

Carbon Storage Planning Framework Dashboard

Rapid insights into carbon storage data

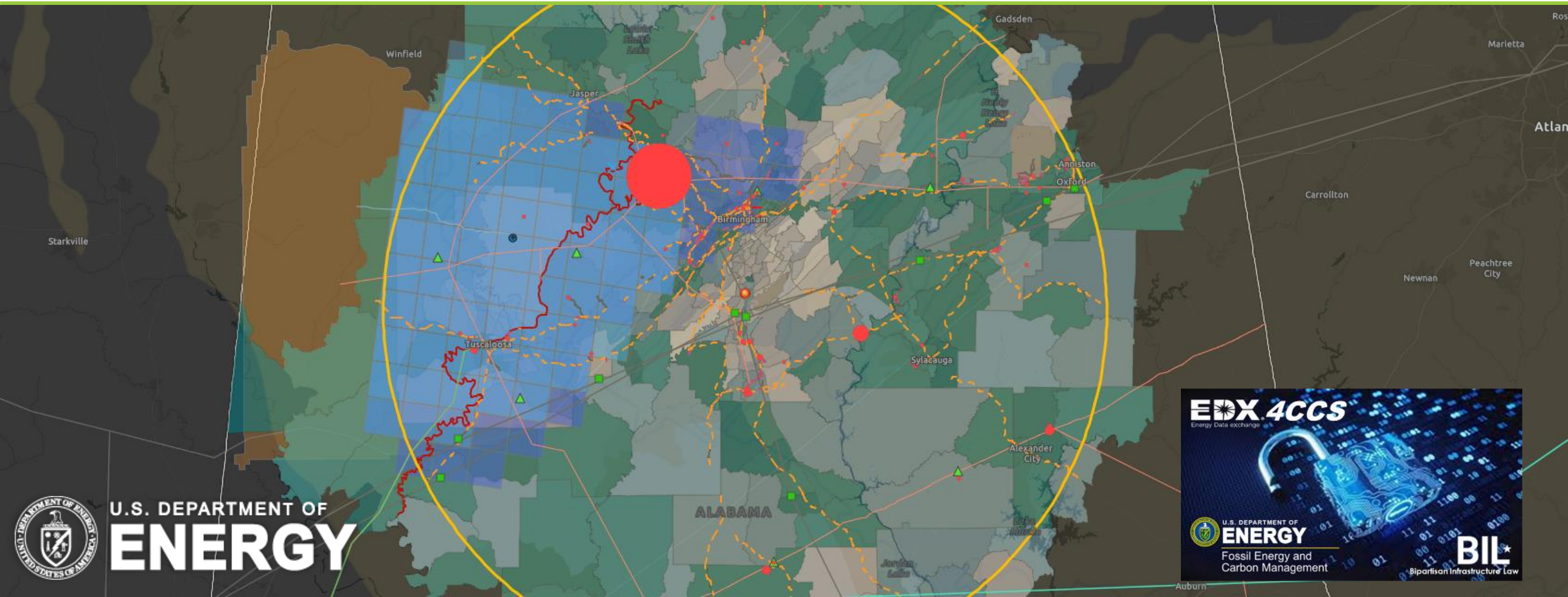


Devin Justman

Geology/Geospatial Research Scientist/NETL Support Contractor

2023 FECM/NETL Carbon Management
Research Project Review Meeting

Aug. 28, 2023



EDX 4CCS
Energy Data Exchange

U.S. DEPARTMENT OF
ENERGY

Fossil Energy and
Carbon Management

BIL
Bipartisan Infrastructure Law



Disclaimer



This project was funded by the U.S. Department of Energy, National Energy Technology Laboratory, in part, through a site support contract. Neither the United States Government nor any agency thereof, nor any of their employees, nor the support contractor, nor any of their employees, makes any warranty, express or implied, or assumes any legal liability or responsibility for the accuracy, completeness, or usefulness of any information, apparatus, product, or process disclosed, or represents that its use would not infringe privately owned rights. Reference herein to any specific commercial product, process, or service by trade name, trademark, manufacturer, or otherwise does not necessarily constitute or imply its endorsement, recommendation, or favoring by the United States Government or any agency thereof. The views and opinions of authors expressed herein do not necessarily state or reflect those of the United States Government or any agency thereof.

Authors and Contact Information



***Devin Justman^{1,2}, Scott Pantaleone^{1,2}, Maneesh Sharma^{3,4}, Lucy Romeo^{1,2}, Paige Morkner^{1,2}
Jennifer Bauer¹***

¹National Energy Technology Laboratory, 1450 Queen Avenue SW, Albany, OR 97321, USA,

²NETL Support Contractor, 1450 Queen Avenue SW, Albany, OR 97321, USA,

³National Energy Technology Laboratory, 3610 Collins Ferry Road, Morgantown, WV 26505, USA,

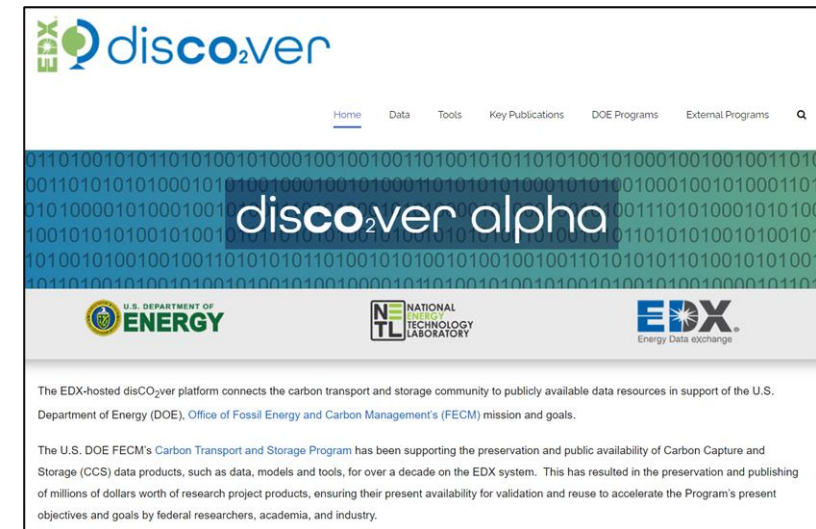
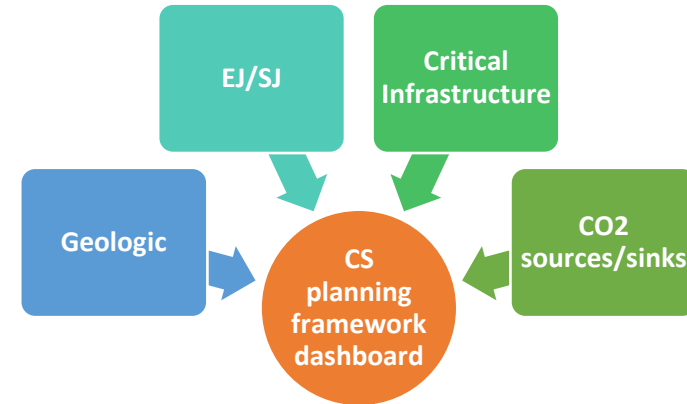
⁴NETL Support Contractor, 3610 Collins Ferry Road, Morgantown, WV 26505, USA



Carbon Storage (CS) Planning Framework Dashboard

Overview

- Ultimate Product**
 - Deploy and host the Carbon Storage Planning Framework Dashboard on the **EDX DisCO₂ver platform**.
- Challenge**
 - CS planning requires careful consideration of many geologic, technical, social, and environmental factors.
 - Integrate disparate, multi-sourced data into a user-friendly, interactive dashboard web application.
- Objective**
 - One-stop shop for visualizing, interrogating, and analyzing relevant datasets.
 - Develop, test, and deploy on the EDX DisCO₂ver platform.
- Value**
 - Provide quick, efficient access and key insights into CS datasets.
 - Support CS planning, feasibility, and resource assessment efforts.



EDX DisCO₂ver (Alpha) Website

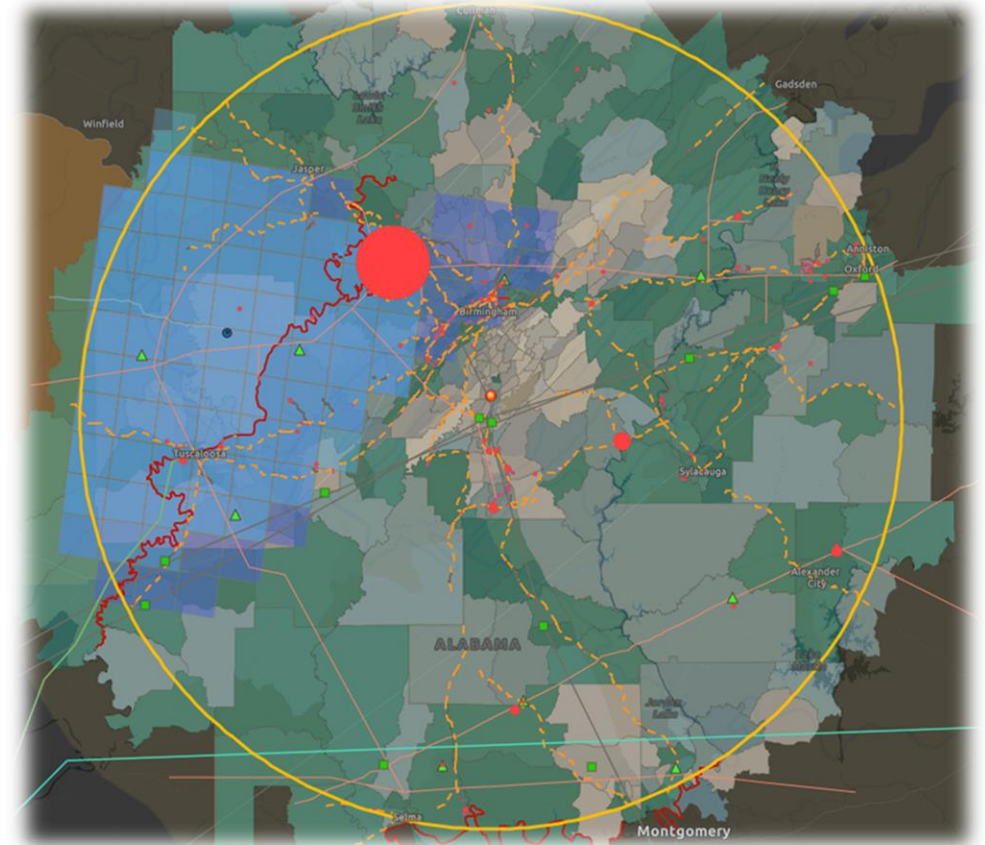
Carbon Storage (CS) Planning Framework Dashboard

Rapid insights for a variety of stakeholders

For any given area.....

