

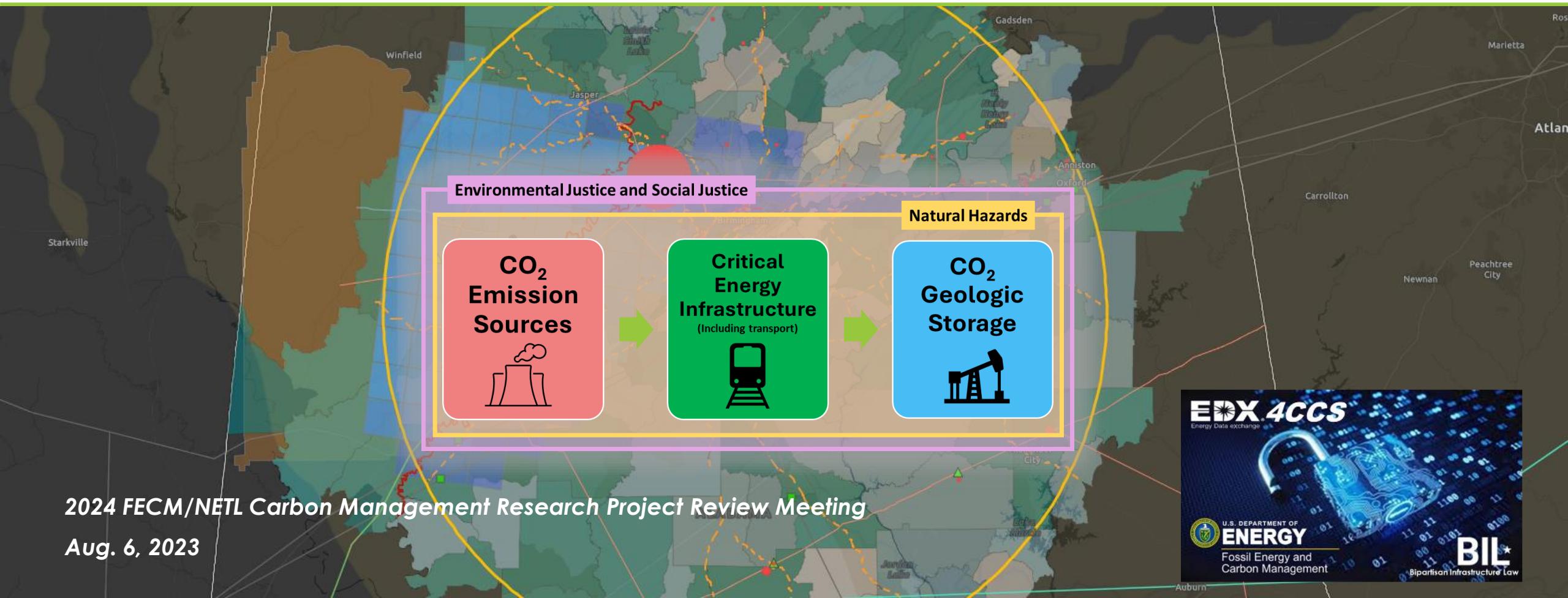
Carbon Storage Planning Inquiry Tool (CS PlanIT)

Providing Data and Insights for Accelerating Carbon Transport & Storage Deployment



Devin Justman

Geology/Geospatial Research Scientist



2024 FECM/NETL Carbon Management Research Project Review Meeting

Aug. 6, 2023

Disclaimer



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Authors and Contact Information



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Overview

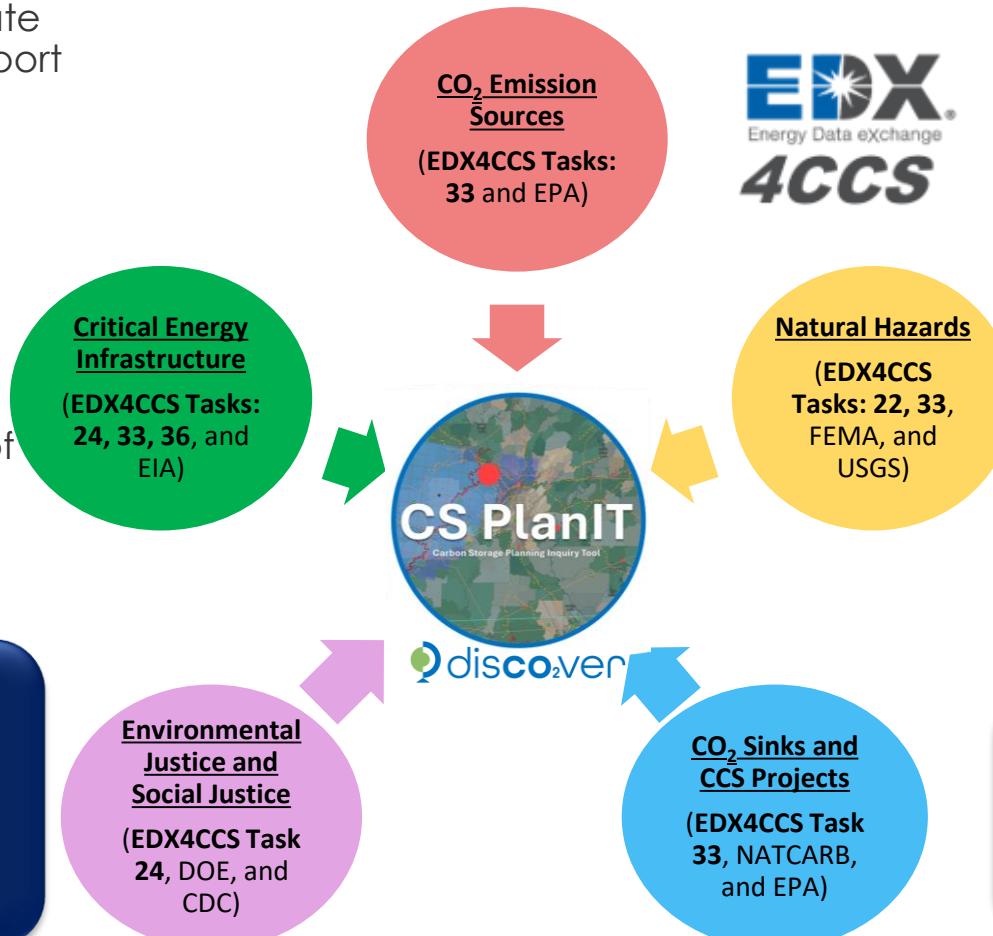
Purpose:

- Provides easy access to explore, query, and evaluate multiple data layers to support and accelerate carbon storage resource feasibility assessments and planning efforts

Problem:

- CS planning requires the consideration of multiple factors linked to a variety of disparate, multi-sourced datasets that require integration

Data Types (Data Source)



EDX- Energy Data eXchange
CCS- Carbon Capture and Storage
DOE- Department of Energy
USGS- United States Geological Survey
FEMA- Federal Emergency Management Administration
EPA- Environmental Protection Agency
EIA- Energy Information Administration
CDC- Center for Disease Control
NATCARB- National Carbon Sequestration Database

User community:

- Potential stakeholders include well/plant operators, policy makers, researchers, public communities

Potential insights for a 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 carbon storage projects?

