

Data Science for International Offshore Carbon Capture and Storage

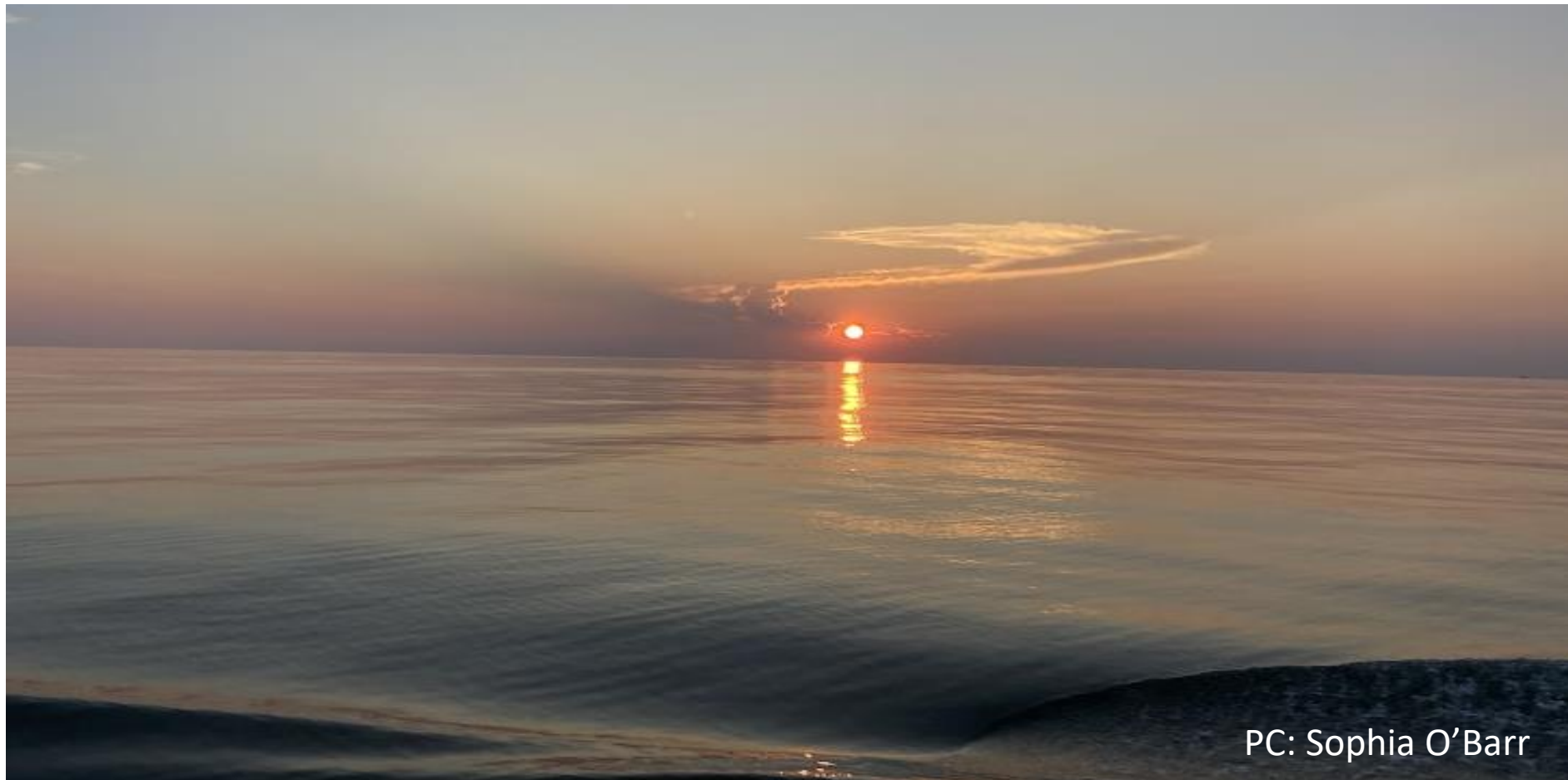


Carbon Storage Data FWP, Task 4

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National Energy Technology Laboratory

**NETL Carbon
Management
Review Meeting**

Aug. 30th, 2023



PC: Sophia O'Barr

Disclaimer



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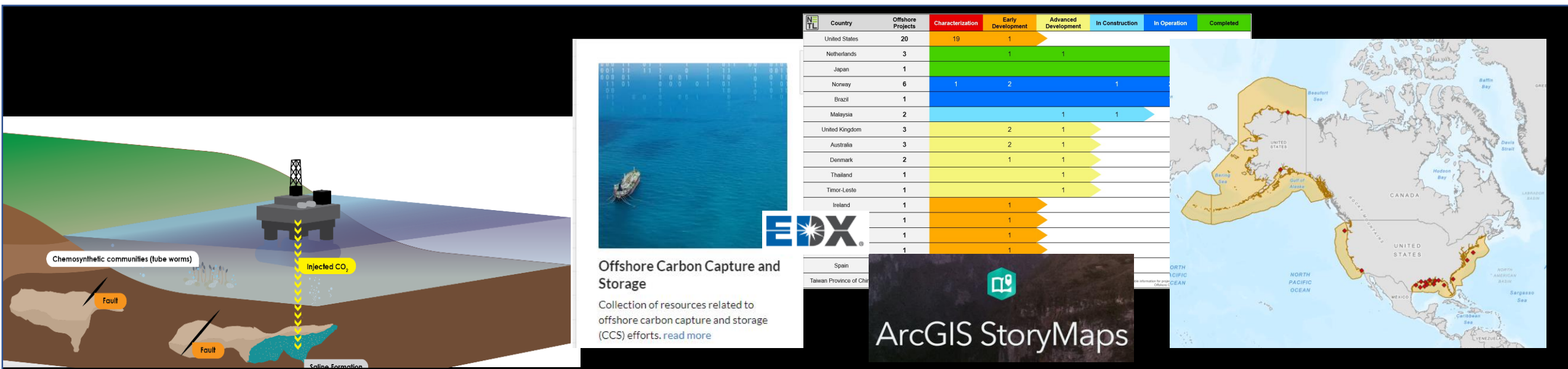
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Task 4.0: Data Science for Offshore CCS (EY22-24)

Goal ⇒ To use data science methods to understand data resources and capabilities presently available to support rule making and strategic needs for U.S. offshore CCS.

- Leverage data science methods and tools to help find, aggregate, synthesize and share information and resources relevant to informing and accelerating opportunities for U.S. offshore CCS/GCS
- Aggregate findings in technical reports and accompanying interactive database via EDX



Offshore Carbon Capture and Storage EDX Group

- Elected existing offshore data resources on EDX to Group
- Groups allow users to browse data/information collections by theme
- Includes multi-scale data e.g. well interpretation, geologic domains
- Contains offshore-relevant databases e.g. Gulf of Mexico Risk Analysis Database (GOMRaD)
- Can facilitate migration of spatial data into EDX Spatial, inclusion in Carbon Storage Open Database
- <https://edx.netl.doe.gov/group/offshore-carbon-capture-and-storage>