- What are the population/community impacts?
- What are the potential natural hazards?
- What are the CO2 emissions sources and amounts?
- Are there candidate infrastructure for reuse?
- Are there potential CO2 reservoirs?
- What are current storage estimates?
- What are the current CS projects?

Potential stakeholders include well operators, policy makers, researchers, public, etc..

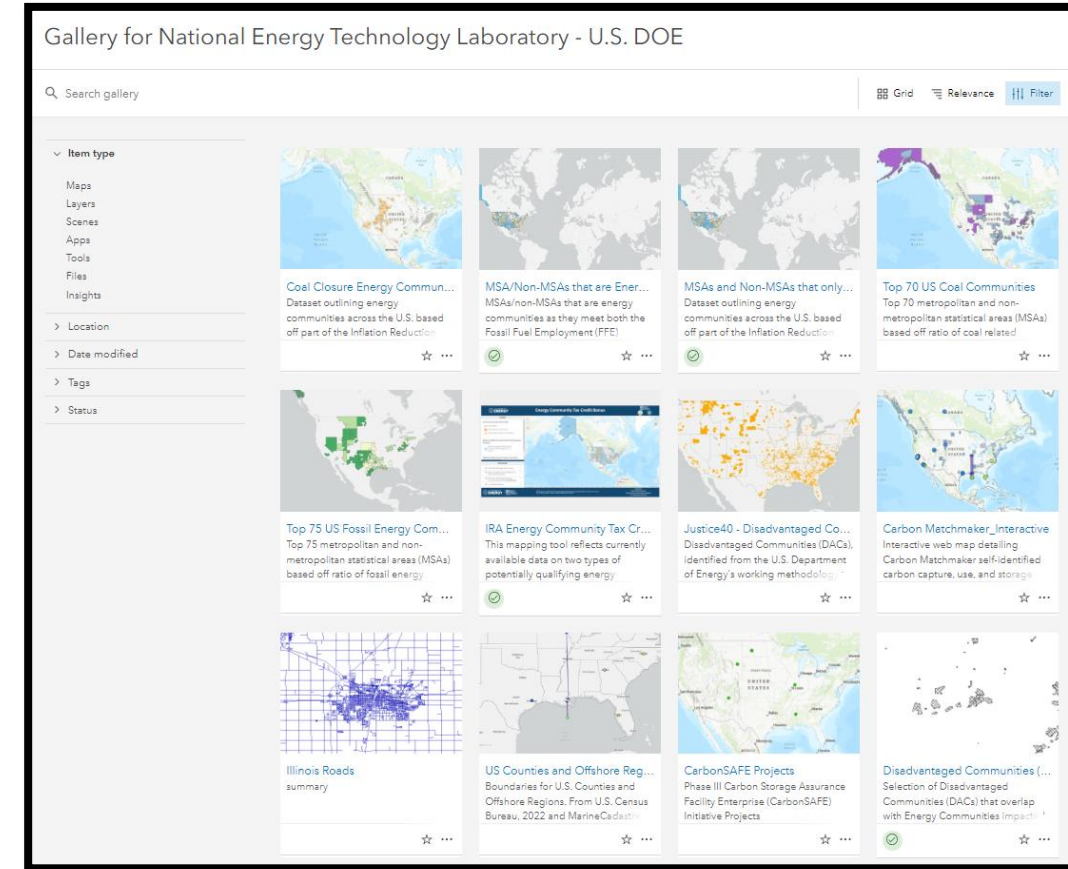


Example buffer query (yellow circle) of dashboard datasets

Carbon Storage (CS) Planning Framework Dashboard

Approach

- Identified the need for a user-defined radial based query functionality
 - Leverage ArcGIS Enterprise web applications
- Identify, prioritize, and catalog priority datasets across the EDX4CCS FWP and other CS data research most relevant to CS planned efforts
 - Incorporate data services where possible to streamline data updates
- Design the layout, functionality, and documentation of the dashboard to be user-friendly



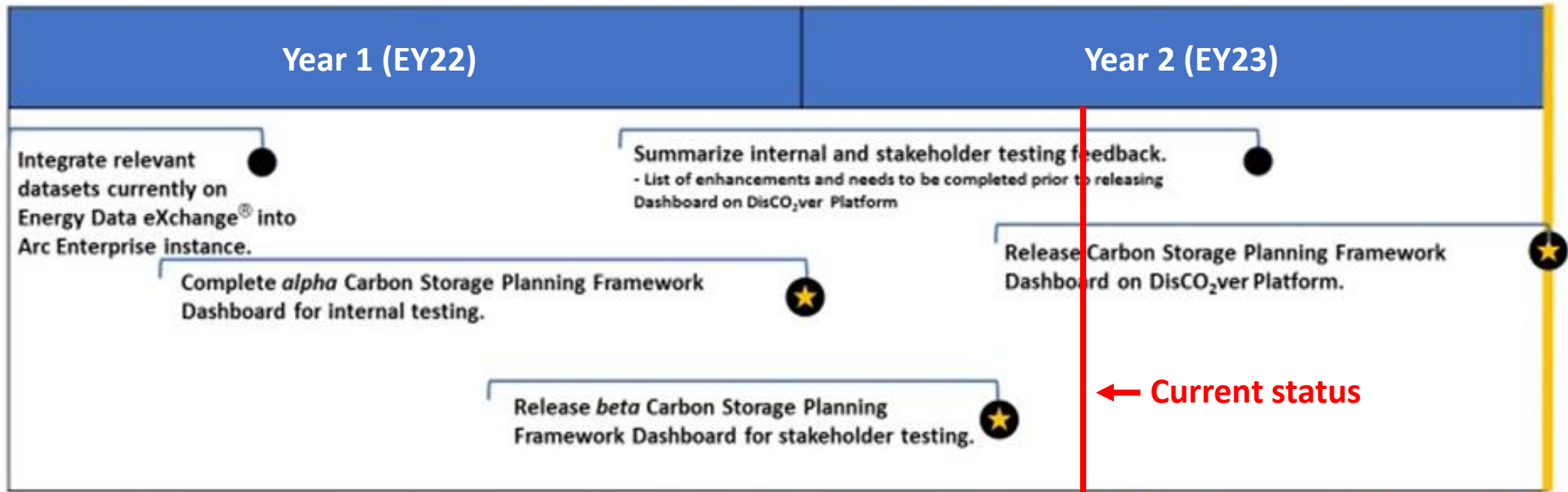
Example data, tools, application on NETL's ArcGIS Enterprise platform

Project Timeline

Goal ⇒ Develop an interactive CCS planning dashboard for DisCO₂ver Platform

- Enable the exploration and evaluation of geologic, technical, social, and environmental data for CCS planning through a user-friendly dashboard
- Support and accelerate CCS resource and feasibility assessments

EY = Effective Year: April - March

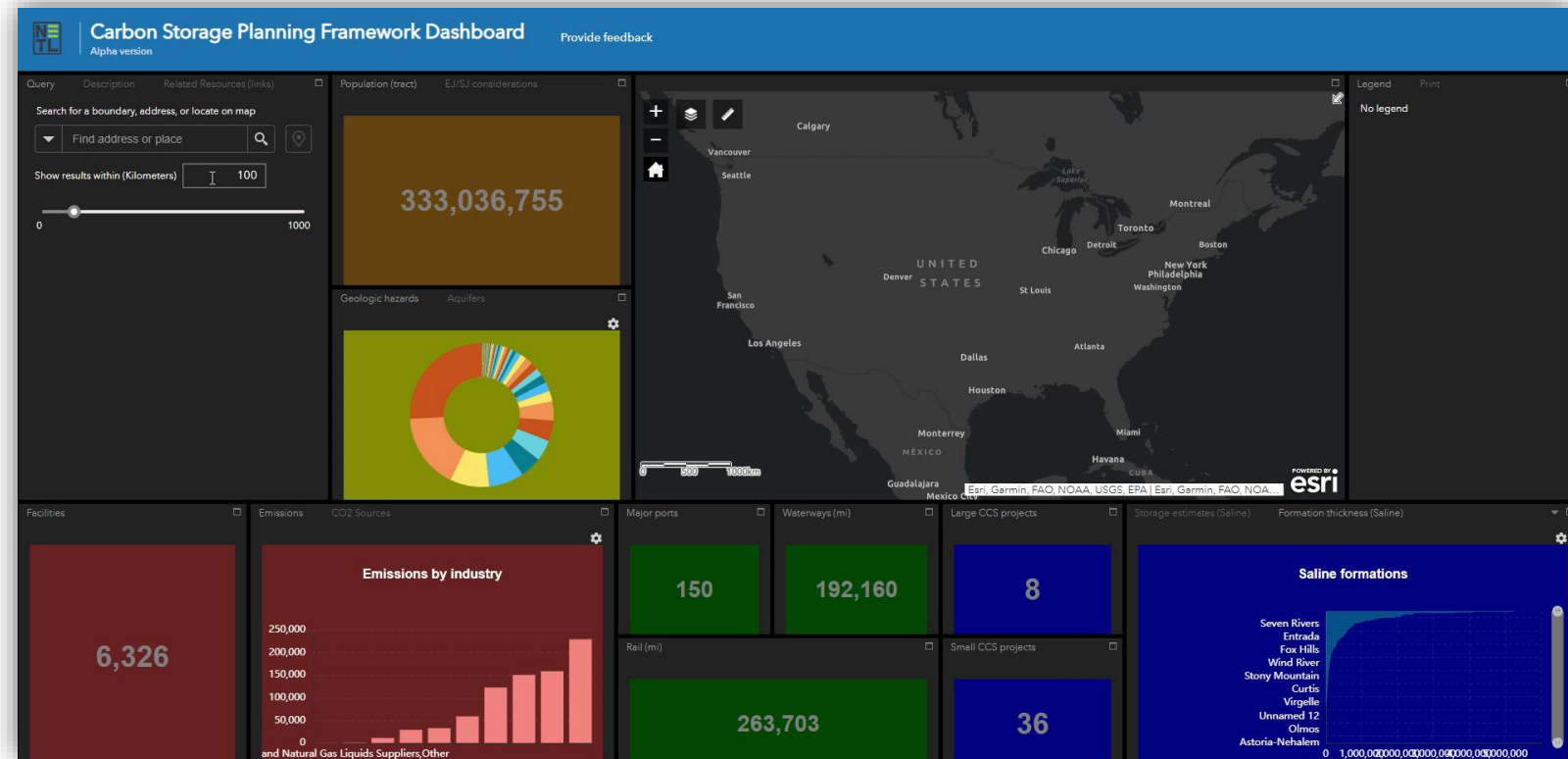


← Current status

Carbon Storage (CS) Planning Framework Dashboard

Year 1 accomplishments

- Developed the **Alpha version** of the dashboard within the **EDX multi-cloud ecosystem** for internal testing
- Identified, cataloged, integrated > **40 datasets** across the EDX4CCS & CS data portfolio
- Data/statistics are grouped into key categories in layout:
 - CO2 sources, Critical energy infrastructure, CO2 sinks/CCS projects, Natural hazards, EJ/SJ
- Incorporates buffer query functionality

