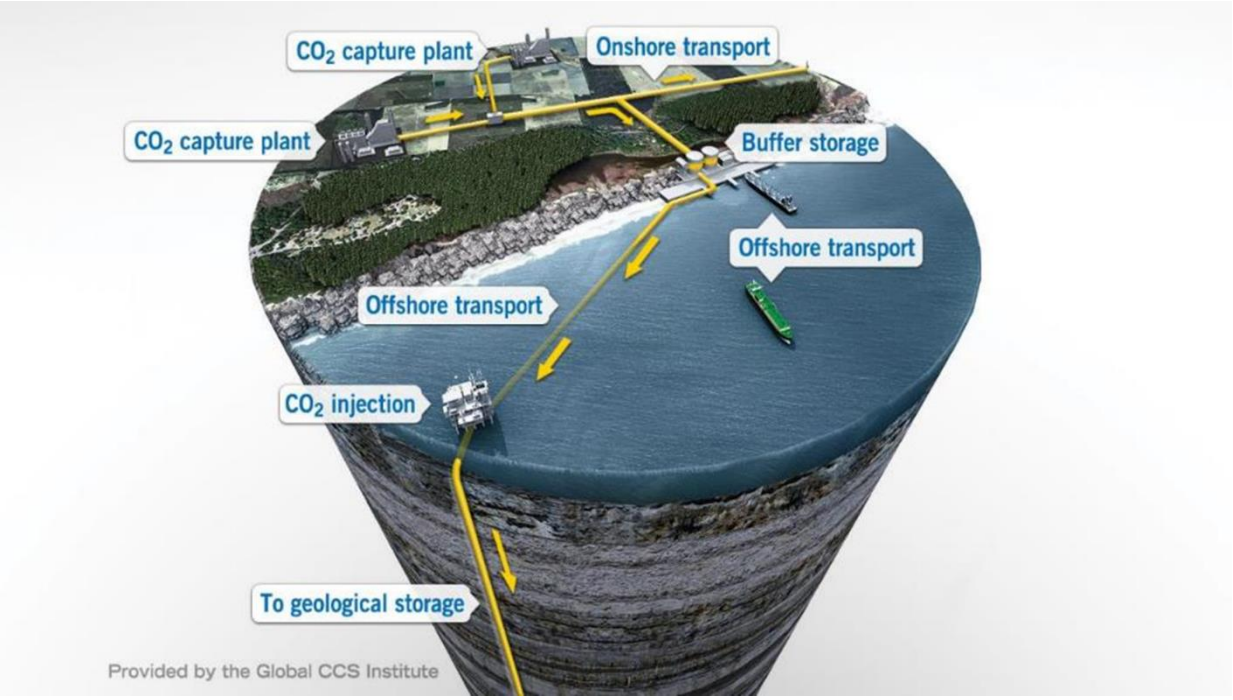
I encourage the subcommittee to recognize the ability to simultaneously address future abundant affordable and reliable energy needs while reducing industrial emissions and addressing climate change by **establishing permitting and regulations** needed for safe and timely development of an offshore CCS industry in the OCS.

Thank you for the opportunity to provide these perspectives, and I am happy to field any questions you may have as time allows.

Dr. Tip Meckel, Senior Research Scientist, CCS Expert, Geology and Geophysics

Supplementary Material

CONCEPTUALIZATION – Offshore storage components related to CCS project development are shown below. Not all projects will have all these components, but this image provides a sense of what types of infrastructure can be involved. Image courtesy of the Global CCS Institute.



JOBS

The Gulf of Mexico offshore oil and natural gas industry is estimated to support around **370,000 jobs per year**. In 2019, the Gulf of Mexico oil and natural gas industry contributed an estimated **$28.7 billion** of to the U.S. economy. Developing a CCS industry in the Gulf of Mexico will maintain and expand similar employment levels and provide similar impact to the national economy. Throughout the Gulf, the offshore energy industry employs thousands of surveyors, engineers, geologists, technicians, and scientists and indirectly supports thousands of contractors and support service employees. The CCS industry is expected to rival the size of the current hydrocarbon production industry.