Followers

2

Submissions

28

 Following

 Data Usage: 11.544 GB

 Downloads: 5601

 Resources: 78



Offshore Carbon Capture and Storage

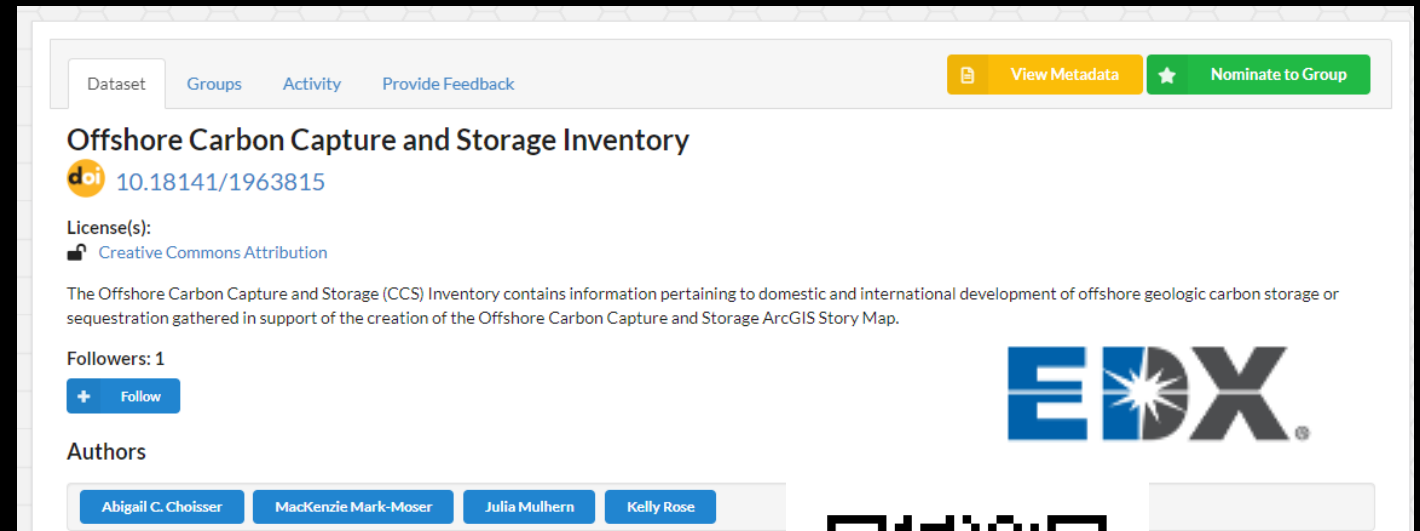
Collection of resources related to offshore carbon capture and storage (CCS) efforts. [read more](#)

Offshore Geologic Carbon Storage Inventory

Spreadsheet inventory containing information pertaining to domestic and international development of offshore geologic carbon storage or sequestration

Includes:

- Offshore Literature Resources
- Offshore Data Resources
- US and International Offshore GCS site/characterization information

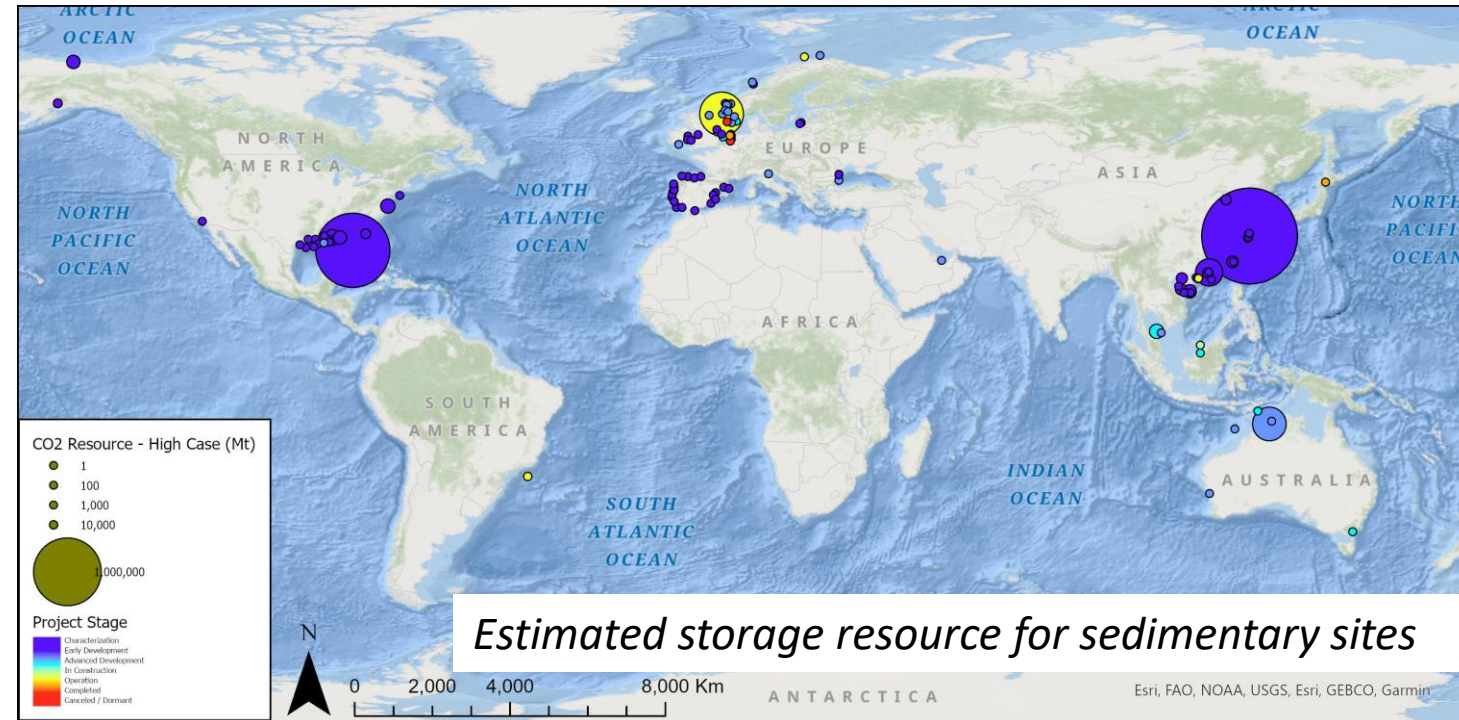


<https://edx.netl.doe.gov/dataset/offshore-ccs-data-inventory>



Offshore Geologic Carbon Storage Inventory

- ***Version 1 released EY21 Q1***
 - Initial collection of information on offshore carbon capture and storage aggregated in tabular format
- ***Offshore GCS Inventory version 1.1 release mid-September***
- ***Planning regular updates to inventory***
- ***Version 2 to be expanded to include additional sites***

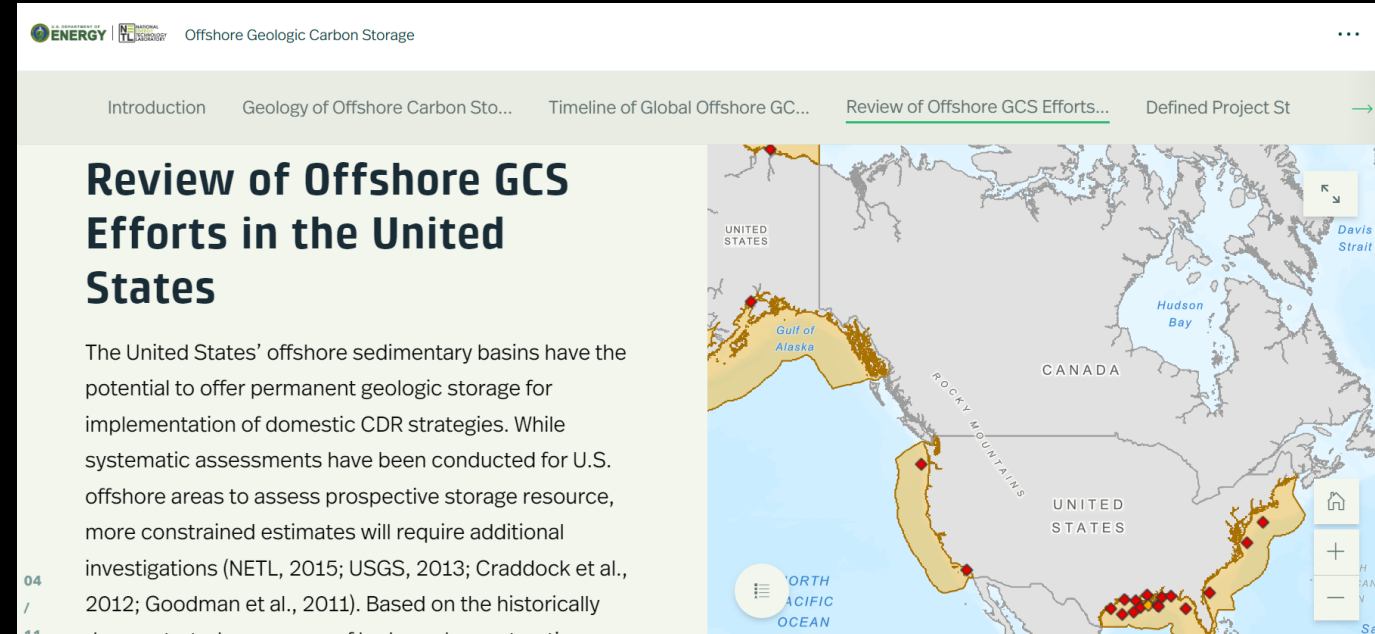


<https://edx.netl.doe.gov/dataset/offshore-ccs-data-inventory>



Offshore Geologic Carbon Storage StoryMap

- **Esri Story Map** provides review of global offshore CCS information and carbon storage characterizations and operations
- Visualizations communicate Offshore CCS progress, stages, locations
- **Synthesizes information gathered in Offshore Carbon Capture and Storage Inventory v1.0**
- **Available via EDX Offshore Carbon Capture and Storage Group**