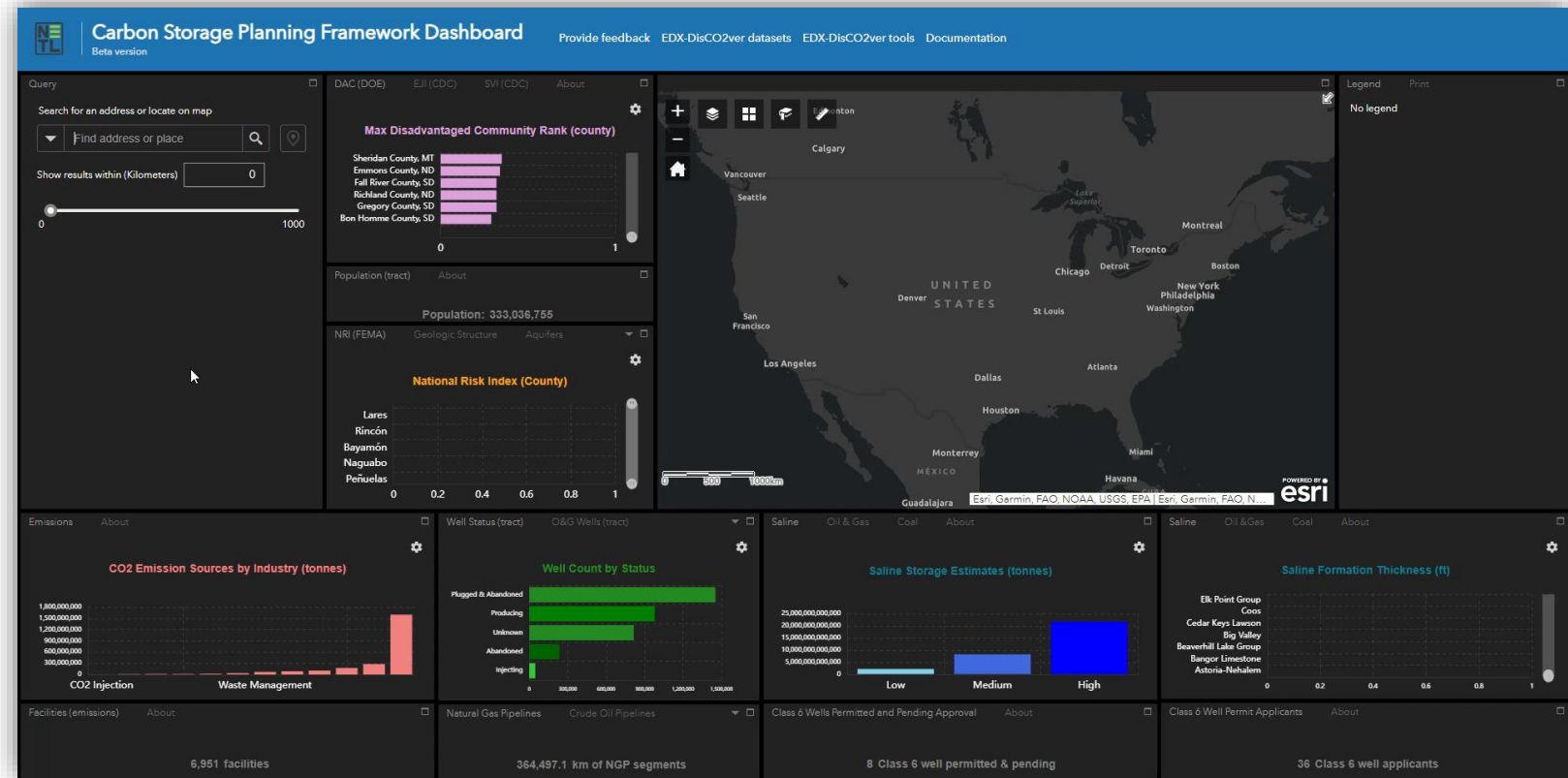


Alpha version undergoing internal testing

Carbon Storage (CS) Planning Framework Dashboard

Year 2 accomplishments & tasks

- Beta version released on EDX-DisCO2ver (7/31/2023)
- Further integrate EDX4CCS data/products as they become available
- Obtain feedback from stakeholder user testing to develop list of enhancements
- Implement enhancements and full public release on EDX DisCO2ver (3/2024)