INTERNATIONAL COMPETITIVENESS

Many countries have already undertaken offshore CO_2 capture and geologic storage projects, most notably **Norway, UK, Brazil, and Japan**. Other countries are actively developing capabilities, including **Indonesia, Malaysia, Australia, Netherlands, and South Africa**. Energy development in these countries is currently strongly linked to emissions abatement in service of national stated targets for 2030 and 2050.

In the **Gulf Coast**, we have already seen some **LNG export** shipments rejected from European ports due to their high environmental impact. Many of these export companies are now positioning to provide LNG exports (as well as hydrogen and ammonia) that have reduced carbon intensity, which they see as a competitive advantage. The technologies associated with development in these export industries are internationally significant, including development of offshore CO_2 storage.

Many industrial ports are currently recognizing the importance of incorporating CCS into their future port competitiveness. For example, the **Port of Corpus Christi** in Texas (the largest energy port in the US) is actively developing CCS, and has established Memoranda of Understanding with international ports such as **Rotterdam**, to rapidly provide CCS to the port's industrial tenants.

INTERNATIONAL COMPETITIVENESS

We are already witnessing a transition to lower carbon intensity in the LNG export industry, but the associated patents and technology development have global significance. US companies can lead in this new technology landscape.

The Gulf of Mexico can become the lowest-cost and largest-scale storage province in the world, establishing a dominant role for CCS similar to its hydrocarbon production history.

ENVIRONMENTAL JUSTICE

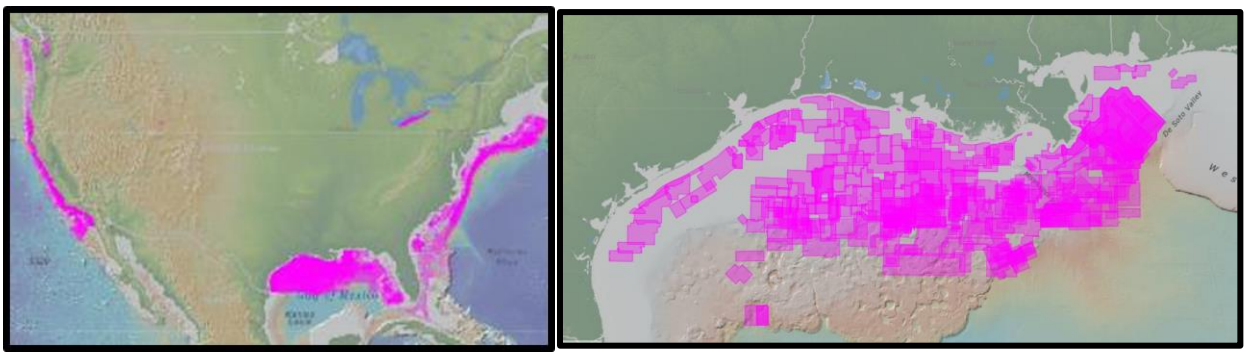
Environmental justice issues have become an important focal point for all aspects of the energy transition. Many of the communities directly affected by current unabated CO_2 emissions will benefit from CCS activities that improve local air quality while reducing greenhouse gas emissions to the atmosphere. The development of CCS will have additional benefit of improving emissions attainment targets for many of the local communities most affected by industrial emissions. In addition, by developing offshore storage, project development will not directly impact local communities, while providing additional jobs to those areas.

REPURPOSING EXISTING INFRASTRUCTURE

The Gulf of Mexico is one of the largest infrastructure decommissioning markets in the world. The possibility to re-purpose existing infrastructure (pipelines, rights-of-way, and platforms) would avoid costly decommissioning, while allowing for accelerated CCS deployment. This topic is rapidly developing, but provides a potential opportunity to leverage existing infrastructure in rapidly developing CCS in offshore settings.