- CS PlanIT v1.0 publicly accessible via EDX 6/30
- Continuing work through EY24- incorporating data from EDX4CCS task 21
- Ultimately to be deployed on EDX DisCO₂ver



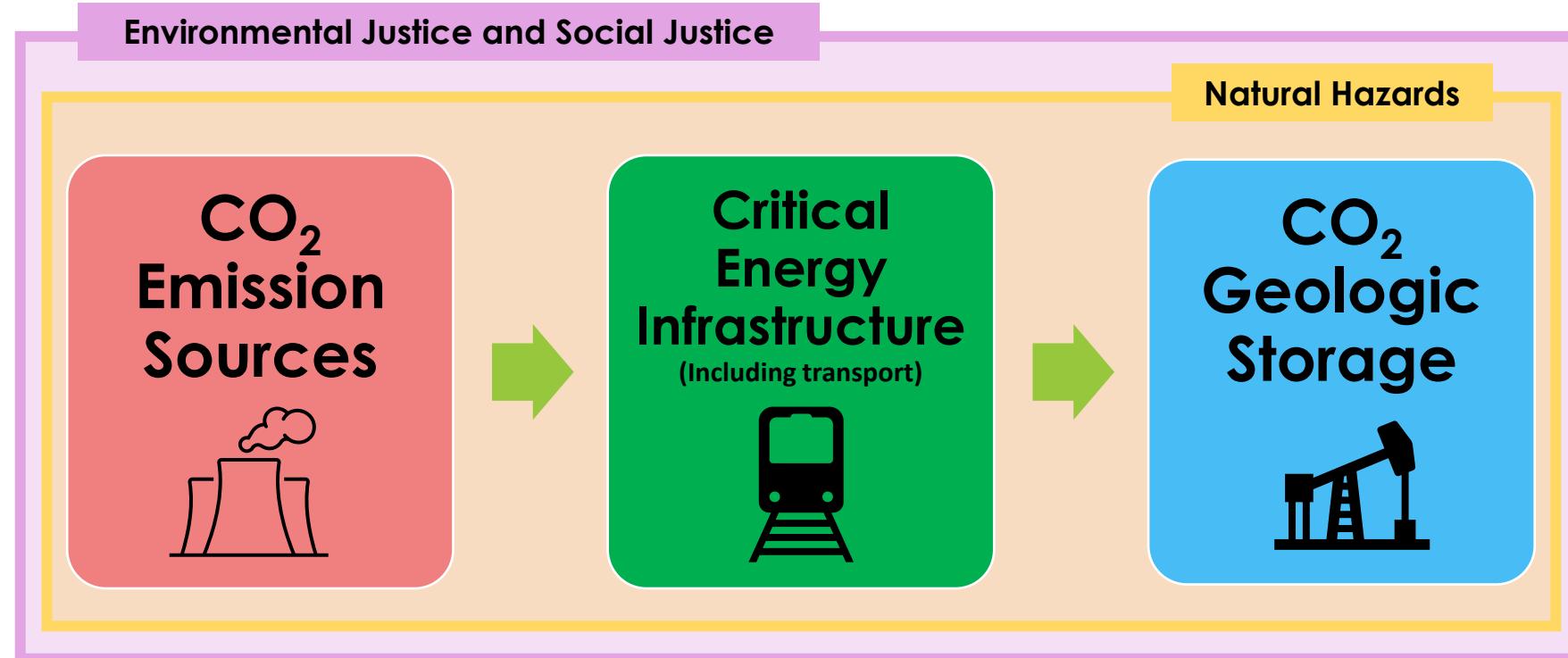
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Design Focus

- The goal of reaching large-scale CS deployment starts with informed planning
- Discover and acquire publicly available data for each stage of the CCS supply chain
(Source -> Critical Energy Infrastructure -> Storage)
- Evaluate impact on the **community** and **environment** at each stage in the CCS supply chain



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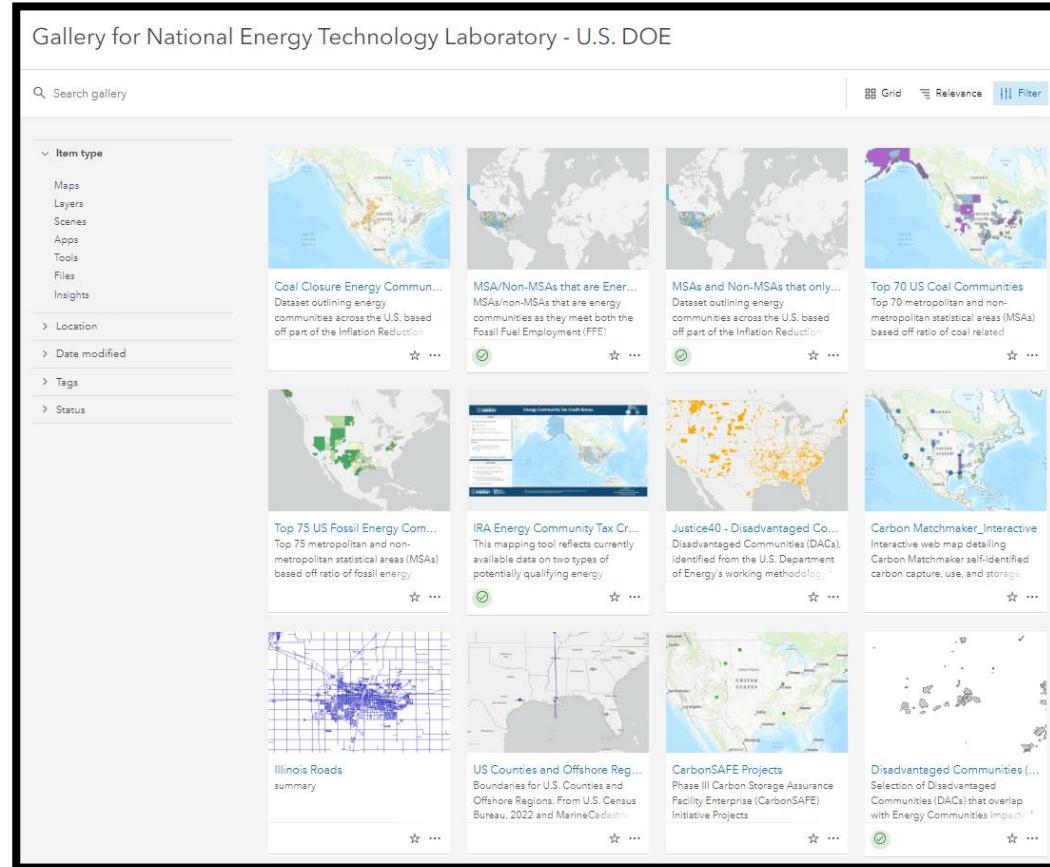
BIL*