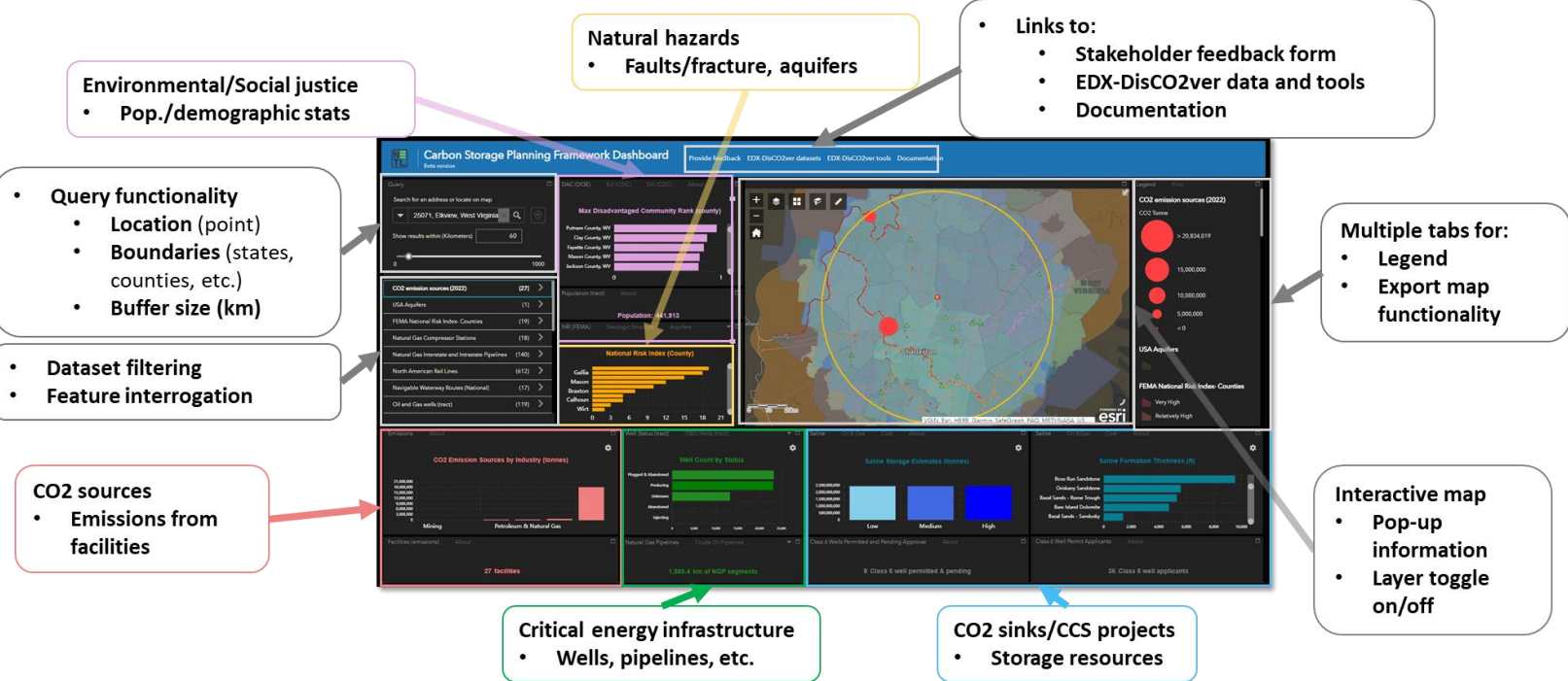
Current version in beta testing

Carbon Storage (CS) Planning Framework Dashboard



Layout & Functionality

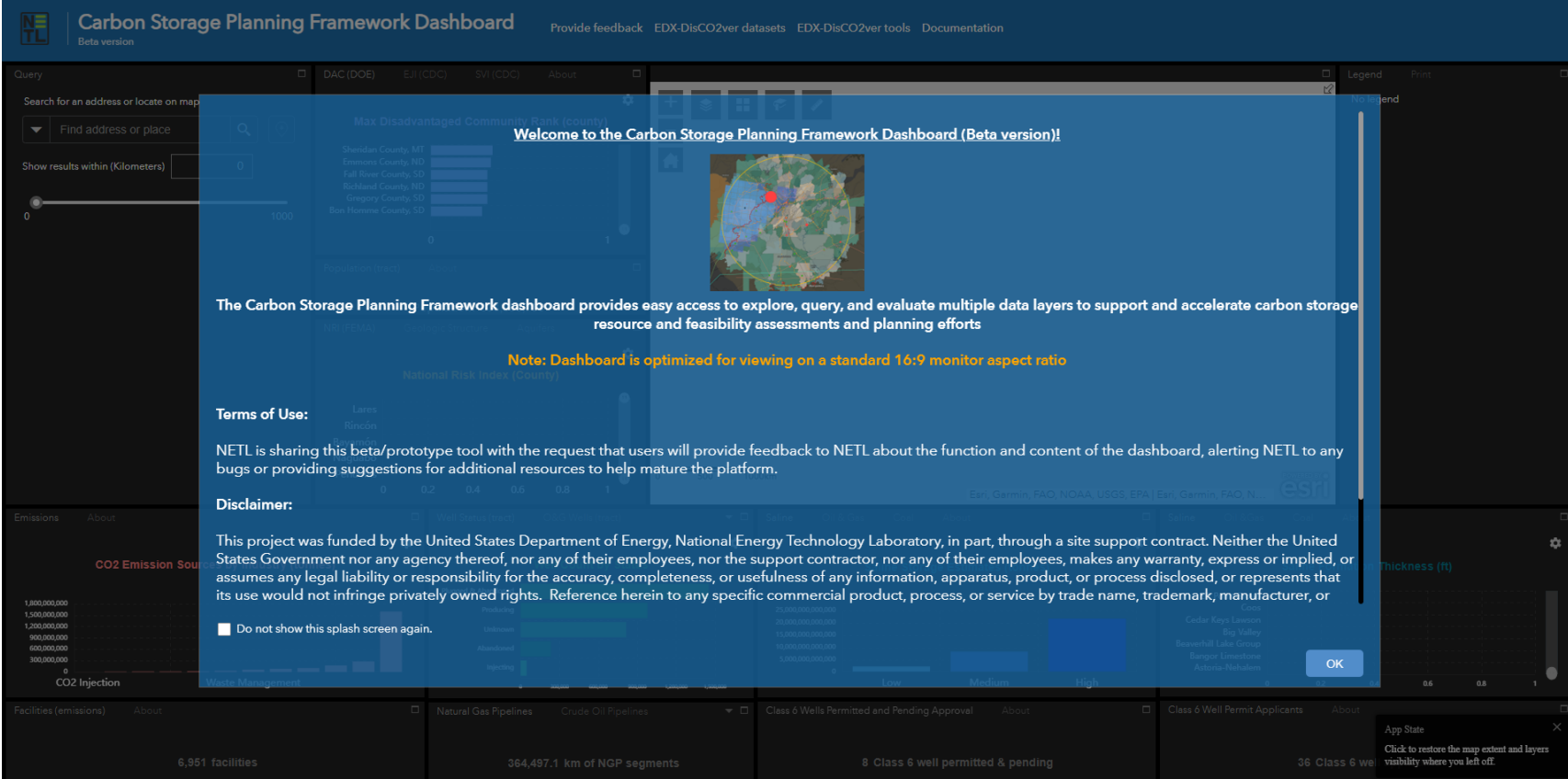
- Splash page
- Data querying/filtering
- Charts and statistics
- Map and legend
- External links



Carbon Storage (CS) Planning Framework Dashboard

Splash page

- Introduction/description
- Terms of Use
- Disclaimer
- Acknowledgements



Carbon Storage Planning Framework Dashboard
Beta version

Provide feedback | EDX-DisCO2ver datasets | EDX-DisCO2ver tools | Documentation

Query: Search for an address or locate on map
Find address or place
Show results within (Kilometers): 0 to 1000

Welcome to the Carbon Storage Planning Framework Dashboard (Beta version)!

The Carbon Storage Planning Framework dashboard provides easy access to explore, query, and evaluate multiple data layers to support and accelerate carbon storage resource and feasibility assessments and planning efforts

Note: Dashboard is optimized for viewing on a standard 16:9 monitor aspect ratio

Terms of Use:
NETL is sharing this beta/prototype tool with the request that users will provide feedback to NETL about the function and content of the dashboard, alerting NETL to any bugs or providing suggestions for additional resources to help mature the platform.

Disclaimer:
This project was funded by the United States Department of Energy, National Energy Technology Laboratory, in part, through a site support contract. Neither the United States Government nor any agency thereof, nor any of their employees, nor the support contractor, nor any of their employees, makes any warranty, express or implied, or assumes any legal liability or responsibility for the accuracy, completeness, or usefulness of any information, apparatus, product, or process disclosed, or represents that its use would not infringe privately owned rights. Reference herein to any specific commercial product, process, or service by trade name, trademark, manufacturer, or

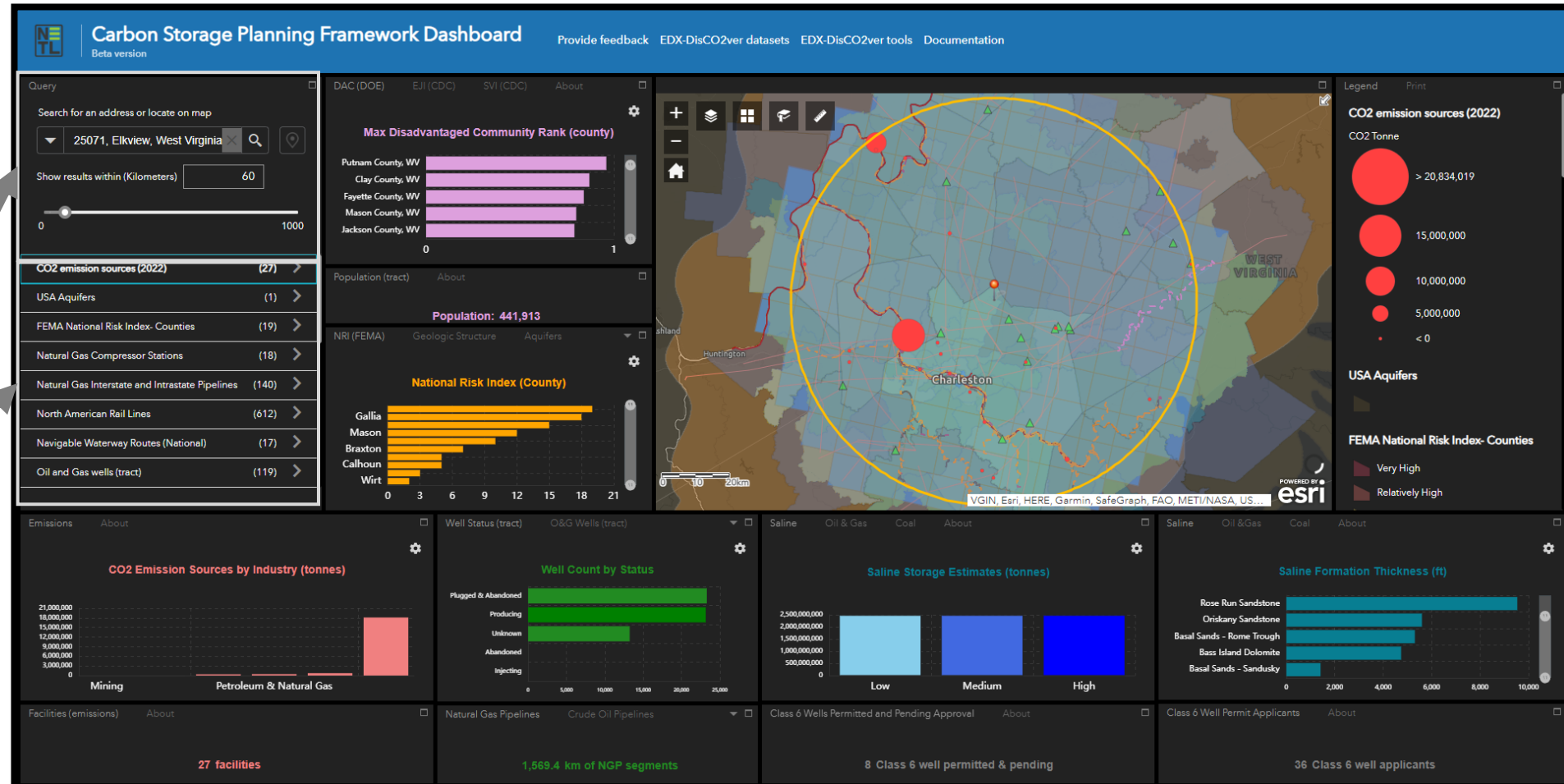
Do not show this splash screen again. **OK**

6,951 facilities | 364,497.1 km of NGP segments | 8 Class 6 well permitted & pending | 36 Class 6 well permit applicants

Carbon Storage (CS) Planning Framework Dashboard

Data Querying/Filtering

- Query functionality
 - Location (point)
 - Boundaries (states, counties, etc.)
 - Buffer size (km)
- Dataset filtering
- Feature interrogation