DATA AVAILABILITY

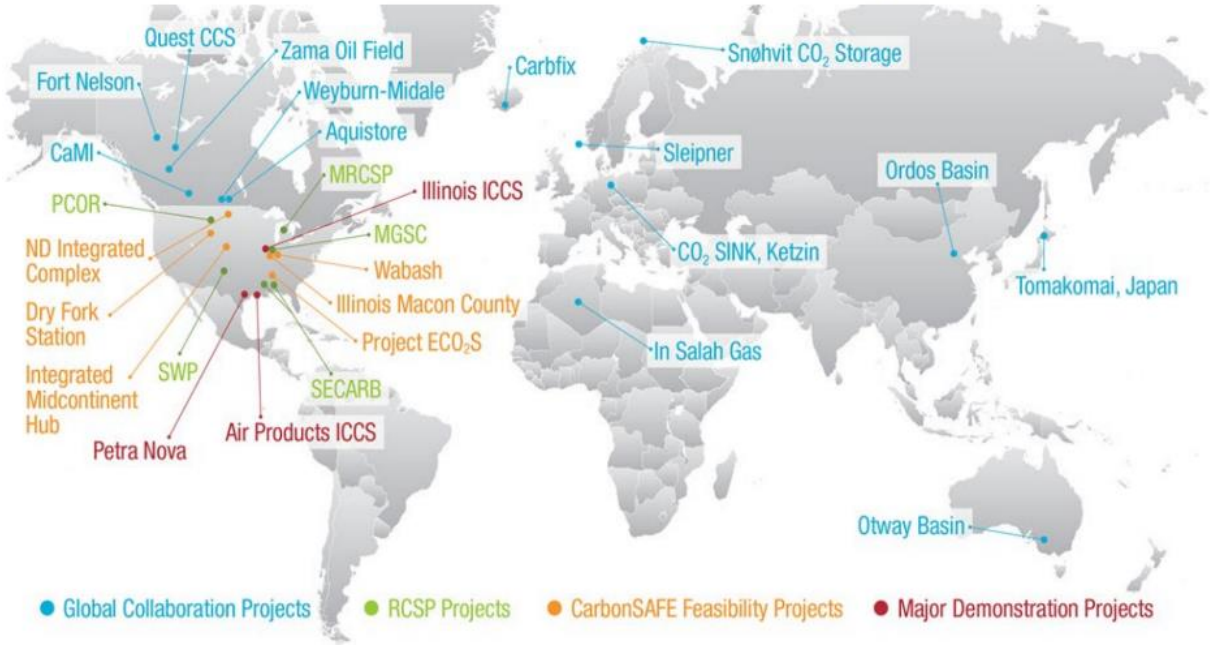
There is a significant amount of current data availability on the OCS that can be leveraged for developing CCS projects. The pink areas in the maps below show data available in the continental US (left) and in the Gulf of Mexico (right). These data cover hundreds of thousands of square miles.



EXPERIENCE

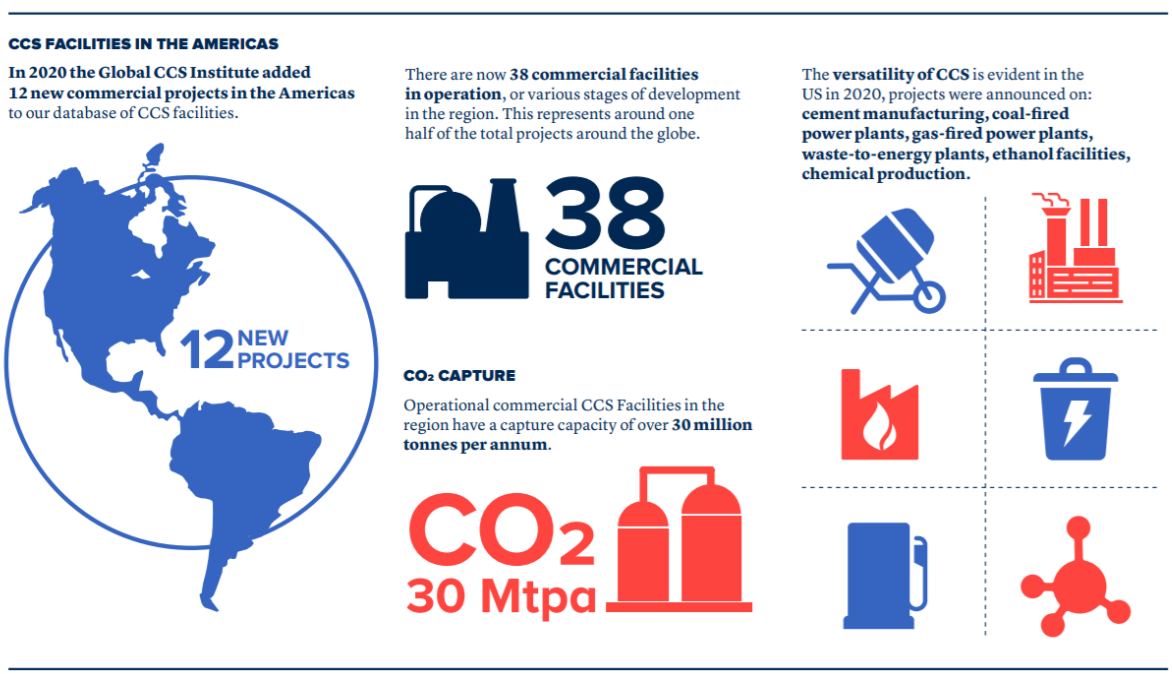
Over the last 20 years, the US Department of Energy has spent billions of dollars developing CCS technology, which is now at a high technology readiness level and ready for widespread deployment.