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Approach

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



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

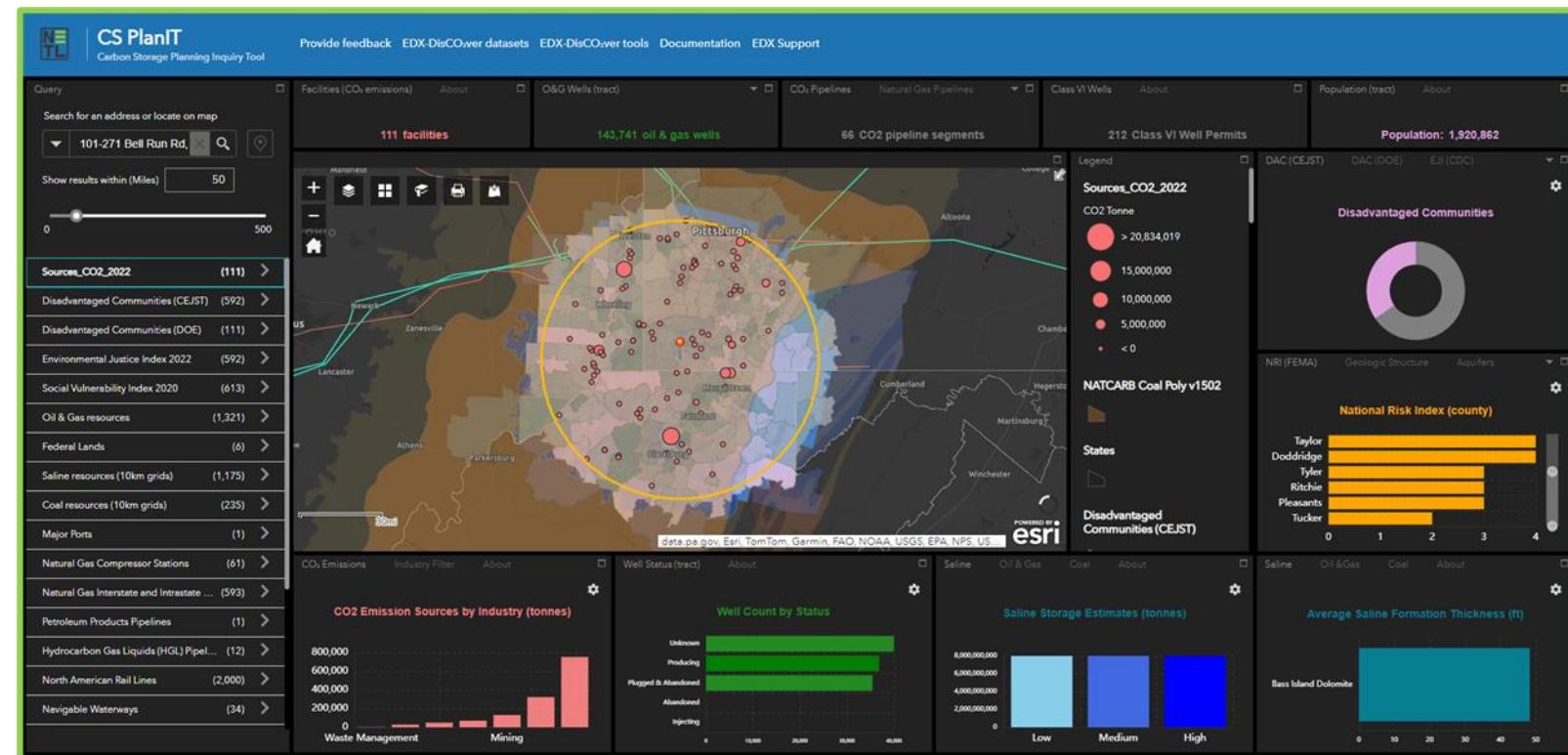
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Accomplishments to Date

- Identified, cataloged, integrated ~40 **datasets** across the EDX4CCS & CS data portfolios
- Organized data/stats into key categories:
 - Carbon dioxide (CO₂) emission sources**
 - Critical energy infrastructure**
 - CO₂ sinks/CCS (Carbon Capture & Storage) projects**
 - Natural hazards**
 - Environmental & Social Justice**
- Successfully developed and tested the **Alpha and Beta versions** (Year 1 and 2, respectively) of CS PlanIT
- Public release of CS PlanIT** on the EDX (Energy Data eXchange) by **6/30/2024**

CS PlanIT v1.0



Example spatial data query within CS PlanIT, yellow circle on map represents user defined area of interest.

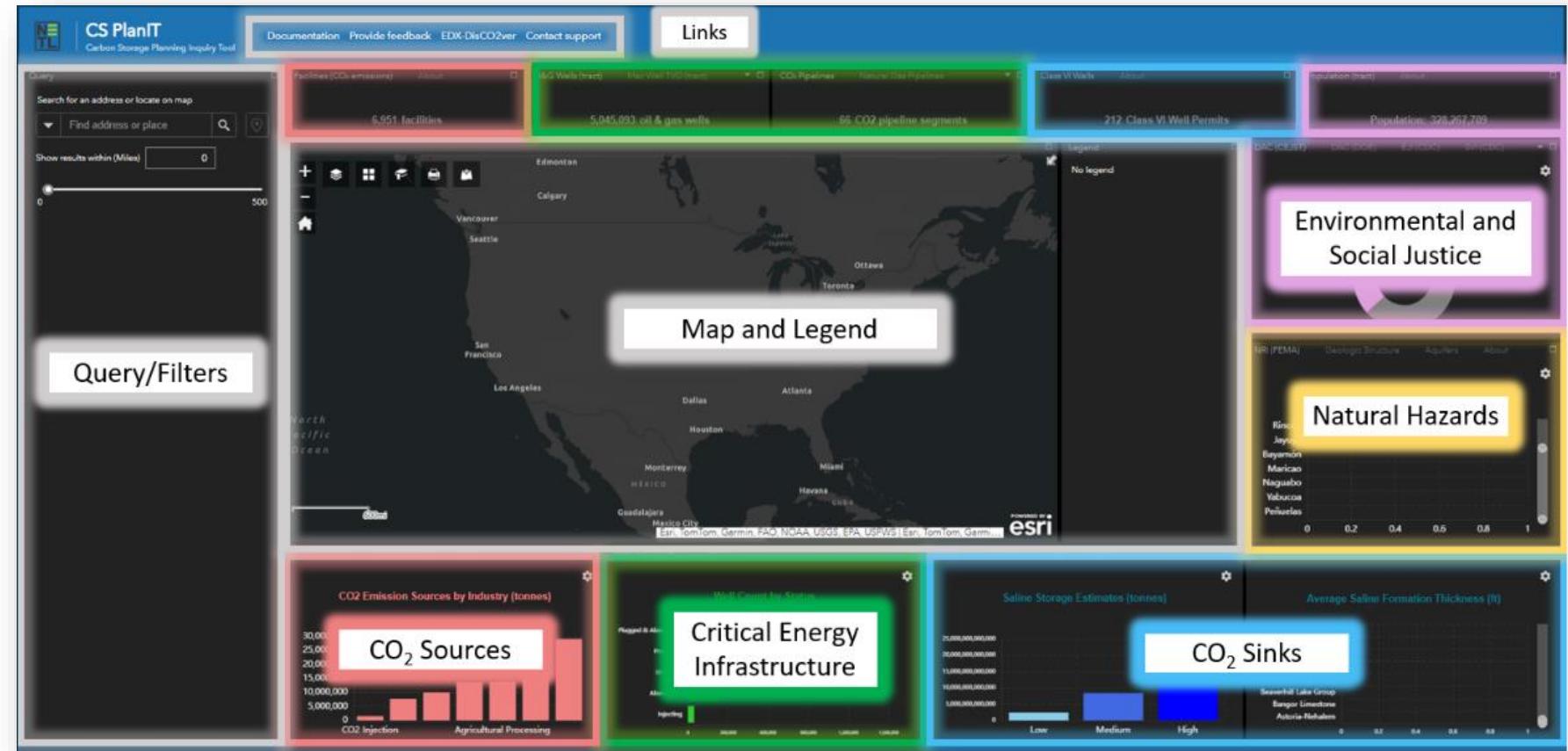
<https://edx.netl.doe.gov/dataset/cs-planit-carbon-storage-planning-inquiry-tool>