Carbon Storage (CS) Planning Framework Dashboard



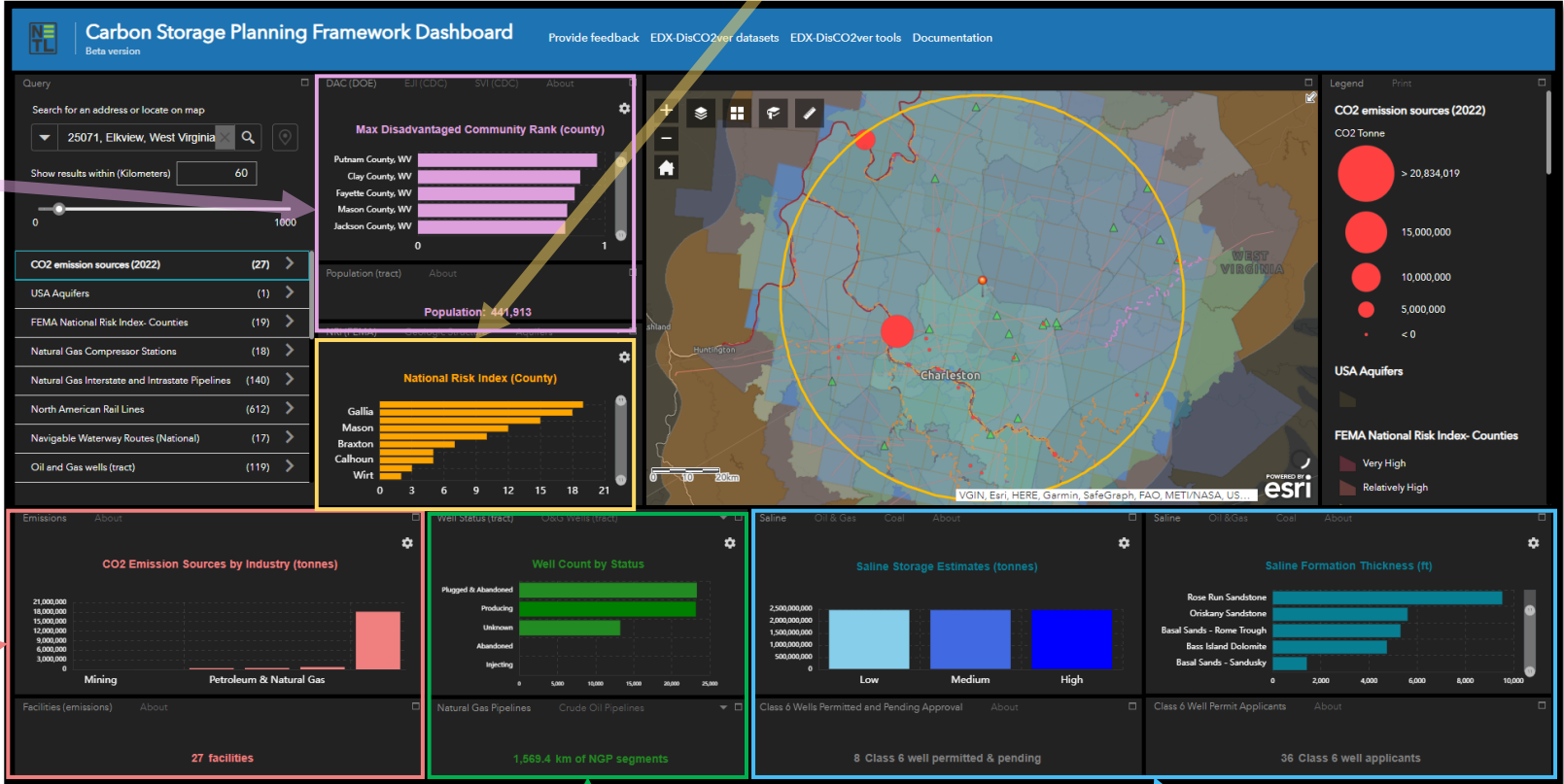
Charts and Statistics

Natural hazards

- Faults/fracture, aquifers

Environmental/Social justice

- Pop./demographic stats



CO2 sources

- Emissions from facilities

Critical energy infrastructure

- Wells, pipelines, etc.

CO2 sinks/CCS projects

- Storage resources

Carbon Storage (CS) Planning Framework Dashboard



Charts and Statistics- "About" tabs

The dashboard interface includes a search bar, a map, and several data panels. The inset window shows the 'About' tab for the 'Saline, Oil & Gas, Coal (storage estimates)' layer. A red arrow points from the inset to the corresponding map layer in the dashboard.

Saline, Oil & Gas, Coal (storage estimates)

- Description:** These 3 vertical bar charts display "Low", "Medium", and "High" CO2 storage estimates in tonnes, based on 10X10km grid cells representing saline, oil & gas, and coal reservoirs. Hovering the cursor over the bars highlight data on the map.
- Data sources:** [saline](#), [oil & gas](#), [coal](#) (National Carbon Sequestration (NATCARB) Database, National Energy Technology Laboratory (NETL))

Carbon Storage (CS) Planning Framework Dashboard



Map and Legend

The dashboard features a central map of West Virginia with a yellow circle highlighting a region around Charleston. The map includes various data layers such as CO2 emission sources (represented by red circles of varying sizes), USA Aquifers, and FEMA National Risk Index. Surrounding the map are several data visualization panels:

- Search and Query:** Search for an address or locate on map (e.g., 25071, Elkview, West Virginia). Show results within (Kilometers) 60.
- Max Disadvantaged Community Rank (county):** Horizontal bar chart showing ranks for Putnam, Clay, Fayette, Mason, and Jackson counties.
- Population (tract):** Population: 441,913.
- National Risk Index (County):** Horizontal bar chart showing risk indices for Gallia, Mason, Braxton, Calhoun, and Wirt counties.
- CO2 Emission Sources by Industry (tonnes):** Bar chart comparing Mining and Petroleum & Natural Gas.
- Well Count by Status:** Horizontal bar chart showing counts for Plugged & Abandoned, Producing, Unknown, Abandoned, and Injecting wells.
- Saline Storage Estimates (tonnes):** Bar chart showing Low, Medium, and High storage estimates.
- Saline Formation Thickness (ft):** Horizontal bar chart showing thicknesses for Rose Run Sandstone, Oriskany Sandstone, Basal Sands - Rome Trough, Bass Island Dolomite, and Basal Sands - Sandusky.
- Facilities (emissions):** 27 facilities.
- Natural Gas Pipelines:** 1,569.4 km of NGP segments.
- Class 6 Wells Permitted and Pending Approval:** 8 Class 6 well permitted & pending.
- Class 6 Well Permit Applicants:** 36 Class 6 well applicants.

Multiple tabs for:

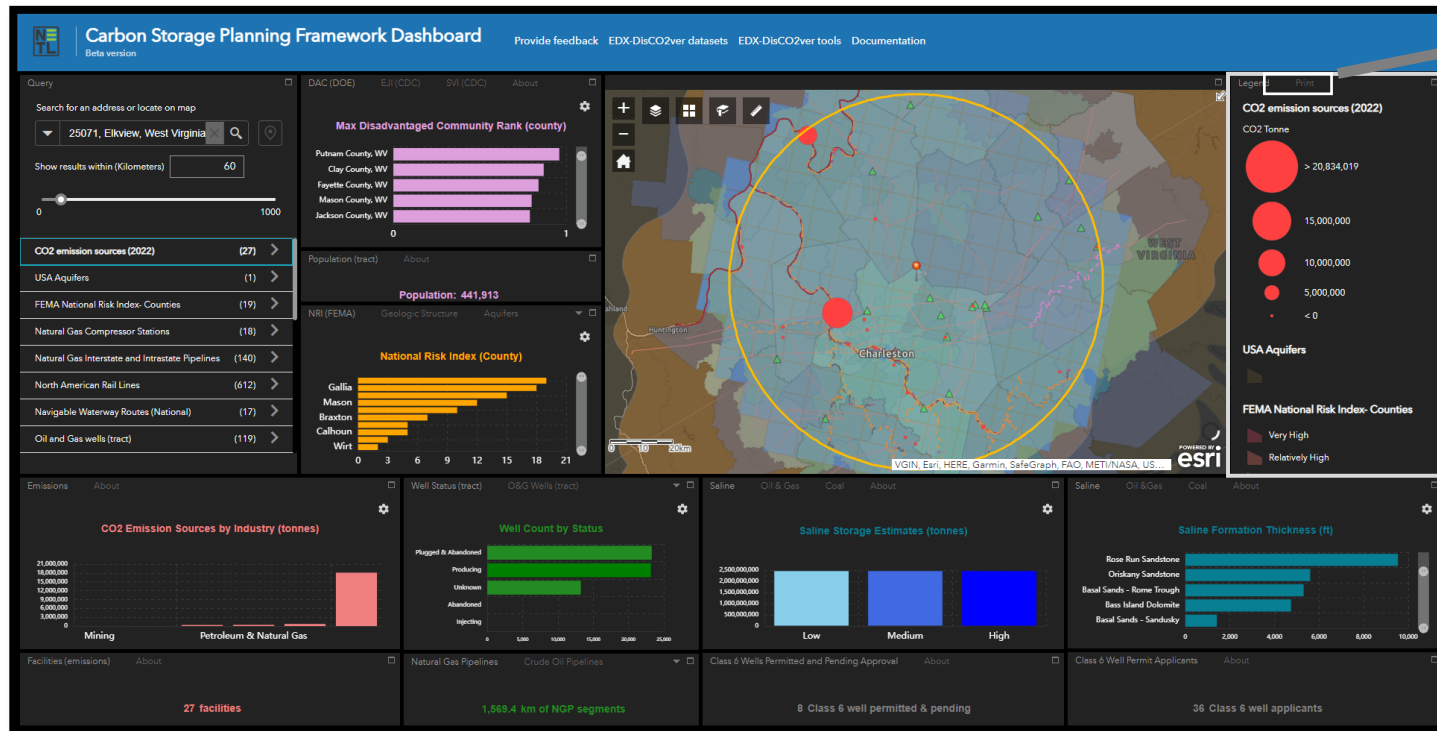
- Legend
- Export map functionality

Interactive map

- Pop-up information
- Layer toggle on/off

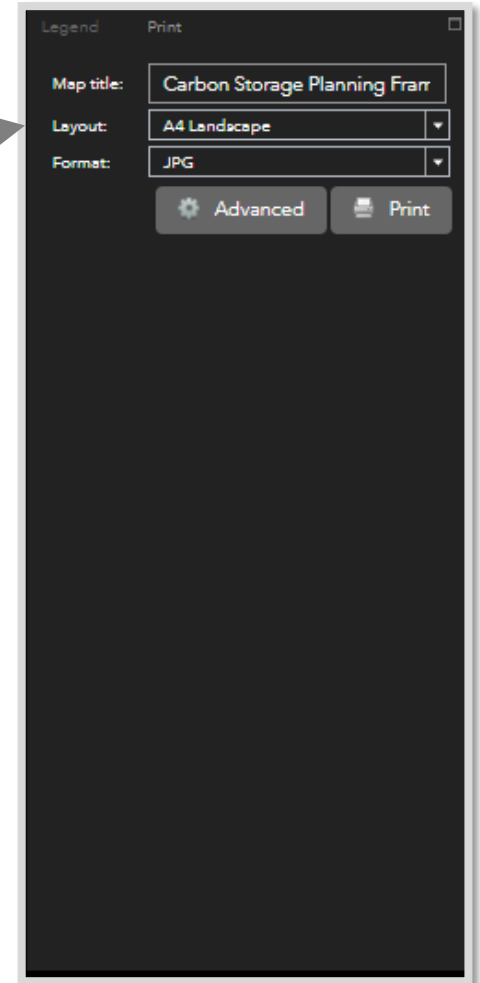
Carbon Storage (CS) Planning Framework Dashboard

Map and Legend- Export Map Functionality



Multiple tabs for:

- Legend
- Export map functionality



The Legend and Print tab interface includes the following elements:

- Map title: Carbon Storage Planning Fram
- Layout: A4 Landscape
- Format: JPG
- Advanced button
- Print button

Carbon Storage (CS) Planning Framework Dashboard



External Links

- Links to:
 - Stakeholder feedback form
 - EDX-DisCO2ver data and tools
 - Documentation