Status of global offshore GCS projects and characterization studies

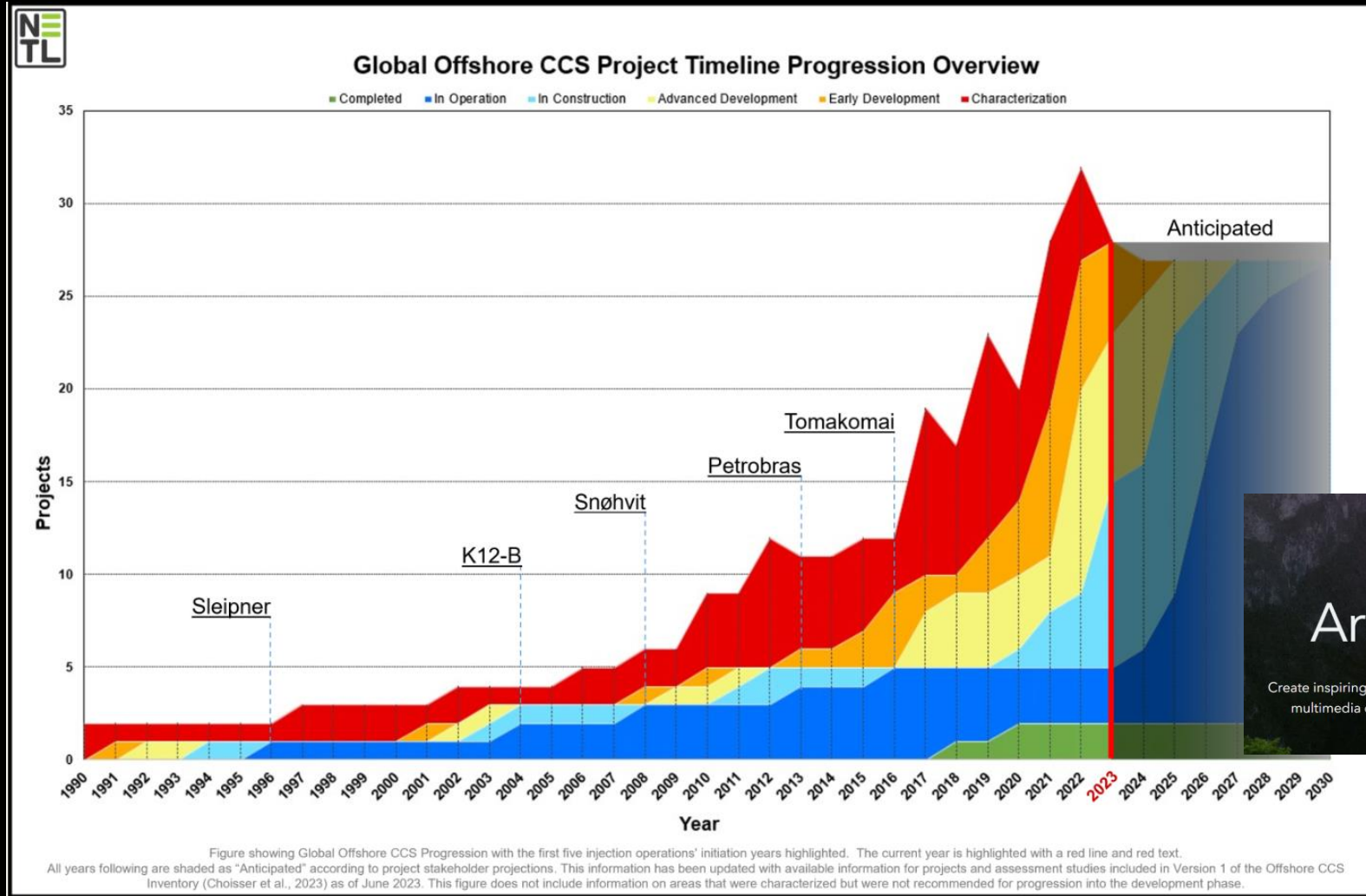
NETL	Country	Offshore Projects	Characterization	Early Development	Advanced Development	In Construction	In Operation	Completed
	United States	20	19	1				
	Netherlands	3		1	1			1
	Japan	1						1
	Norway	6	1	2		1	2	
	Brazil	1					1	
	Malaysia	2			1	1		
	United Kingdom	3		2	1			
	Australia	3		2	1			
	Denmark	2		1	1			
	Thailand	1			1			
	Timor-Leste	1			1			
	Ireland	1		1				
	Italy	1		1				
	Bulgaria	1		1				
	United Arab Emirates	1		1				
	Spain	1	1					
	Taiwan Province of China	1	1					

This information has been updated with available information for projects and assessment studies included in Version 1 of the Offshore CCS Inventory (Choi et al., 2023) as of March 2023.

 **ArcGIS StoryMaps**

Create inspiring, immersive stories by combining text, interactive maps, and other multimedia content. Publish and share your story with your organization or everyone around the world.

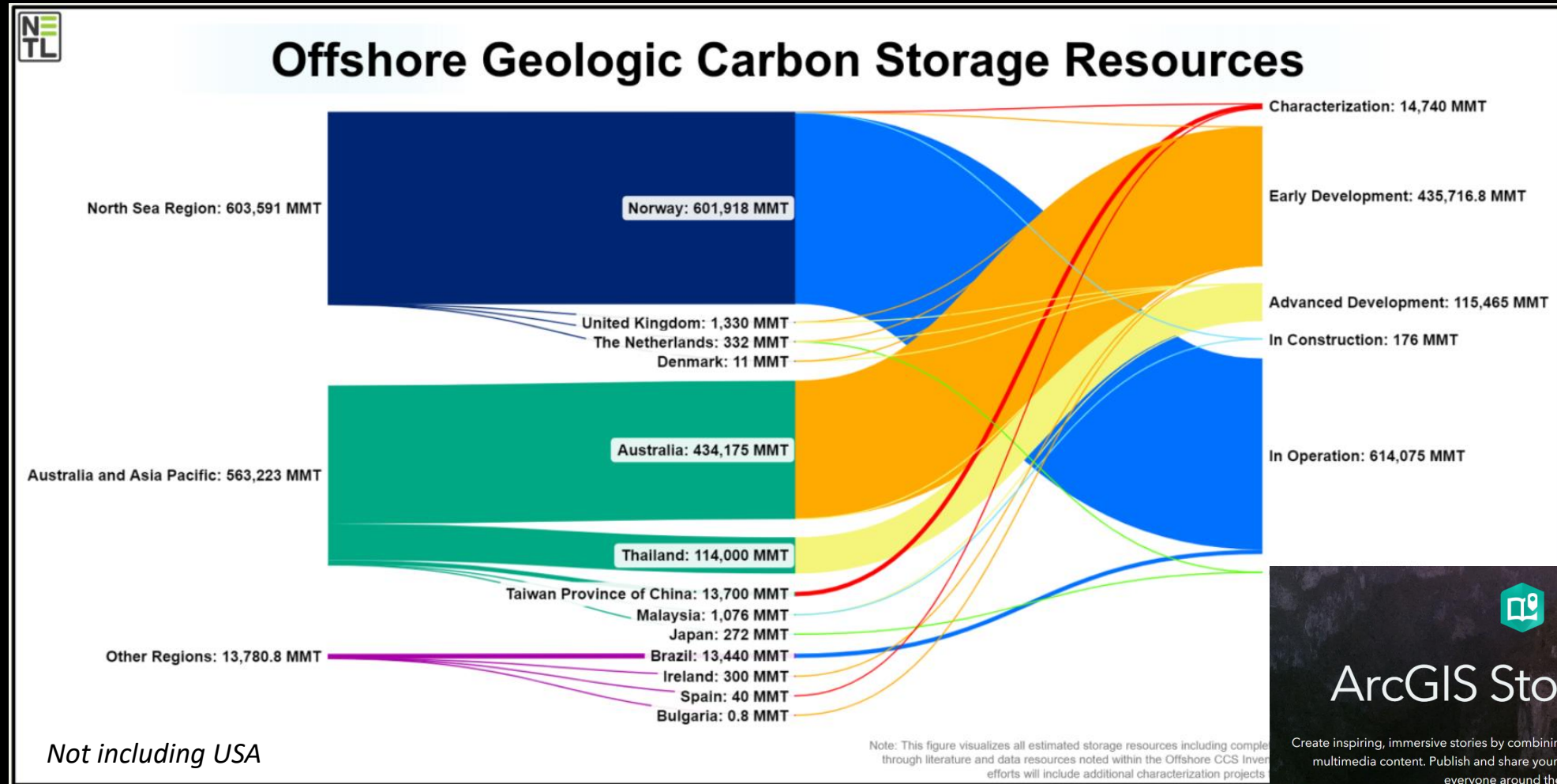
Global Offshore GCS Project Timeline Progression Overview