Carbon Storage Planning Inquiry Tool (CS PlanIT) v1.0



General Layout

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



Carbon Storage Planning Inquiry Tool (CS PlanIT) v1.0



Walkthrough - Query Location

The screenshot shows the CS PlanIT v1.0 dashboard with a red box highlighting the 'Query' section on the left. The 'Query' section contains a search bar with the text 'four co' and a dropdown menu showing search results for 'Sources_CO2_2022', 'Four Corners Steam Elec Station', 'ArcGIS World Geocoding Service', 'Four Corners, FL, USA (Osceola County)', and 'Four Corners, OR, USA (Marion County)'. The main dashboard features a map of North America with various data overlays, including facility counts (6,951 facilities, 5,045,093 oil & gas wells, 66 CO2 pipeline segments, 212 Class VI Well Permits), population (328,267,709), and disadvantaged communities. Below the map are four data cards: 'CO2 Emission Sources by Industry (tonnes)', 'Well Count by Status', 'Saline Storage Estimates (tonnes)', and 'Average Saline Formation Thickness (ft)'. The 'CO2 Emission Sources by Industry (tonnes)' card shows data for CO2 Injection and Ethanol Plant. The 'Well Count by Status' card shows data for Plugged & Abandoned, Unknown, and Injecting wells. The 'Saline Storage Estimates (tonnes)' card shows data for Low and High storage levels. The 'Average Saline Formation Thickness (ft)' card shows data for various geological formations.



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Walkthrough - Query Location

The screenshot shows the CS PlanIT v1.0 dashboard with the 'Query' section highlighted by a red box and arrows. The 'Query' section includes a search bar ('Search for an address or locate on map') with the text 'Four Corners Steam Elec Station', a distance selector ('Show results within (Miles) 40'), and a 'Search nearby' button. The main map area shows the location of the Four Corners Steam Elec Station in San Juan County, NM, with a red dot indicating the exact location. The map also displays various geological features like Morgan Lake and the San Juan River, along with a 0.4mi scale bar. The dashboard features several data cards and charts on the right side, including CO2 Emission Sources (2022), Disadvantaged Communities, National Risk Index (county), and various energy storage and formation thickness metrics. The bottom navigation bar includes links for CO2 Emissions, Well Status (tract), Saline, Oil & Gas, Coal, and Average Saline Formation Thickness (ft).