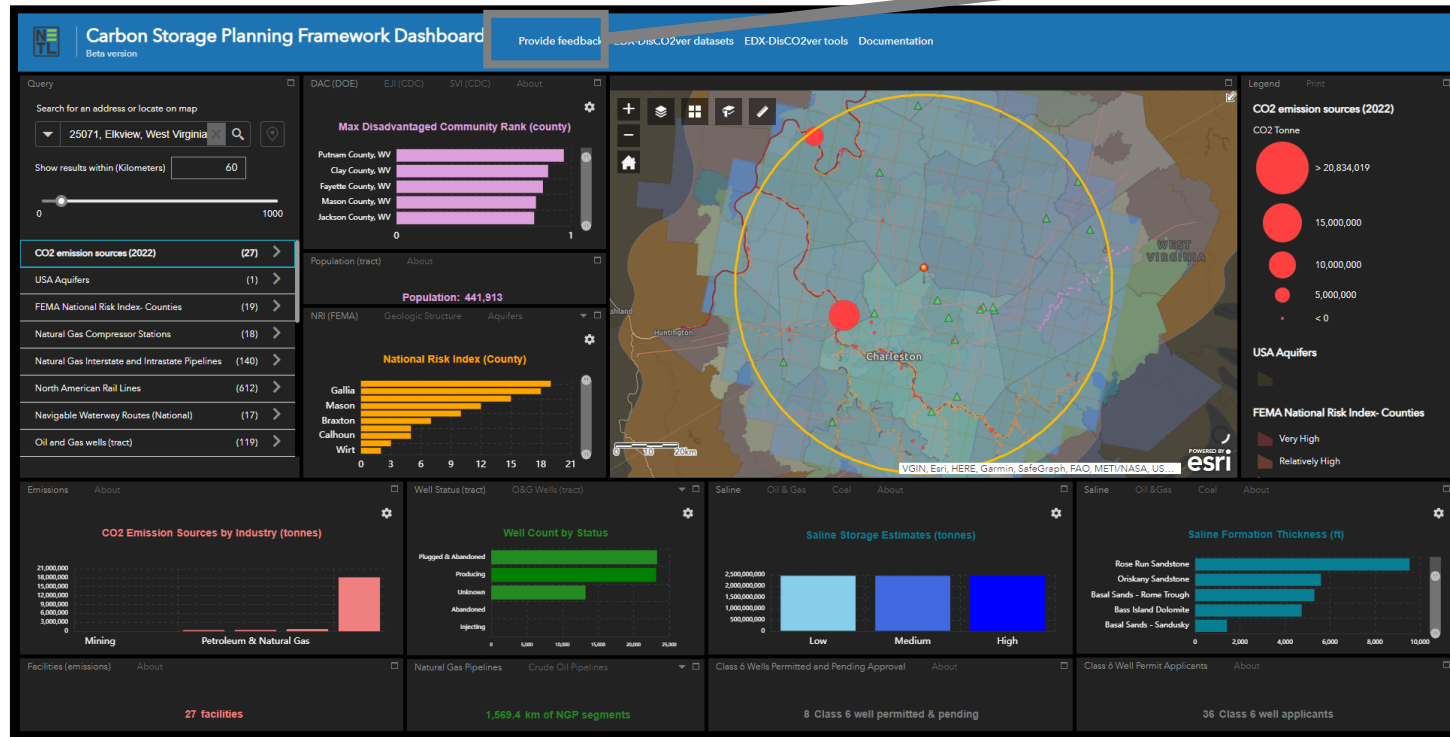
The dashboard screenshot displays several key components:

- Navigation Bar:** Includes links for "Provide feedback", "EDX-DisCO2ver datasets", "EDX-DisCO2ver tools", and "Documentation".
- Search and Location:** A search bar with "Elkview, West Virginia" and a "Show results within (Kilometers)" slider set to 60.
- Max Disadvantaged Community Rank (county):** A horizontal bar chart showing ranks for Putnam, Clay, Fayette, and Mason counties in West Virginia.
- Map:** A central map showing a circular area of interest with a red dot.
- CO2 emission sources (2022):** A pie chart showing a source with a value greater than 20,834,019 tonnes.
- Bottom Row of Charts:**
 - North American Rail Lines:** (612)
 - Navigable Waterway Routes (National):** (17)
 - Oil and Gas wells (tract):** (119)
 - CO2 Emission Sources by Industry (tonnes):** A bar chart comparing Mining and Petroleum & Natural Gas.
 - Well Status (tract):** A bar chart showing counts for Plugged & Abandoned, Producing, Unknown, Abandoned, and Injecting.
 - Saline Storage Estimates (tonnes):** A bar chart showing Low, Medium, and High estimates.
 - Saline Formation Thickness (ft):** A bar chart showing thickness for Rose Run Sandstone, Ordinary Sandstone, Basal Sands - Rome Trough, Basal Sands - Sandusky, and Basal Sands - Sandusky.
 - Facilities (emissions):** 27 facilities
 - Natural Gas Pipelines:** 1,569.4 km of NGP segments
 - Class 6 Wells Permitted and Pending Approval:** 8 Class 6 well permitted & pending
 - Class 6 Well Permit Applicants:** 36 Class 6 well applicants

Provide feedback EDX-DisCO2ver datasets EDX-DisCO2ver tools Documentation

Carbon Storage (CS) Planning Framework Dashboard

External Links- Feedback Form



CS Planning Framework Dashboard Feedback Form

Description content for the survey

Name*

Organization*

Date*

List or describe data/statistics preferences*

Responsiveness

☆☆☆☆

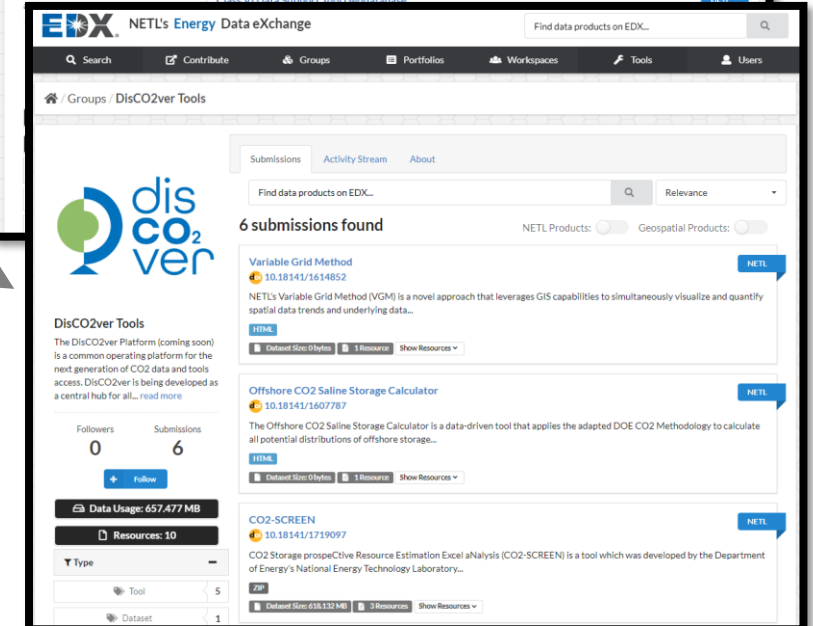
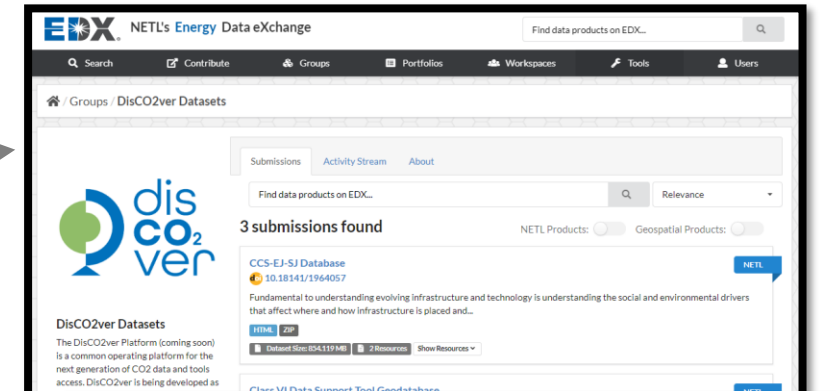
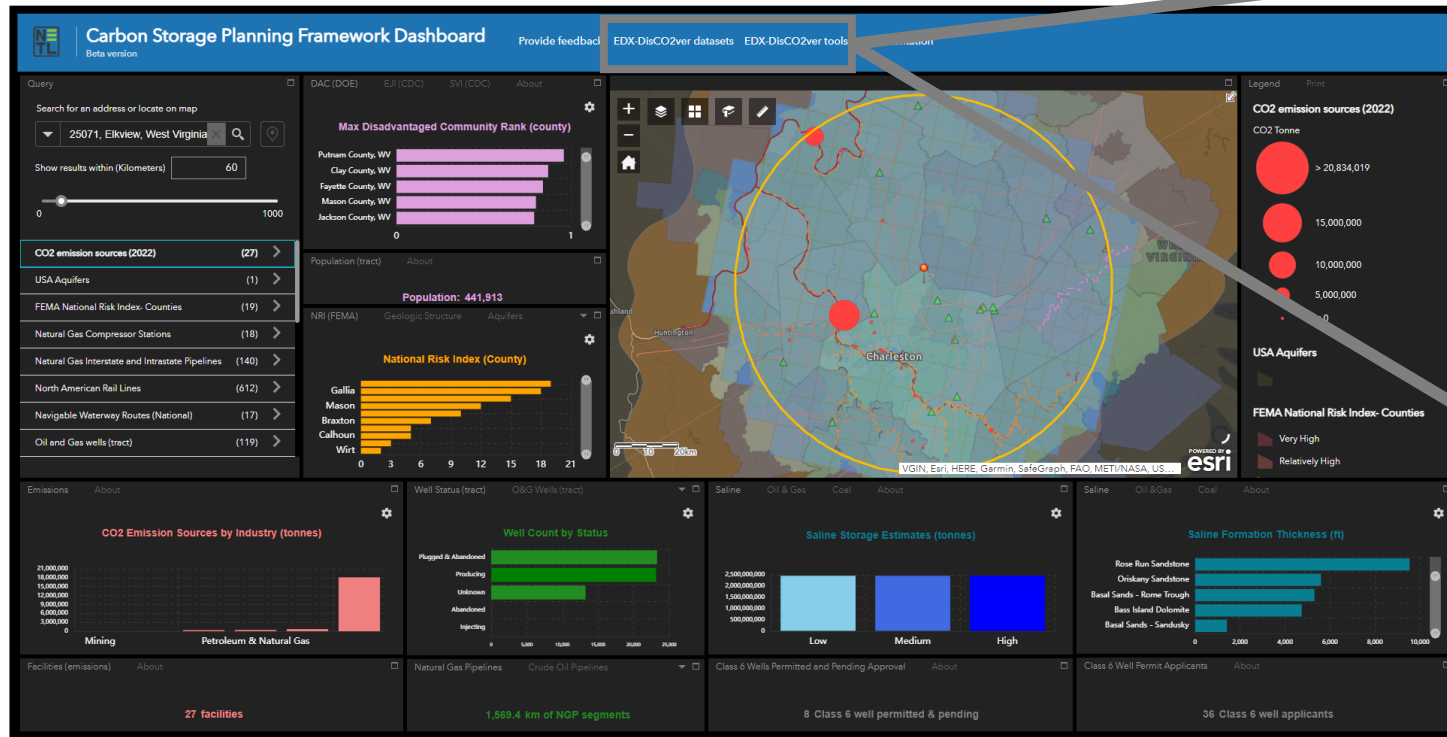
Layout