ArcGIS StoryMaps

Create inspiring, immersive stories by combining text, interactive maps, and other multimedia content. Publish and share your story with your organization or everyone around the world.

Overview of International Offshore Geologic Carbon Storage Resources




ArcGIS StoryMaps

Create inspiring, immersive stories by combining text, interactive maps, and other multimedia content. Publish and share your story with your organization or everyone around the world.

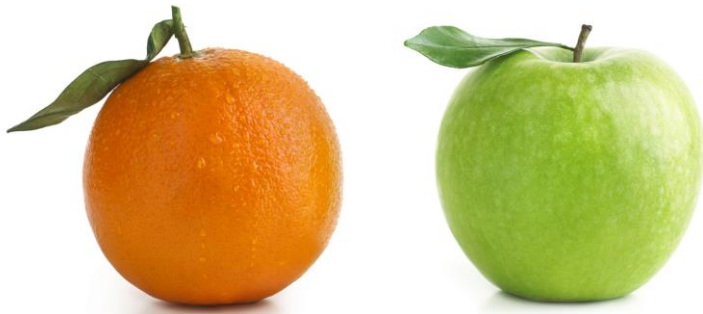
Offshore GCS Technical Report

- Technical report expands on Offshore GCS information overview in Story Map
- **Increased detail** on international vs. domestic CS sites
- Once published, will be nominated to **Offshore Carbon Capture and Storage EDX Group** along with Story Map, spatial data layers produced from Offshore GCS inventory, Carbon Storage Open Database, Gulf of Mexico GeoCube, other pertinent offshore GCS/CCS resources
- Expected finalized publication EY23 Q3

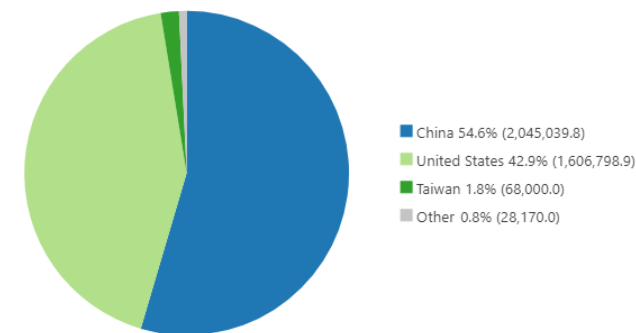
The screenshot displays the EDX website interface. At the top, the header includes the EDX logo, the text 'NETL's Energy Data eXchange', and a search bar with the placeholder 'Find data products on EDX...'. Below the header is a navigation bar with links for 'Search', 'Contribute', 'Groups', and 'Portfolios'. The main content area features a section titled 'What is a Group?' with a brief explanation: 'Groups allow you to group together submissions under a community (for example Environment) to make it easier for users to browse submissions by theme. Submitting or editing or authorization purposes.' Below this is a search bar labeled 'Search groups...' and a result count '58 groups found'. A blue button with a plus sign and the text 'Add Group' is visible. On the right side, there is a featured image of an offshore oil rig in the ocean, with the title 'Offshore Carbon Capture and Storage' and a description: 'Collection of resources related to offshore carbon capture and storage (CCS) efforts. [read more](#)'.

Offshore CCS Projects as Analogs

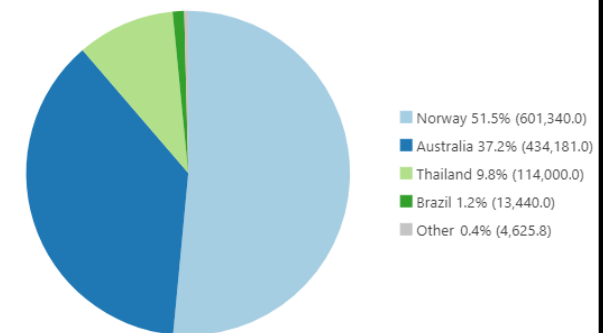
- Differences in reporting create discrepancies/challenges, e.g.
 - potential storage volume vs planned feasible injection volumes
 - Planned rates
- Project also vary in type, scale, scope, CO₂ source etc.



Characterization Projects Only - Sum CO2 Resource - High Case (Mt) by Country



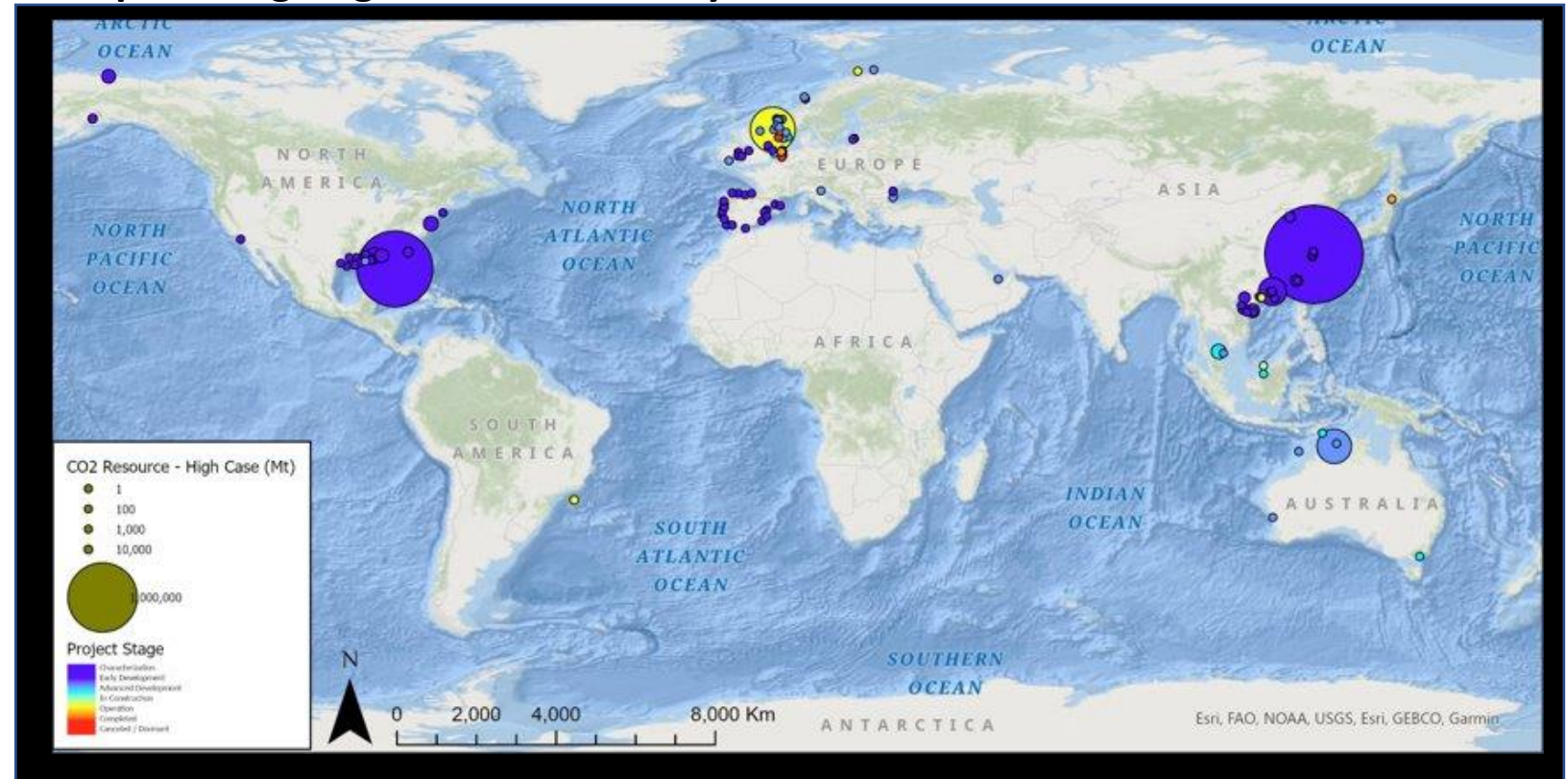
Non - Characterization Projects - Sum CO2 Resource - High Case (Mt) by Country