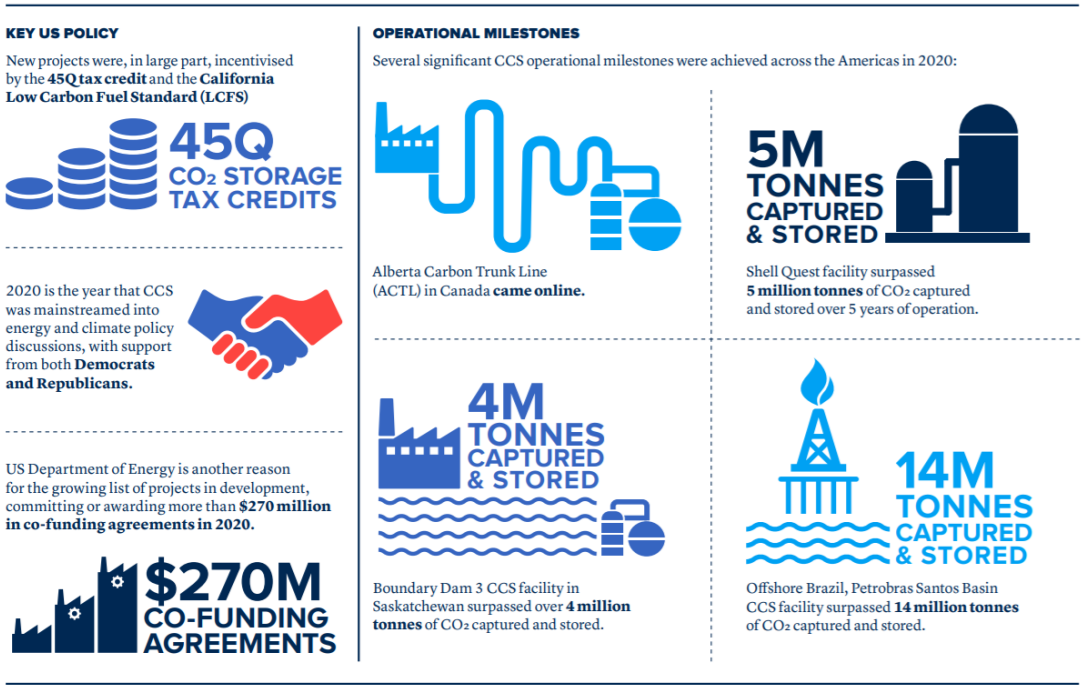
Exhibit 2-2. Map depicting locations of major U.S. DOE/NETL projects and global collaborations



The summary images below illustrate the current state of CCS in the Americas as determined by the Global CCS Institute.