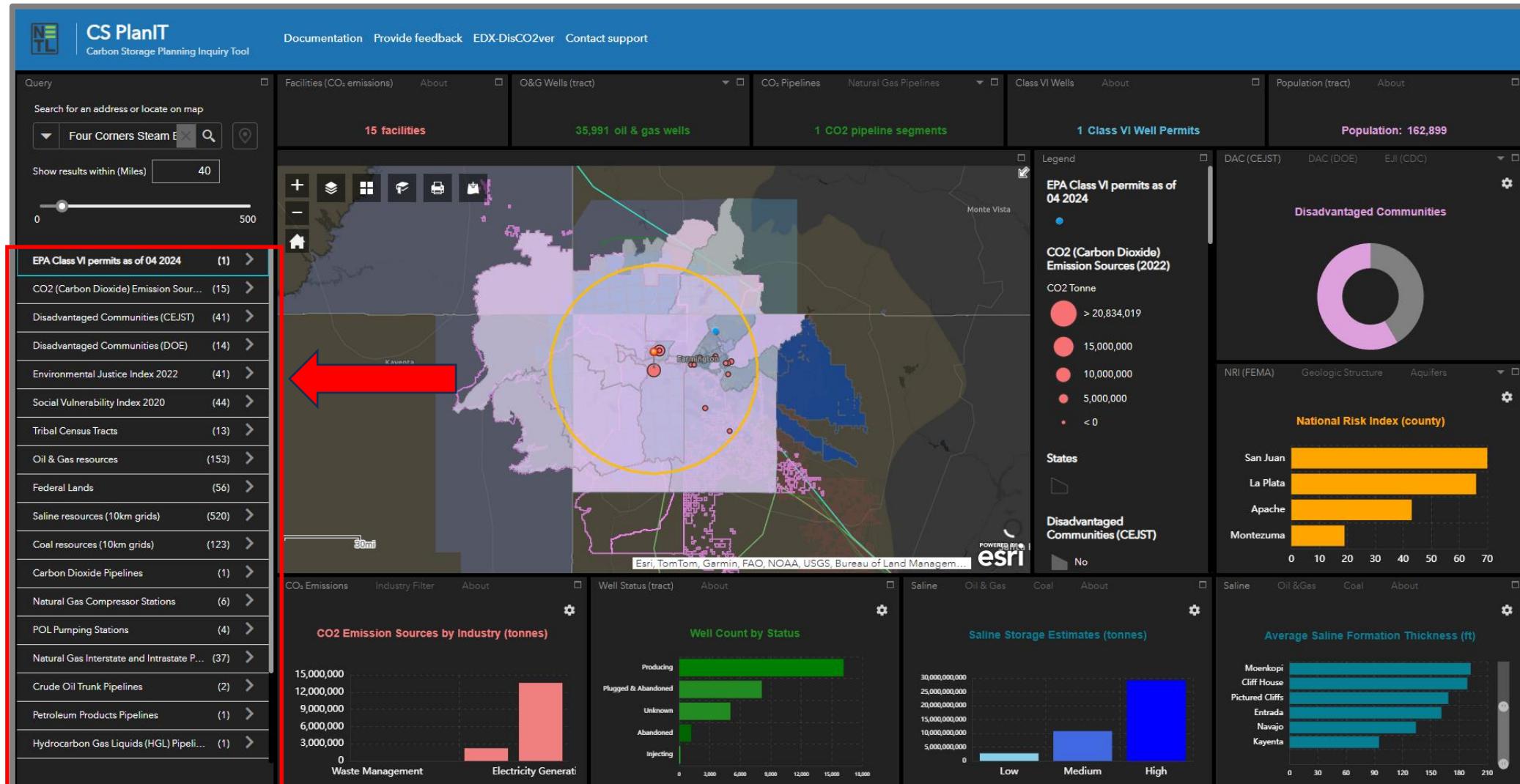


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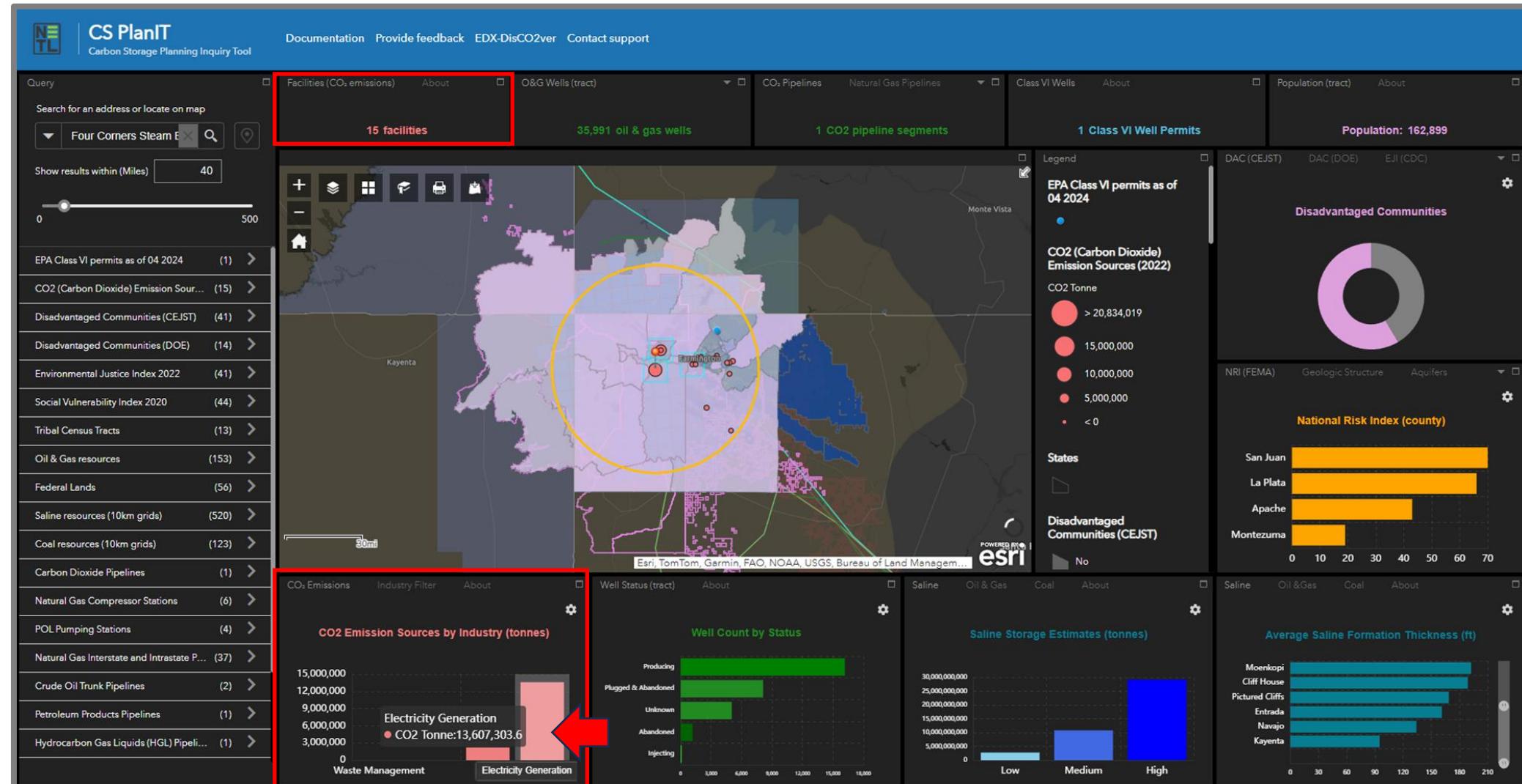
Walkthrough - Charts and Statistics