Inventory Expansion and Meta-Analysis

- Offshore GCS Inventory is being expanded:
 - Additional projects
 - Characterization Studies
 - Updated Projects and Global Characterization Studies
- Phase 2 will contains additional attributes and categoricals for each project/study
- Meta-analysis of the expanded dataset is on-going and will aim to highlight strengths and biases in the dataset
- Ultimately, ID crosscuts for US systems from international insights

Map of On-going Phase 2 Inventory Data Collection



Expanded attribute list:

- Spatial Information
- Project Metadata – Identification, Location, Descriptions, Water Depth, Distance from Coast, Companies Involved
- Categoricals – Stage, Project Type, Project Scope, CO2 Source, On vs. Offshore
- Project Size – High, Low, and Injection Range
- Timing – Expected Operational Year, End Date
- Reservoir Properties – Lithology, Fluid, Formation, Age, Porosity, Permeability, Thickness, NTG, EOD
- Seal Properties – Lithology, Thickness, Formation, Age

Mix of Project Types and Scopes

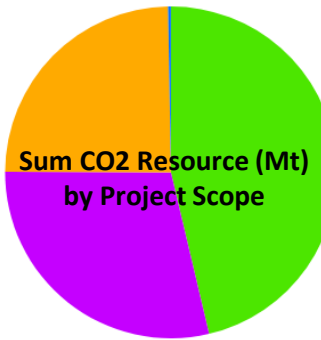
- Categoricals have been added to allow projects and studies to be filtered by the project type as well as the project scope
- This highlights the diversity of projects included in the dataset, ensuring that similar and contrasting types can be compared effectively

Number of Projects by Project Scope

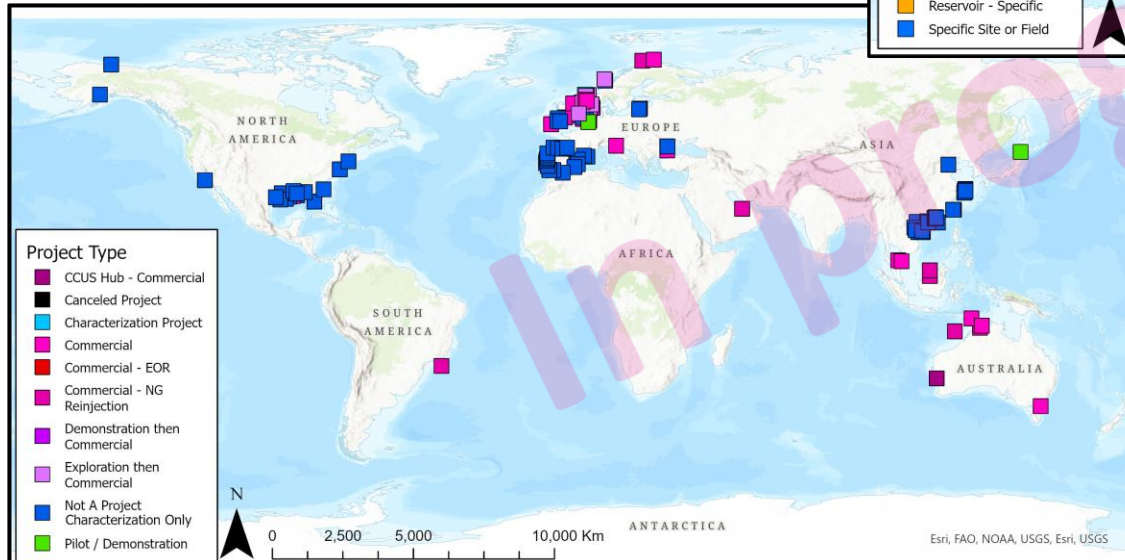
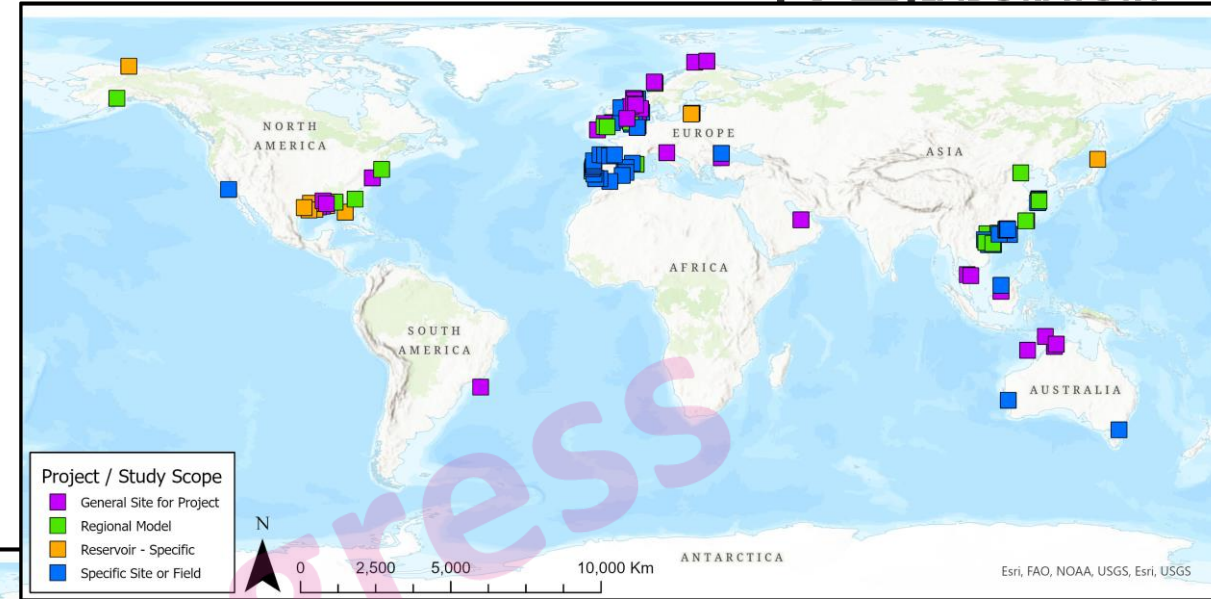


■ Specific Site or Field 40.3% (56.0)
■ General Site for Project 25.9% (36.0)
■ Regional Model 25.9% (36.0)
■ Reservoir - Specific 7.9% (11.0)

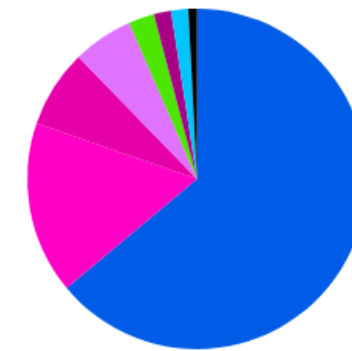
■ Regional Model 94.0% (41,235,850.4)
■ General Site for Project 3.2% (1,413,617.8)
■ Reservoir - Specific 2.8% (1,213,057.2)
■ Specific Site or Field 0.0% (13,120.1)