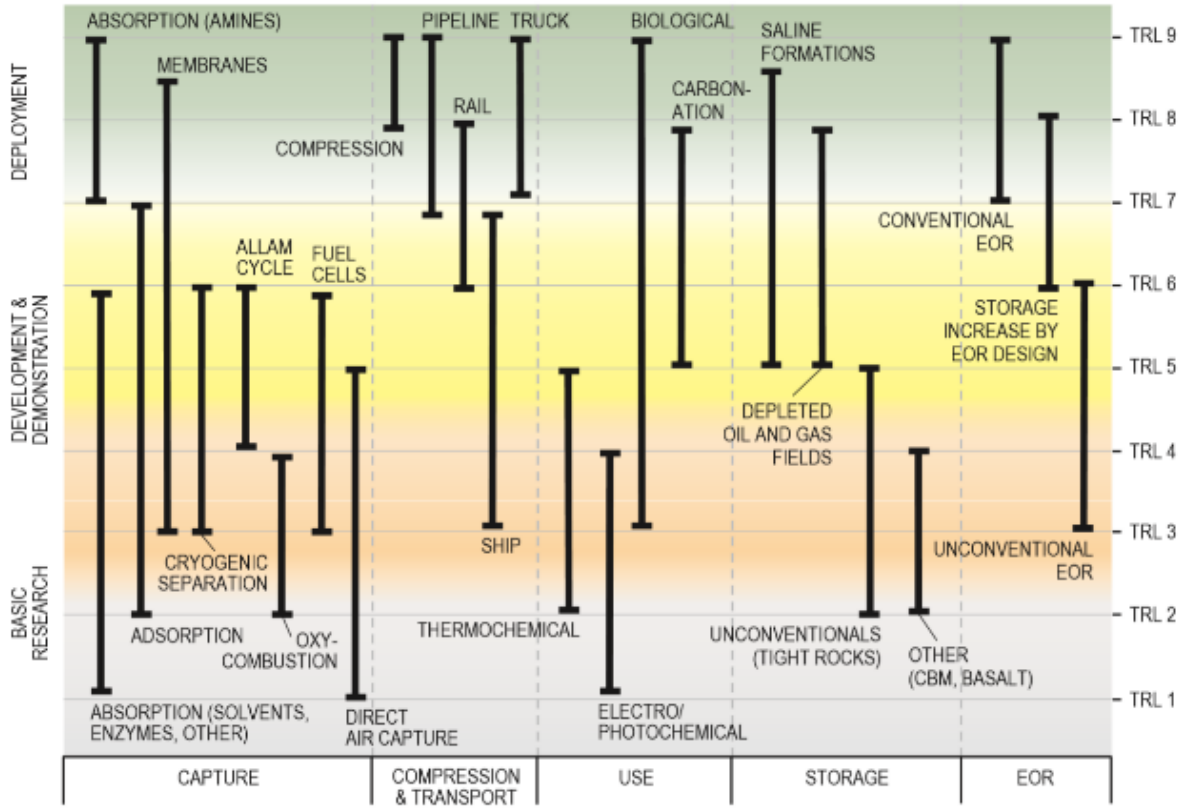
4.1 AMERICAS





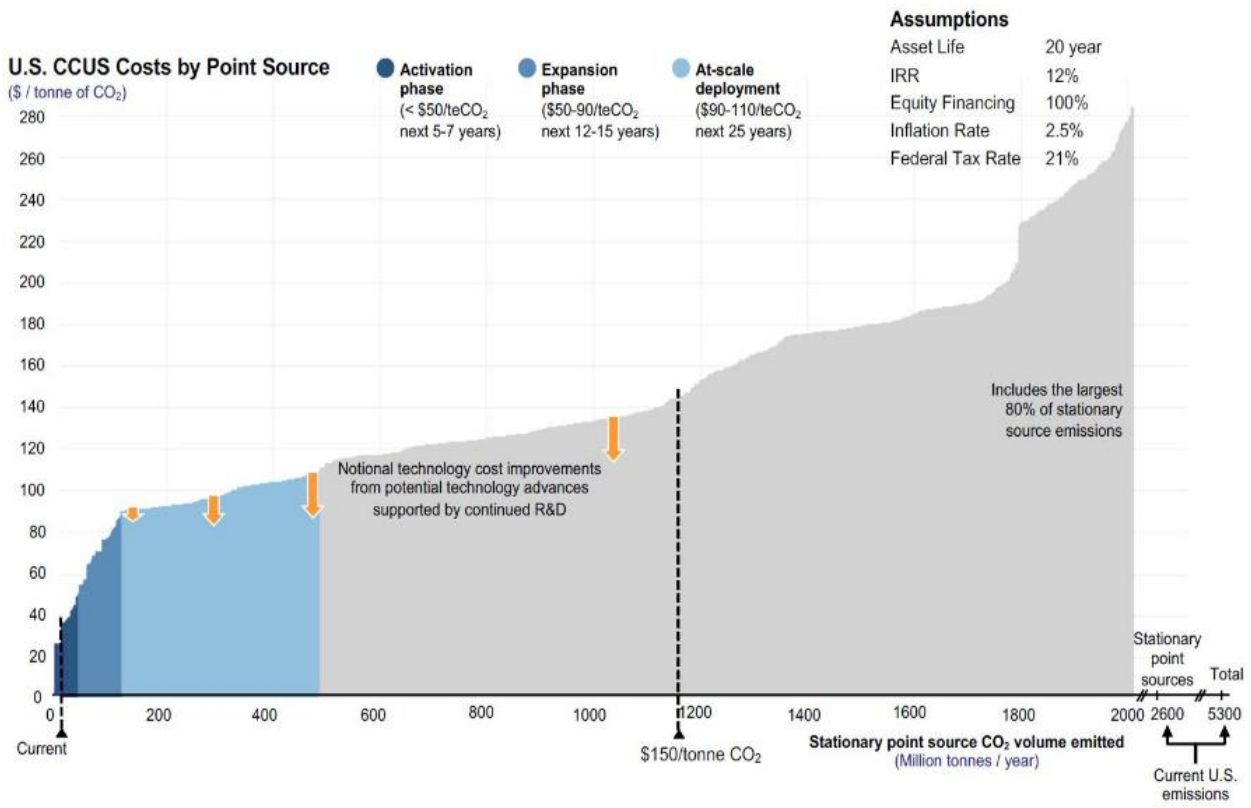
All of the components of CCS currently have some technologies at high Technology Readiness Level (TRL) in the deployment phase. Each component also has many technologies at lower TRL level that will continue to be developed for fit-to-purpose projects. The image below is from the National Petroleum

Council Report: *Meeting the Dual Challenge - A Roadmap to At-Scale Deployment of Carbon Capture, Use, and Storage*. The report was provided to the Secretary of Energy in 2019.



COSTS

The costs of CCS are high, mostly related to emissions capture engineering, but also including transport and subsurface storage. The costs of capture technology are falling, as is typical for all technologies as they move from demonstration to commercial deployment. The National Petroleum Council study provides the graphic below for considering the amount of CO_2 abatement possible (horizontal axis – millions of tons of CO_2), and the approximate costs for mitigating incremental amounts of CO_2 emission. The current IRS Section 45Q tax credit is around $39/ton and consideration is underway to raise that to $85/ton. At $85/ton credit value, NPC estimates that approximately 150 million tons of CO_2 could be abated. Currently, companies are paying as much as $600/ton for carbon offsets, suggesting the value of carbon may eventually rise to allow for mitigation of billions of tons of CO_2, which would be a significant portion of the national targets by 2050.



INDUCED PRESSURE

Decades of wastewater injection in the onshore counties of the Gulf of Mexico geologic basin indicate that risks of induced seismicity in Gulf of Mexico geology are low and unlikely to replicate our onshore experience in older and more brittle onshore geologic basins.

Examples of giga-ton scale storage are illustrated by this wastewater injection experience, illustrating the value of Gulf of Mexico geology (and OCS in general) as a CO_2 storage resource.

MIGRATION OF BUOYANT FLUIDS

The offshore region has lower density of legacy wells than onshore, and those wells are generally younger with better documented engineering.

Prior experience onshore managing CO_2 retention has been accomplished in projects involving hundreds of CO_2 injection wells. Offshore projects will benefit from this experience.

MONITORING

Using Department of Energy funding, I have personally led the deployment of 3D seismic subsurface imaging technology for CCS monitoring both in the Gulf of Mexico and in Japan. New technologies will evolve, but we know how to monitor injection sites for safe operation today.

European experience with CO_2 monitoring of both offshore subsurface and marine ecosystems provides a strong background for work in the US offshore.

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