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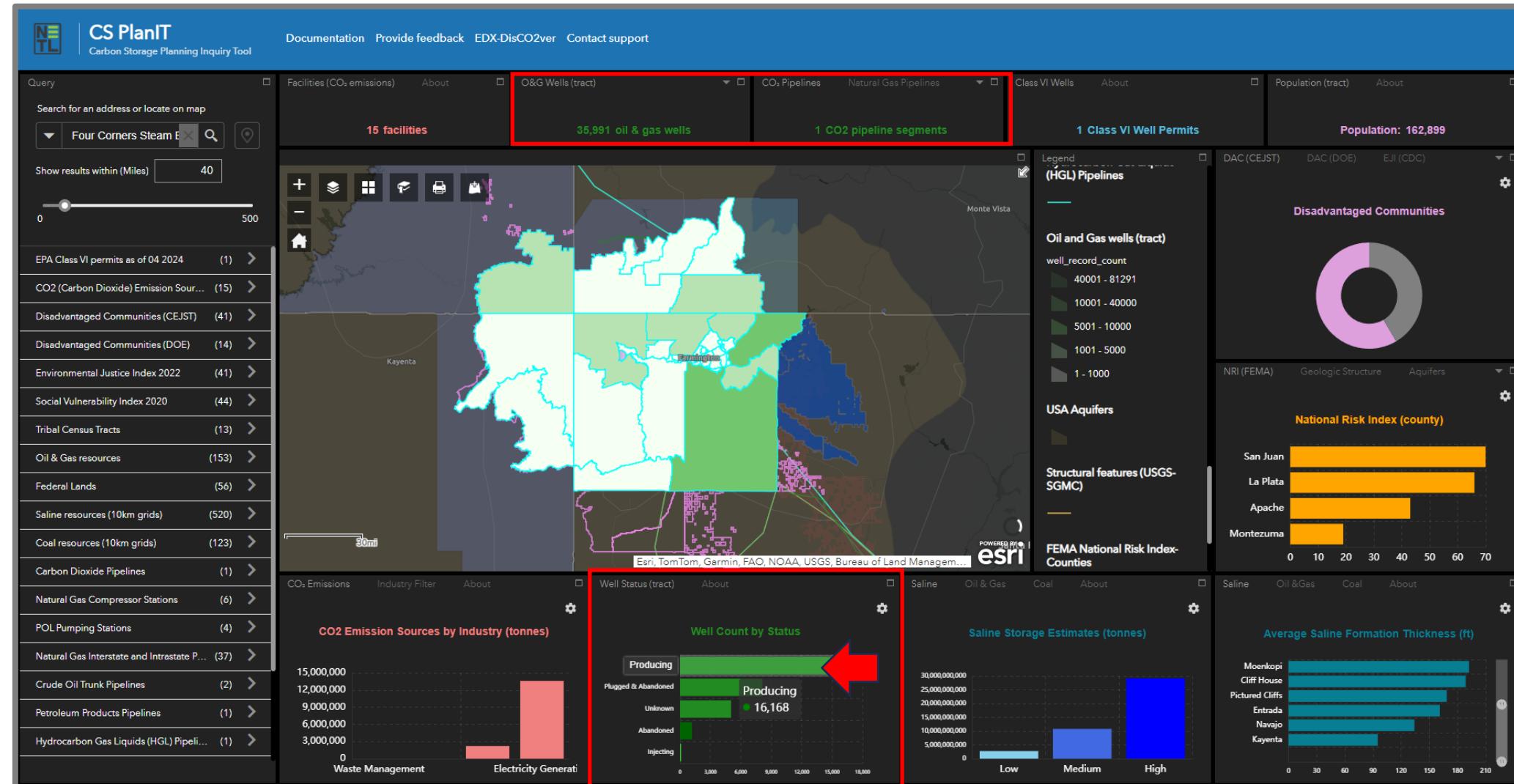
Walkthrough - Charts and Statistics



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Walkthrough - Charts and Statistics