Sum CO2 Resource (Mt)
by Project Scope



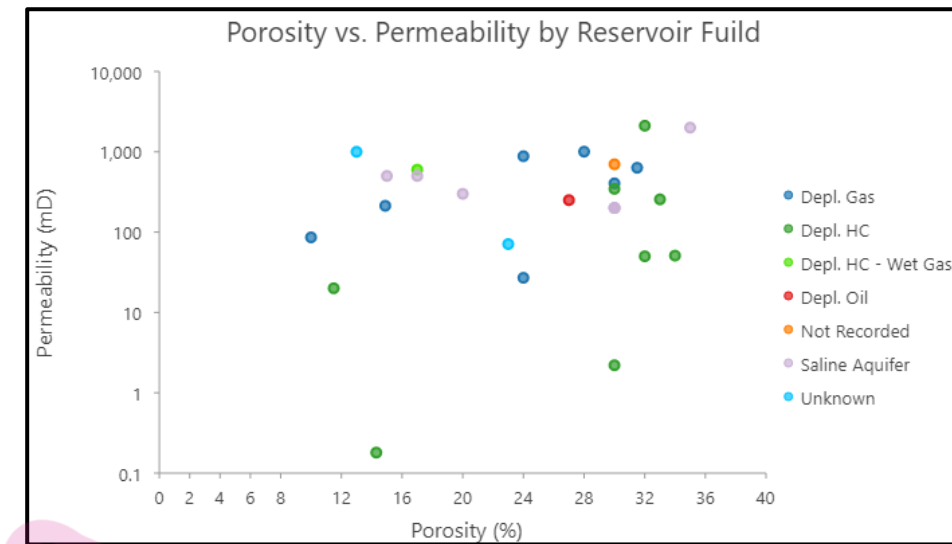
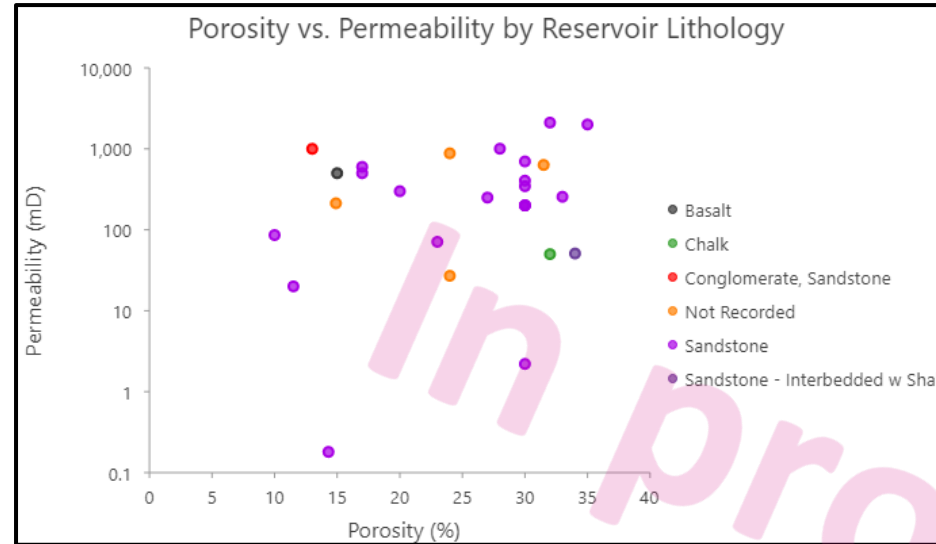
Number of Projects / Studies by Project Type



■ Not A Project - Res Char Only 63.9% (78.0)
■ Commercial 16.4% (20.0)
■ Commercial - NG Reinjection 7.4% (9.0)
■ Exploration then Commercial 5.7% (7.0)
■ Pilot / Demonstration 2.5% (3.0)
■ CCUS Hub - Commercial 1.6% (2.0)
■ Characterization Project 1.6% (2.0)
■ Canceled Project 0.8% (1.0)

Additional Attributes and Comparisons

- Aggregating and plotting porosity and permeability allows geology of projects to be compared
- Water depth, distance from coast, and CO2 source sector also included

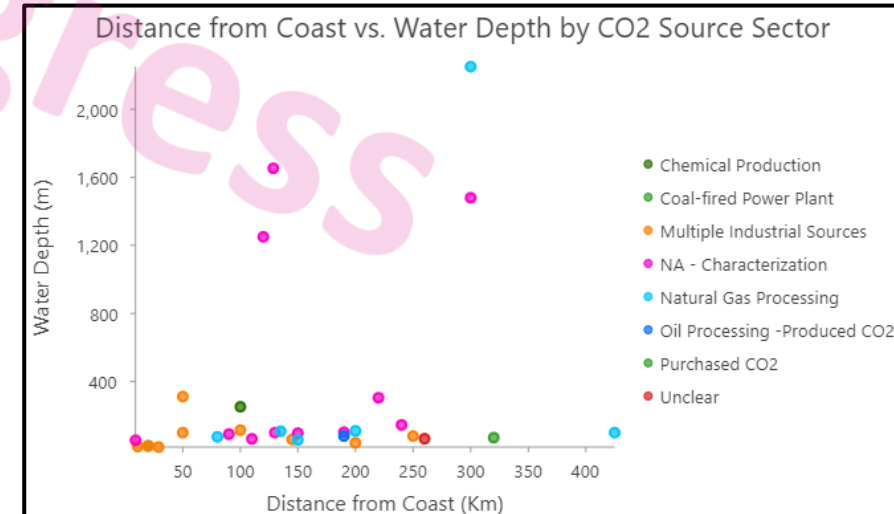
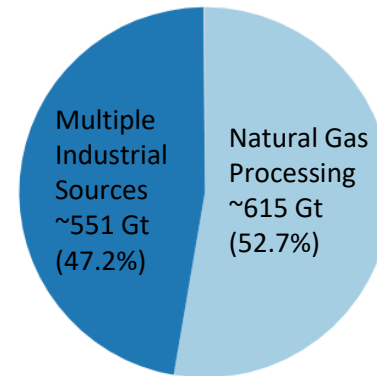


Work In Progress



Inventory and analysis are very much a work in progress, please reach out with thoughts, comments, and additional resources to include

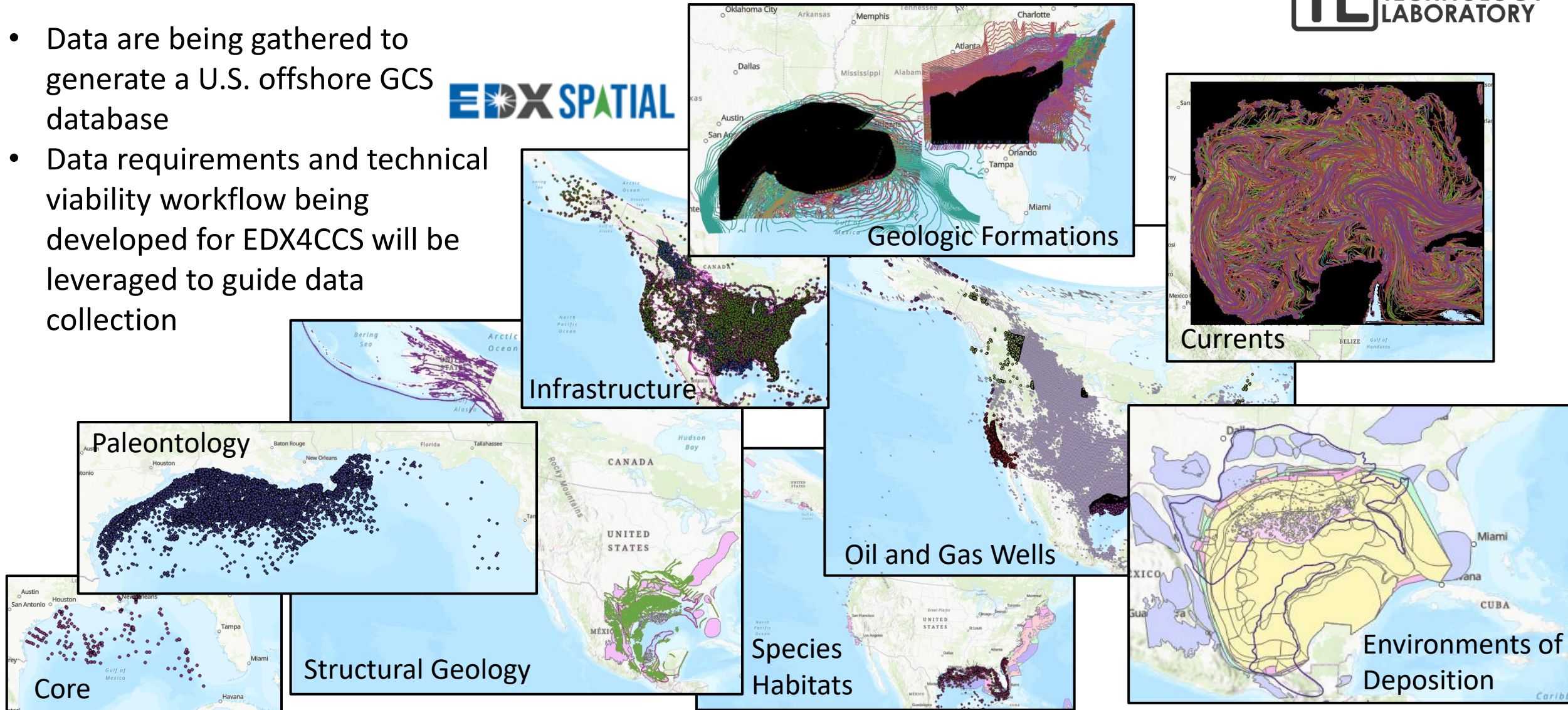
Sum of CO₂ Resource by CO₂ Source Sector (Characterization Studies Excluded)