☆☆☆☆

General comments/issues/suggestions*

Carbon Storage (CS) Planning Framework Dashboard

External Links- EDX-DisCO2ver



Carbon Storage (CS) Planning Framework Dashboard



Documentation (External Links)

Carbon Storage Planning Framework Dashboard

Instructions and documentation

last update:
July 25, 2023

Description Layout Functionality



Carbon Storage (CS) Planning Framework Dashboard



Documentation (External Links)- Dashboard Description/About

Description

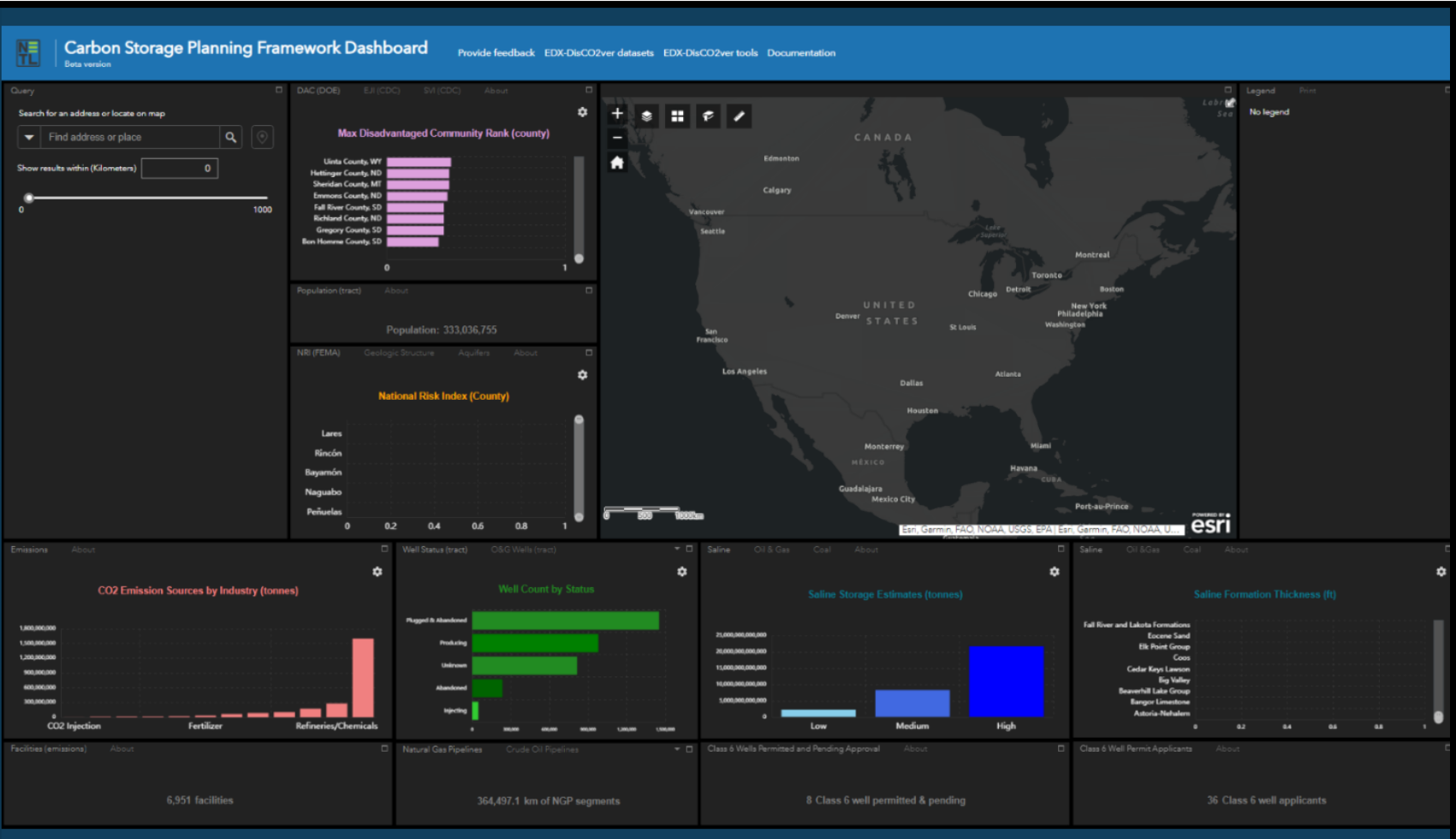
The Carbon Storage Planning Framework dashboard provides easy access to explore, query, and evaluate multiple data layers to support and accelerate carbon storage resource and feasibility assessments and planning efforts.

The interactive dashboard currently contains a range of datasets associated with geologic, technical, social, and environmental factors. The data sets can be filtered geographically for an area of interest to update statistics and charts within the dashboard. The dashboard is divided into different sections called widgets, relating to different steps in the carbon storage planning process.

Notes:

- Dashboard is optimized for viewing on a standard 16:9 monitor aspect ratio
- Documentation may not reflect the most up to date version of the dashboard as updates are expected.

[Access the dashboard here](#)



Carbon Storage (CS) Planning Framework Dashboard



Documentation (External Links)- Dashboard Layout

Layout

Query/Filters

- Location (Point) and Boundaries (States, Counties, etc.) with Buffer Size (km)
- Dataset Filtering
- Feature Interrogation

Map and legend

Map (left):

- Map widgets (Upper left on map)

Section (right):

- Legend
- Print (Export Map)

Charts and Statistics by category

- Environmental Justice and Social Justice (EJSJ)
- Natural Hazards
- Carbon Dioxide (CO2) Sources
- Critical Energy Infrastructure
- Carbon Dioxide (CO2) Sinks and Carbon Capture and Storage (CCS) Projects

Links

- Provide Feedback
- EDX-DisCO2ver Datasets
- EDX-DisCO2ver Tools
- Documentation

Carbon Storage Planning Framework Dashboard
Provide feedback EDX-DisCO2ver datasets EDX-DisCO2ver tools Documentation
Links

Query/Filters

Search for an address or locate on map

1846 E 2400 North Rd, Blue Mound

Show results within (Kilometers) 120

Environmental and Social justice

Max Disadvantaged Community Rank (county)

Population: 1,685,795

Natural Hazards

National Risk Index (County)

Map and Legend

CO2 Sources

CO2 Emission Sources (tonnes)

46 facilities

Critical Energy Infrastructure

Well Count by Status

2,037.3 km of NGLP segments

CO2 Sinks/CCS Projects

Saline Storage Estimates (tonnes)

Saline Formation Thickness (ft)

8 Class 6 well permitted & pending

3 Class 6 well applicants

22

Carbon Storage (CS) Planning Framework Dashboard



Documentation (External Links)- Dashboard Functionality

Functionality

General Widget Interaction

General widget functions

- Widget's have multiple tabs of data relevant to the overall theme of the widget; tabs with long titles are available by clicking the drop down arrow on top right corner.
- Maximize button to extend widget information to fill the screen; return widget to default size by pressing the minimize button.

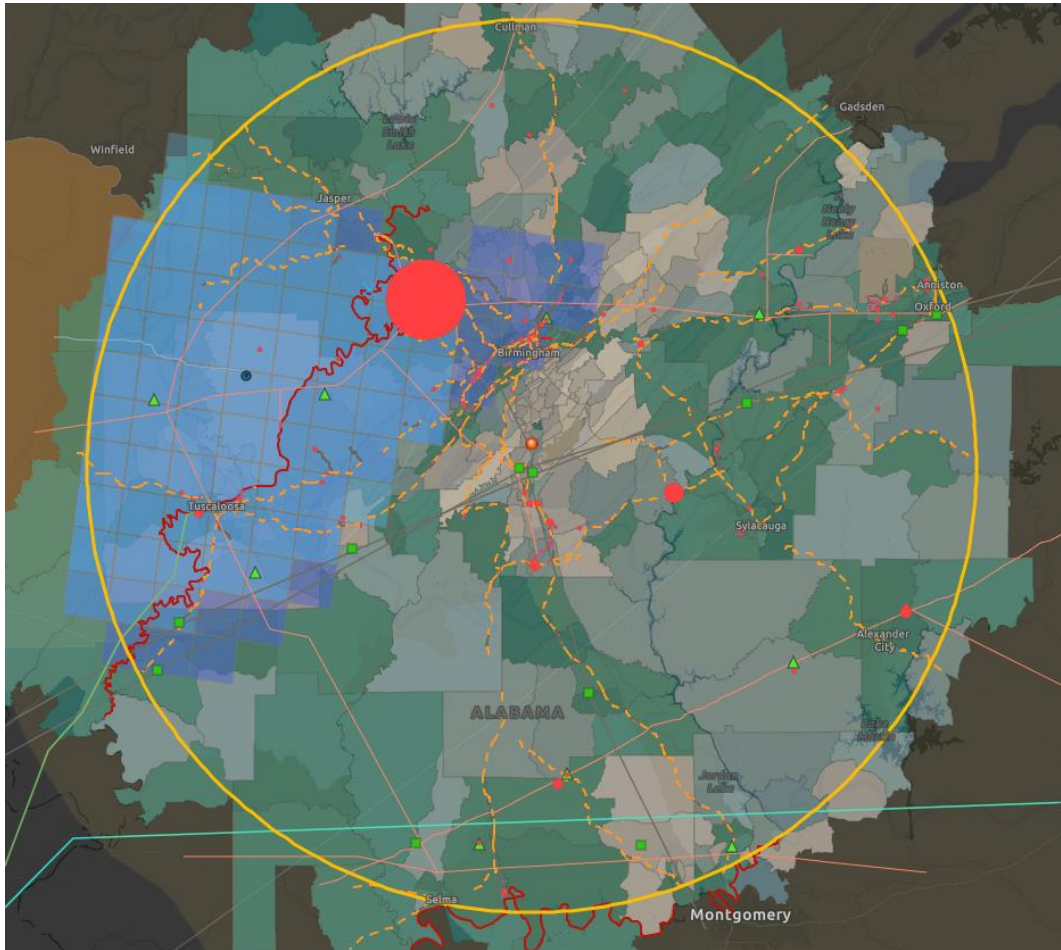
1a. Query by location

The dashboard screenshot shows the following components:

- 1a:** Search query widget for "1846 E 2400 North Rd, Blue Mound" with a distance filter of 120 km.
- 1b:** A list of widget categories including "Class 6 Well Permit Applicants", "Geologic validation phase storage projects", "Small scale CCS projects", "Large scale CCS projects", "CCS site characterization projects", "Development phase storage projects", "CO2 emission sources (2022)", "USA Aquifers", "FEMA National Risk Index- Counties", "Natural Gas Compressor Stations", "POL Pumping Stations", and "Natural Gas Interstate and Intra-state Pipelines".
- 2a:** A map of the region with a red circle highlighting a specific area.
- 2b:** A legend on the right side of the map showing various project types and their corresponding colors.
- 3:** A "National Risk Index (County)" bar chart showing risk levels for various counties, with Jersey having the highest risk.