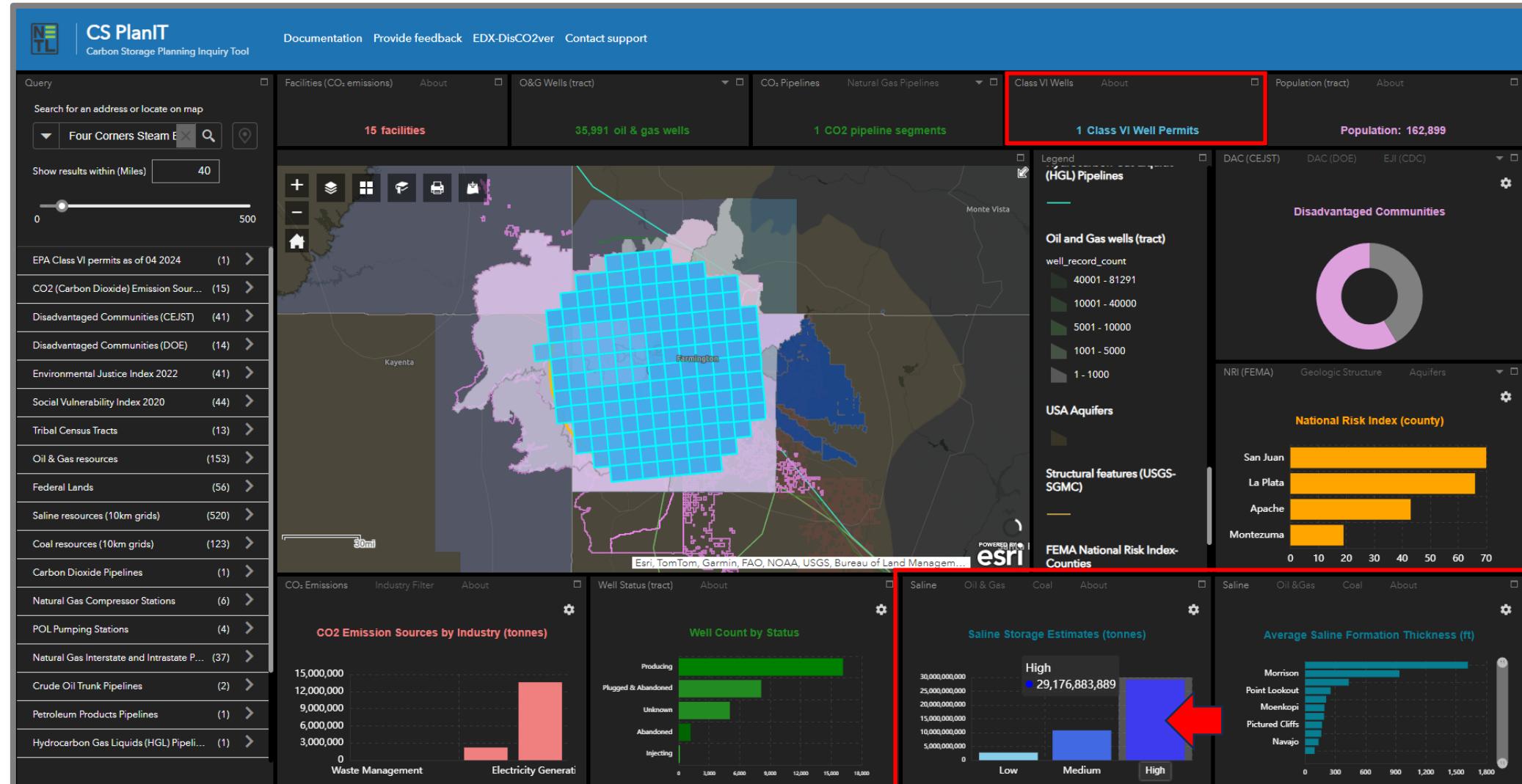


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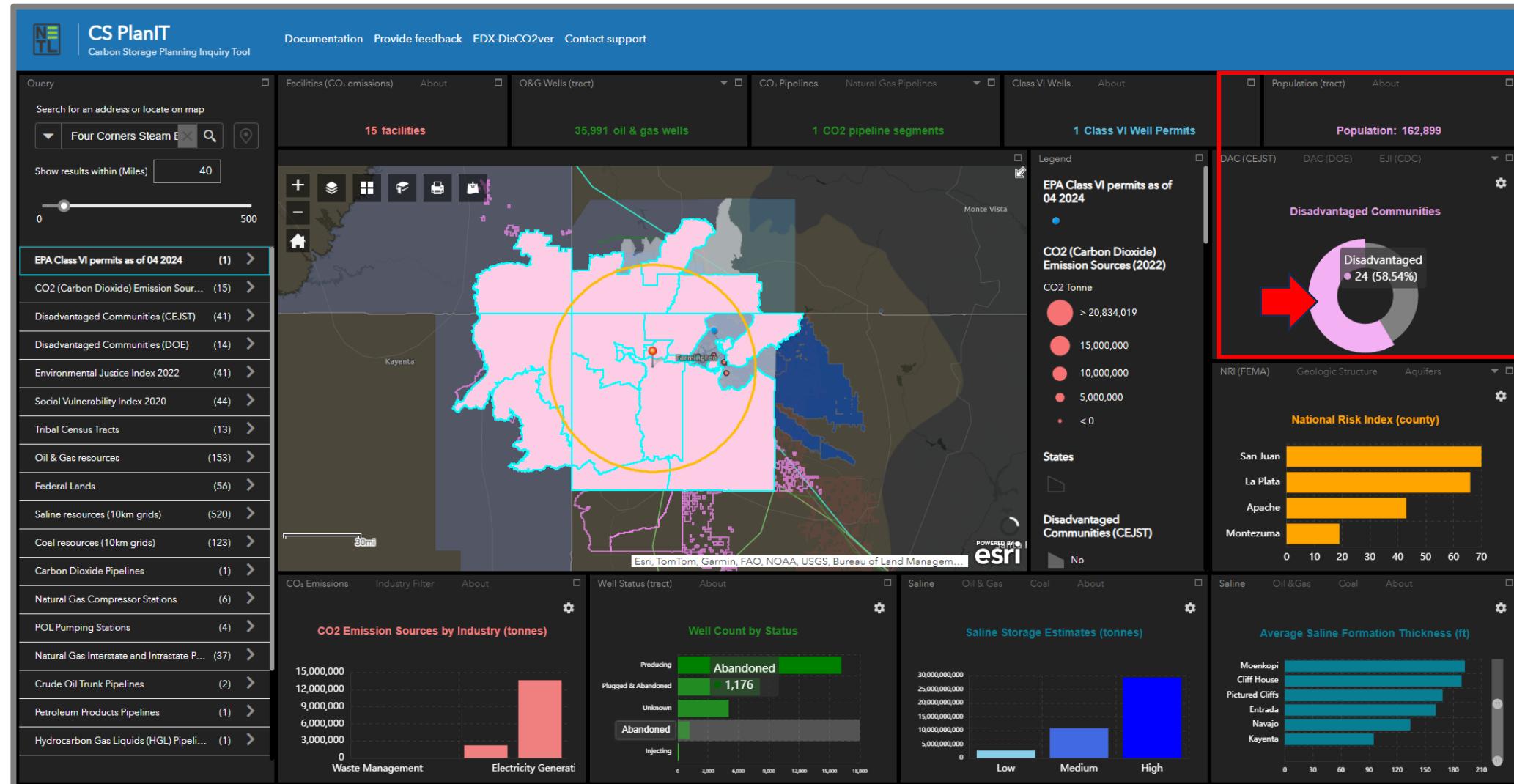
Walkthrough - Charts and Statistics



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Walkthrough - Charts and Statistics

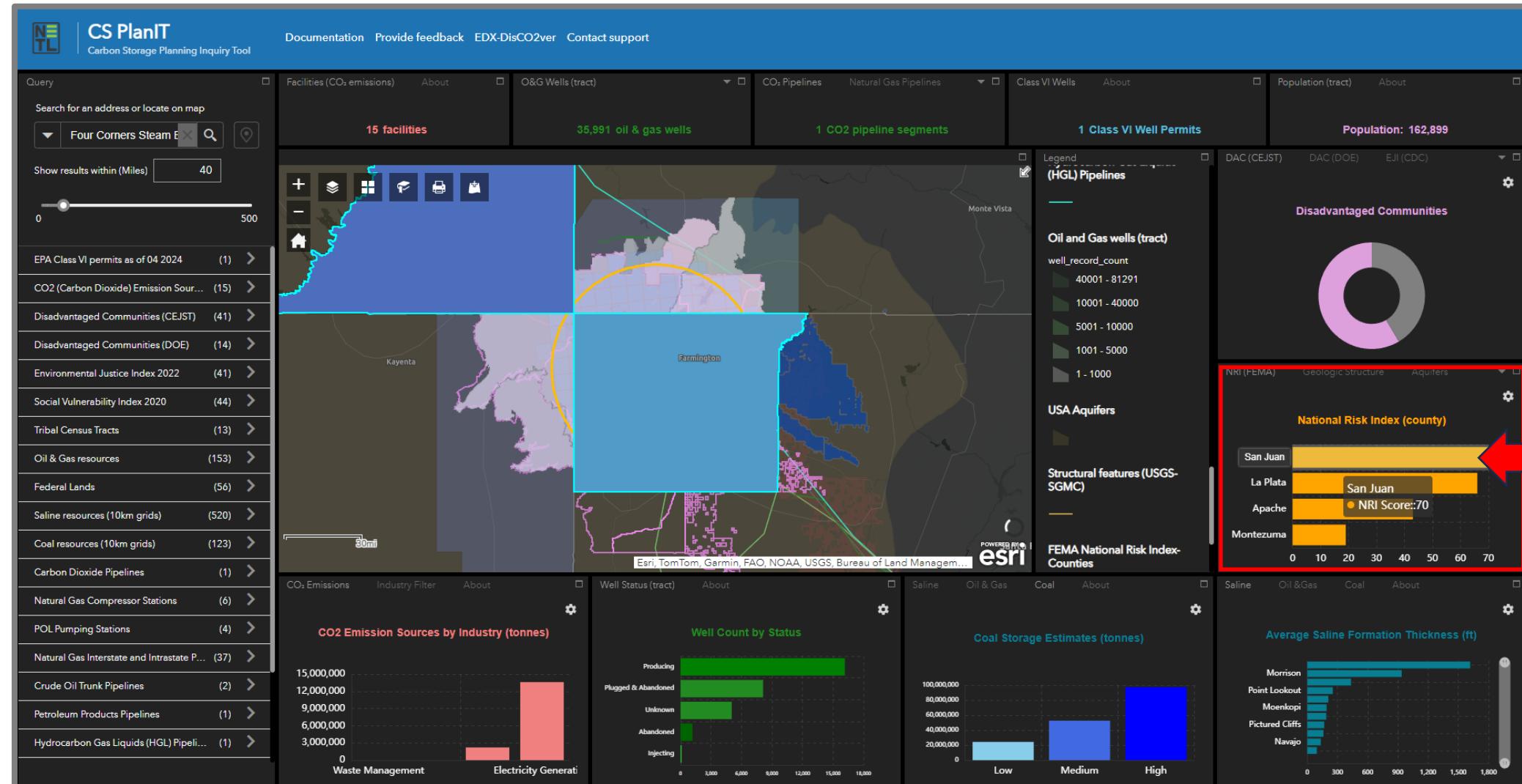


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Walkthrough - Charts and Statistics



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Walkthrough - Charts and Statistics “About” Tabs