Offshore GCS Database in Development

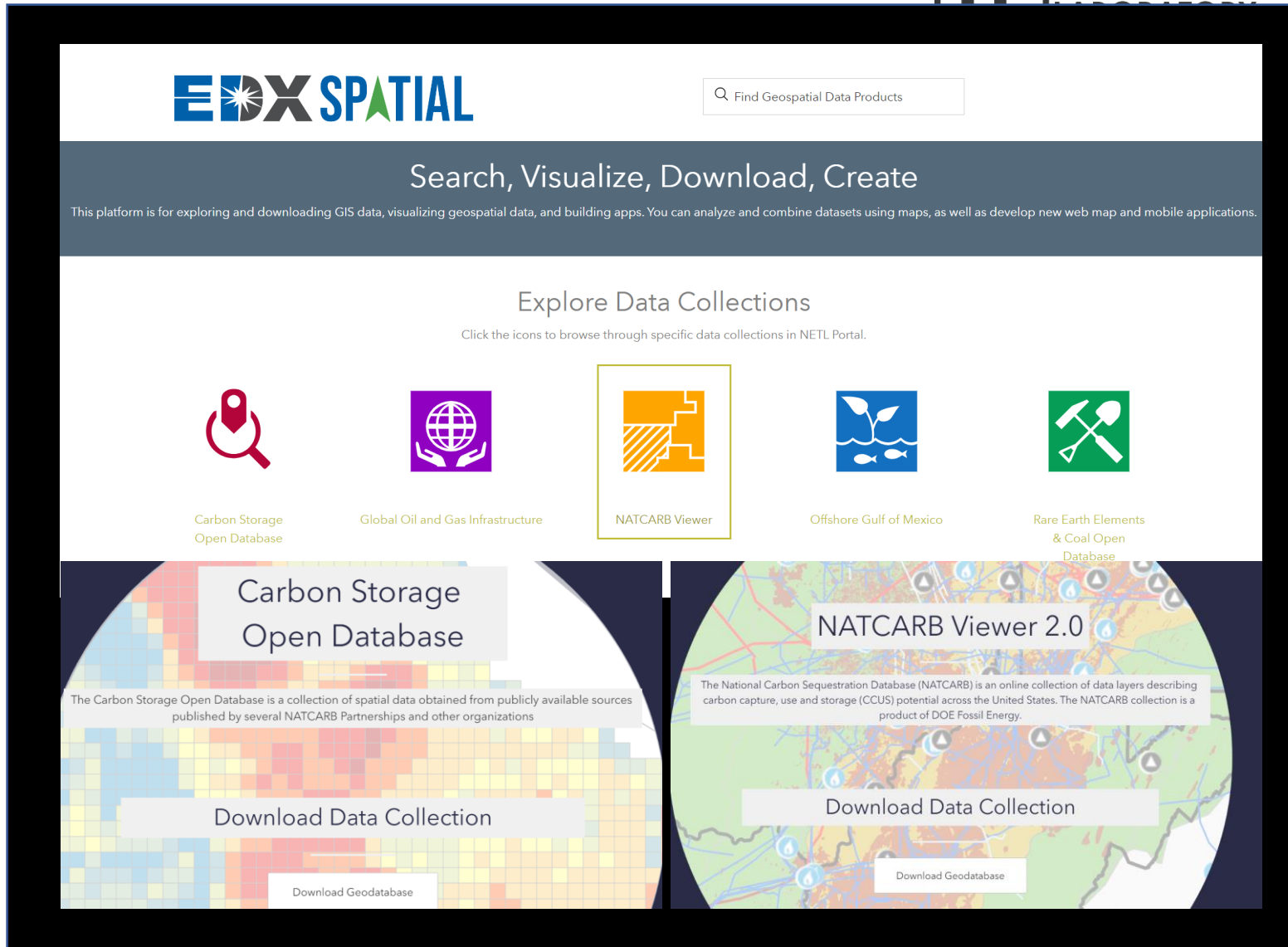
- Data are being gathered to generate a U.S. offshore GCS database
- Data requirements and technical viability workflow being developed for EDX4CCS will be leveraged to guide data collection

EDX SPATIAL



Interactive U.S. Offshore GCS Database, coming in EY24

- EDX Spatial, a curated web mapping platform of resources on EDX
- Supports visualization & access to spatial data
- Allows users to explore online and/or download
- Will host US Offshore CCS Database for public accessibility



Interconnects with other Projects



Offshore Carbon Capture and Storage

Collection of resources related to offshore carbon capture and storage (CCS) efforts. [read more](#)