Carbon Storage (CS) Planning Framework Dashboard

Progress and Next Steps



Example radial buffer query of dashboard datasets

- **Progress to date:**
 - Key datasets integrated
 - beta version developed
- **Next steps/Challenges:**
 - Integrate relevant data as they are identified and become available
 - Adjusting/testing layout and functionality
 - **Beta version available for stakeholder testing/feedback- sign up for testing!**
 - Identification of gaps, data, needs

Carbon Storage (CS) Planning Framework Dashboard

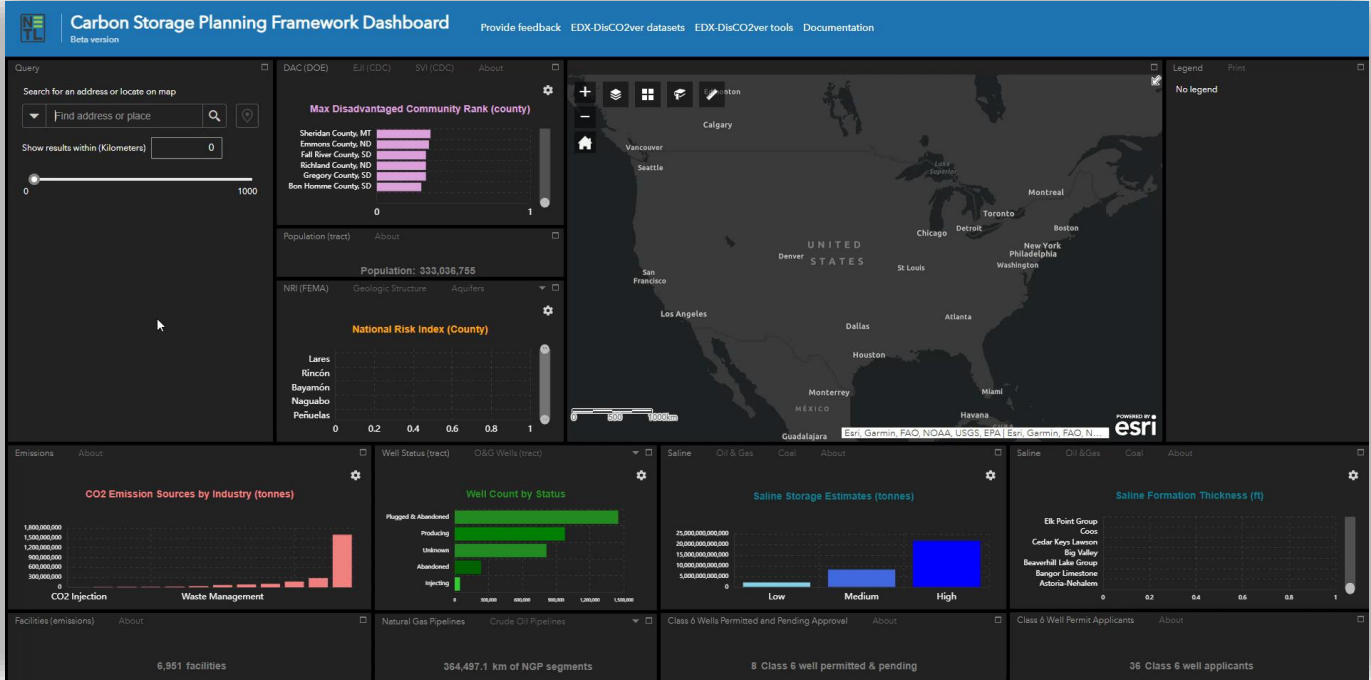


Ultimate Outcomes

- Deploy and host the Carbon Storage Planning Framework Dashboard on the EDX DisCO2ver platform.
- Anticipated public release of dashboard- 3/2024

Stakeholder Benefit

- Quick and efficient access and insights into key CS datasets (including geologic, technical, environmental, EJ/SJ) to support CCS planning, feasibility, and resource assessment efforts.
- Results can be leveraged to inform carbon storage resource and feasibility assessment





Join us Tuesday evening for live Tool Demos!

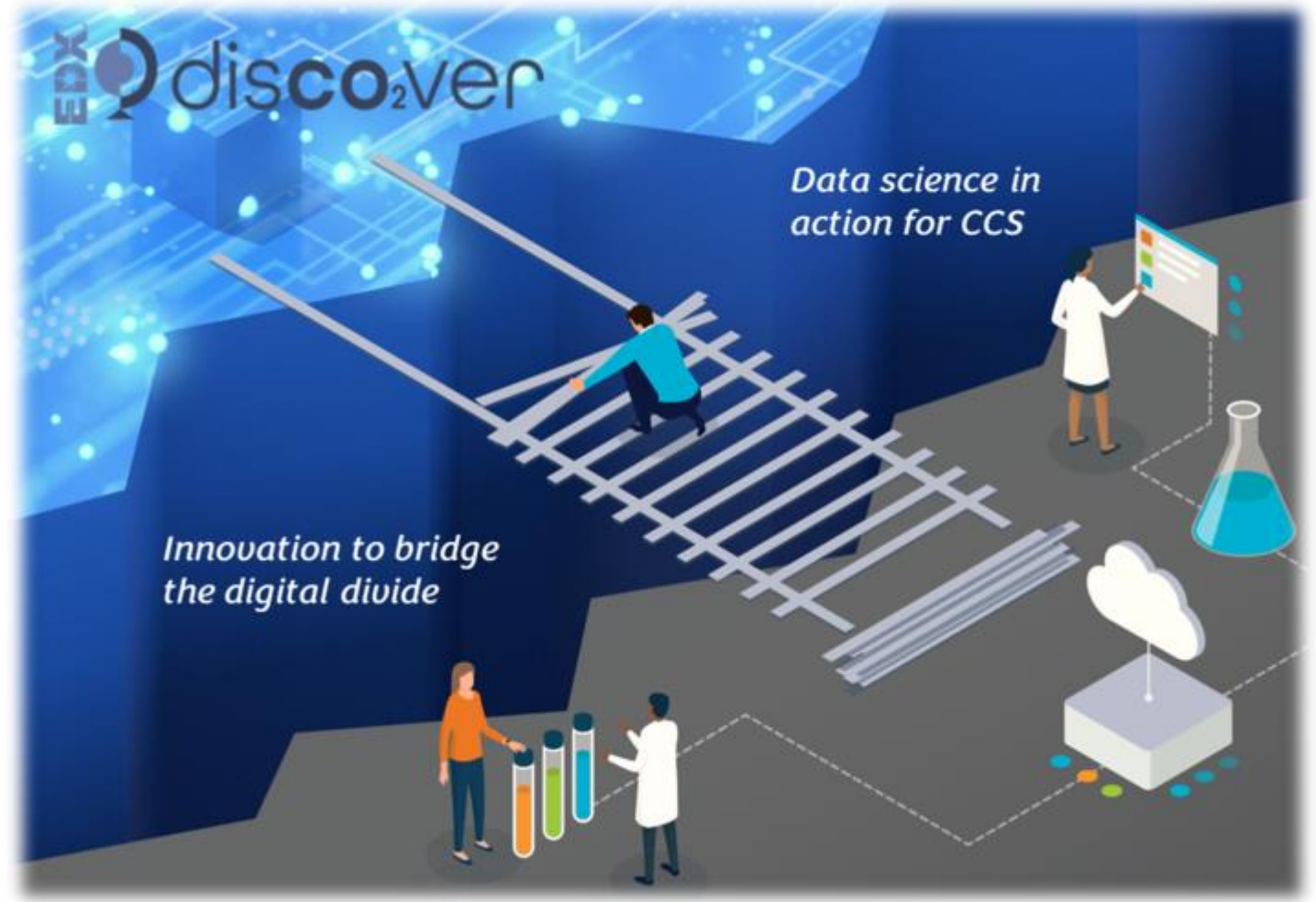
When: 5:45 - 7:45 p.m.

**Where: The Ballroom Foyer
and East/West Atriums**

What:

- Environmental Justice and Social Justice for CS Systems
- The international offshore CS and web-database and tool
- RokBase, Virtualizing CS Rock Property Data platform
- Class VI Data Support Tool for regulatory requirements
- CO2 Pipeline Routing Smart Tool
- Co2Locate - Class II Well Reuse and Regional Evaluation Tool
- **Carbon Storage Planning Framework Dashboard**
- 3D Data Viewer and Preview Capability
- AIIM Model, Assessing Infrastructure Reuse Potential for CS
- EDX disCO₂ver, a one-stop tool for CO₂ digital resources

 In demo "theater room"  support team will offer in person demos & Q&A



Acknowledgments



This work was performed in support of the U.S. Department of Energy's Fossil Energy and Carbon Management's Geo-Analysis and Monitoring Team and was developed jointly through the U.S. DOE Office of Fossil Energy and Carbon Management's EDX4CCS Project (DE-FE 1025007), in part, from the Bipartisan Infrastructure Law.

This research was supported in part by an appointment to the U.S. Department of Energy (DOE) Postgraduate Research Program at the National Energy Technology Laboratory (NETL) administered by the Oak Ridge Institute for Science and Education (ORISE).

NETL RESOURCES

VISIT US AT: www.NETL.DOE.gov

 @NETL_DOE

 @NETL_DOE

 @NationalEnergyTechnologyLaboratory

Thank you!



Devin Justman,
devin.justman@netl.doe.gov