EDX SPATIAL

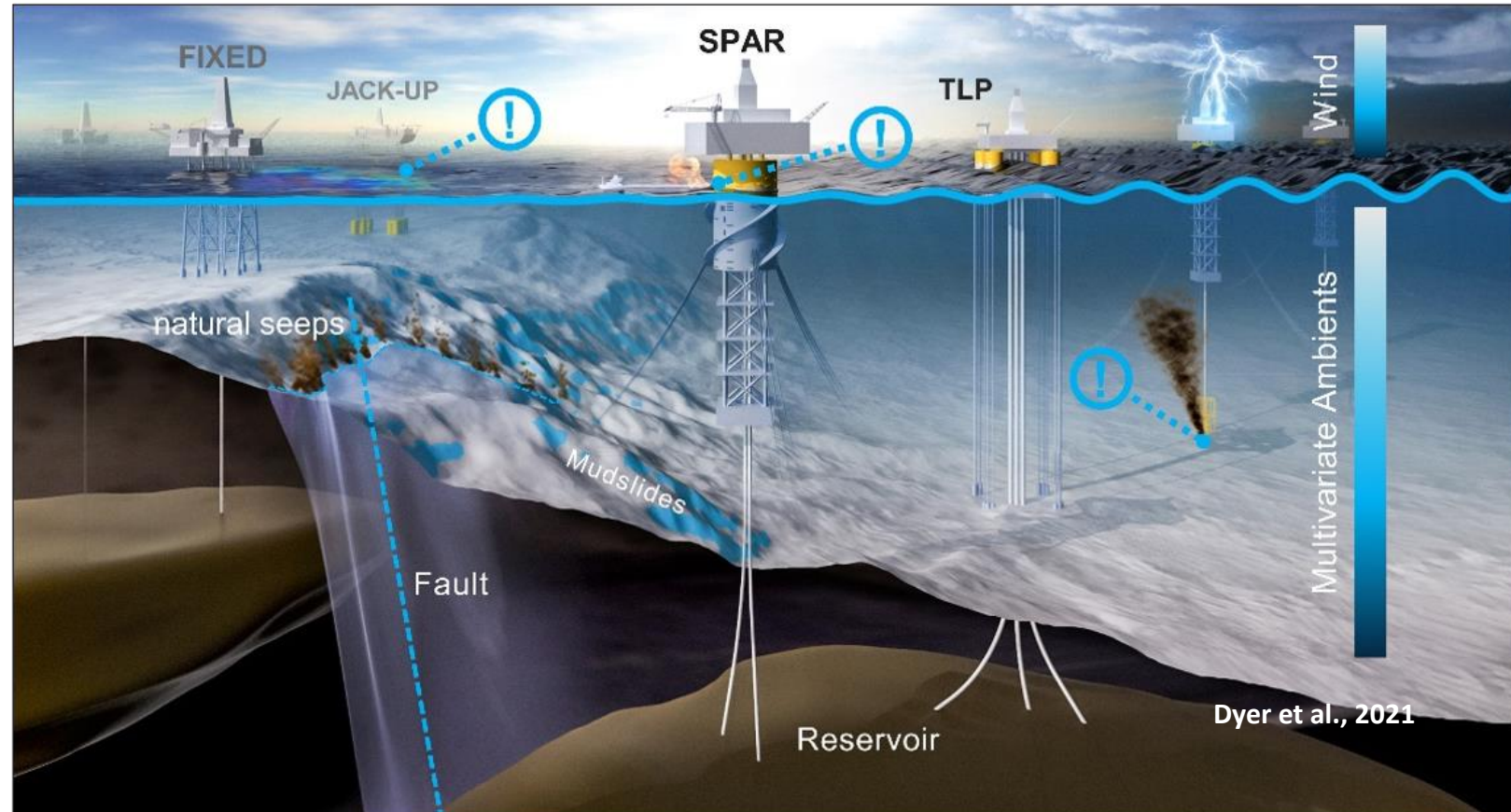


<https://edx.netl.doe.gov/disco2ver>

- **Carbon Storage Data Task 2:** Expanding Carbon Storage Open Database, EDX Spatial
- **Carbon Storage Data Task 5:** Inputs for Co-Saline Carbon Storage Method
- **EDX4CCS Task 21:** Leveraging Carbon Storage Technical Viability Approach Matrix for offshore data gathering
- **EDX4CCS Task 22:** Structural complexity analyses for U.S. offshore
- **EDX4CCS Task 31:** Inclusion of offshore core data in RokBase

Future Work for Carbon Storage Data 4

- Inclusion of infrastructure selected for offshore GCS
- Meta-analysis publication
- Point source distance analyses
- Release of U.S. offshore GCS open resource database
- Interactive web UI for data exploration



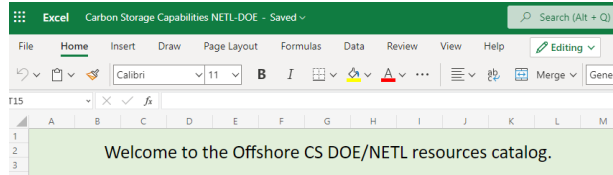
Carbon Storage Data Task 4 Summary

2022

2023

2024

- Compilation of key data resources on information supporting offshore CCS including geologic setting, infrastructure, policy
- Comprehensive, up-to-date review of international CCS efforts



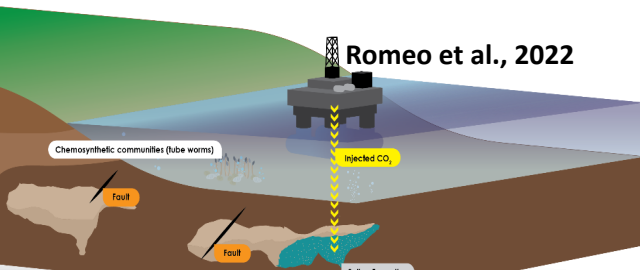
- Use NETL data science tools to update and integrate available data into U.S. Offshore CCS evaluations
- Compile and release U.S. offshore CCS open resource database v1

- Integrate additional data released from ongoing research and release U.S. offshore CCS open resource database v2
- Share findings and products with stakeholders

End Product:

Accessible databases covering both international CCS project products and data for **potential U.S. Offshore CCS**, accompanied by web user interfaces and technical reports **summarizing global offshore CCS efforts** to date

Makes available potential analogs, storage resource potential, carbon storage tools and data resources



Acknowledgments

EDX4CCS 2.1



This work was performed in support of the U.S. Department of Energy's (DOE) Fossil Energy and Carbon Management's Carbon Storage Data Project, FWP DE-FE 1022465.

NETL RESOURCES

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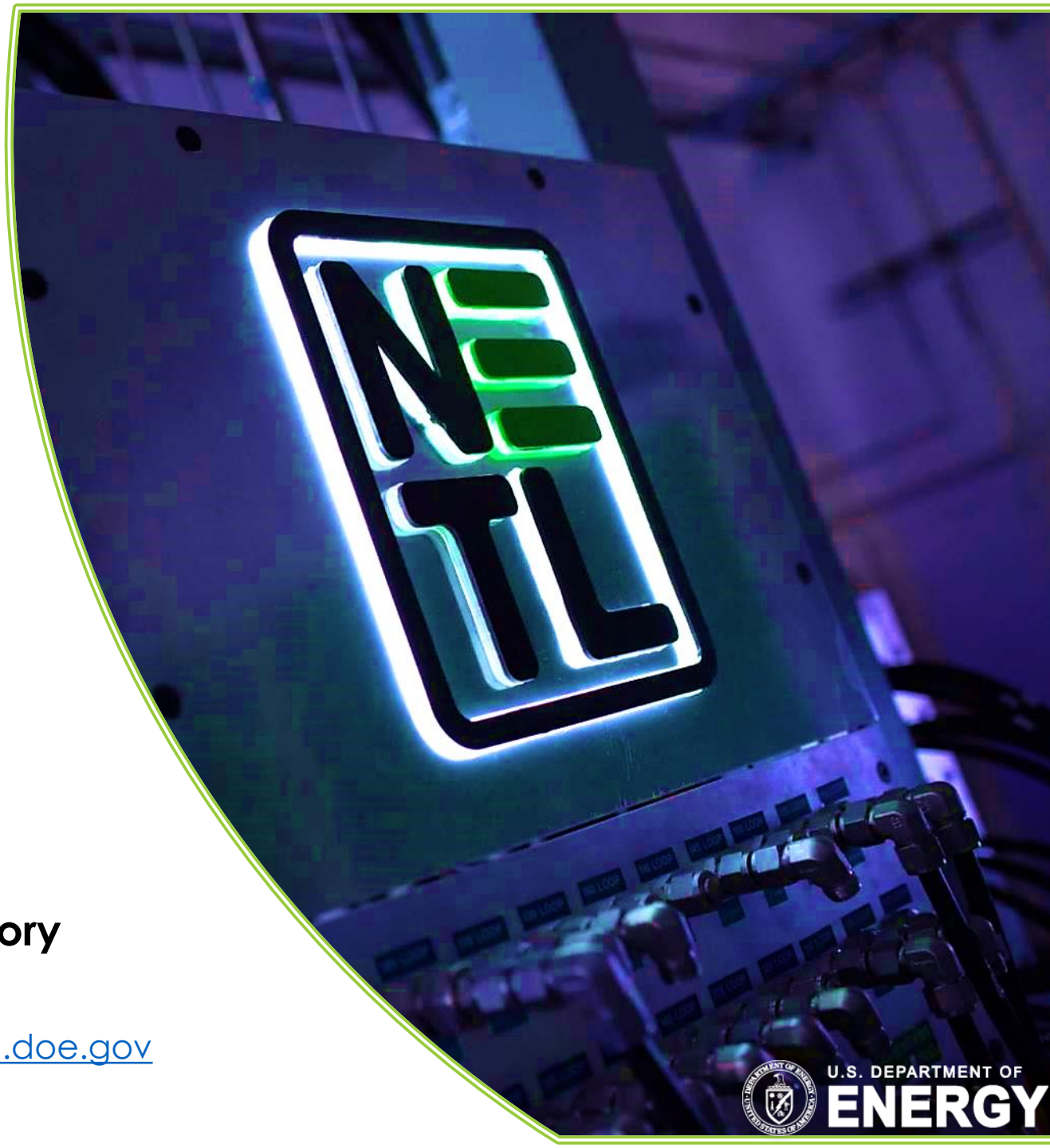


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POCs

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