CS PlanIT | Documentation | Provide feedback | EDX-DisCO2ver | Contact support

About NRI (FEMA) Geologic Structure Aquifers

NRI (FEMA)

- Description:** This horizontal bar chart displays the National Risk Index (NRI; from 0 to 100) composite score for 18 natural hazards by county. A score of 100, represents the highest risk associated with the 18 natural hazards. Hovering the cursor over the bars highlight data on the map.
- Data source:** U.S. Federal Emergency Management Agency (FEMA)

Population (tract) About

Population: 162,899

CEJST DAC (DOE) EJI (CDC)

Disadvantaged Communities



ABOUT NRI (FEMA) Geologic Structure

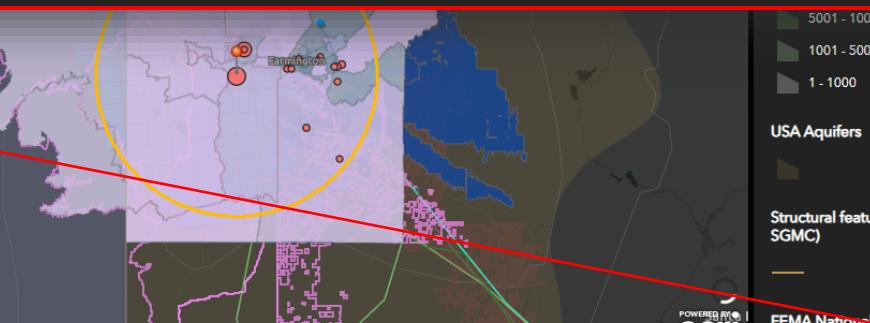
NRI (FEMA) About

- Description: This horizontal bar chart displays the National Risk Index (NRI; from 0 to 100) composite score for 18 natural hazards by county. A score of 100, represents the highest risk associated with the 18 natural hazards. Hovering the cursor over the bars highlight data on the map.
- Data source: U.S. Federal Emergency Management Agency (FEMA)

Geologic Structure

- Description: This pie chart displays the type of geologic structure.

30mi



5001 - 10000
1001 - 5000
1 - 1000

USA Aquifers

Structural features (USGS-SGMC)

FEMA National Risk Index-Counties

CO2 Emissions Industry Filter About

Well Status (tract) About

Saline Oil & Gas Coal About

Waste Management Electricity Generation

CO2 Emission Sources by Industry (tonnes)

Industry	CO2 Emissions (tonnes)
Electricity Generation	12,000,000
Waste Management	0

Well Count by Status

Status	Count
Producing	15,000
Plugged & Abandoned	8,000
Unknown	5,000
Abandoned	2,000
Injecting	0

Coal Storage Estimates (tonnes)

Storage Level	Estimate (tonnes)
Low	20,000,000
Medium	40,000,000
High	100,000,000

Average Saline Formation Thickness (ft)

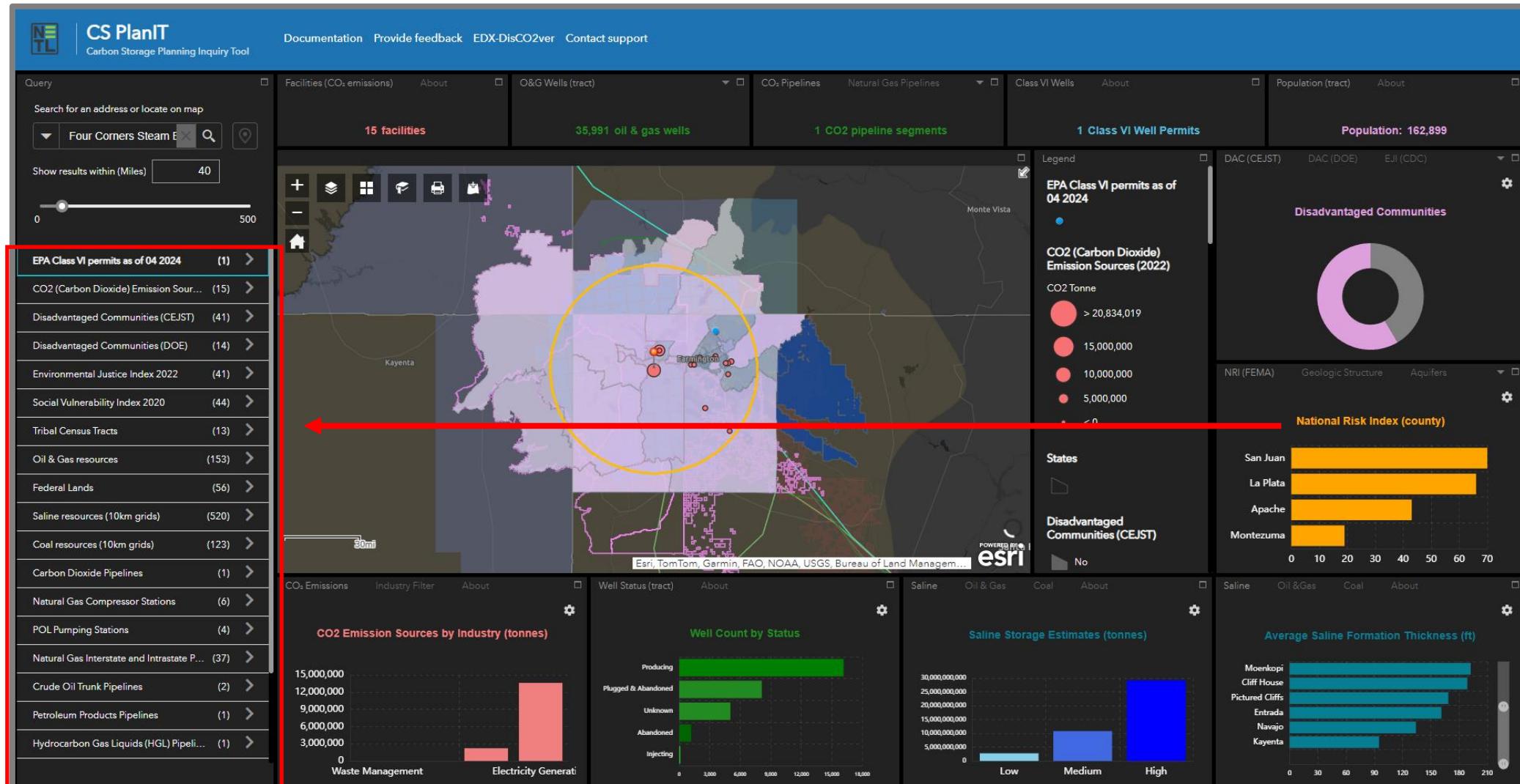
Formation	Average Thickness (ft)
Morrison	1,500
Point Lookout	300
Moenkopi	500
Pictured Cliffs	100
Navajo	100



Carbon Storage Planning Inquiry Tool (CS PlanIT) v1.0



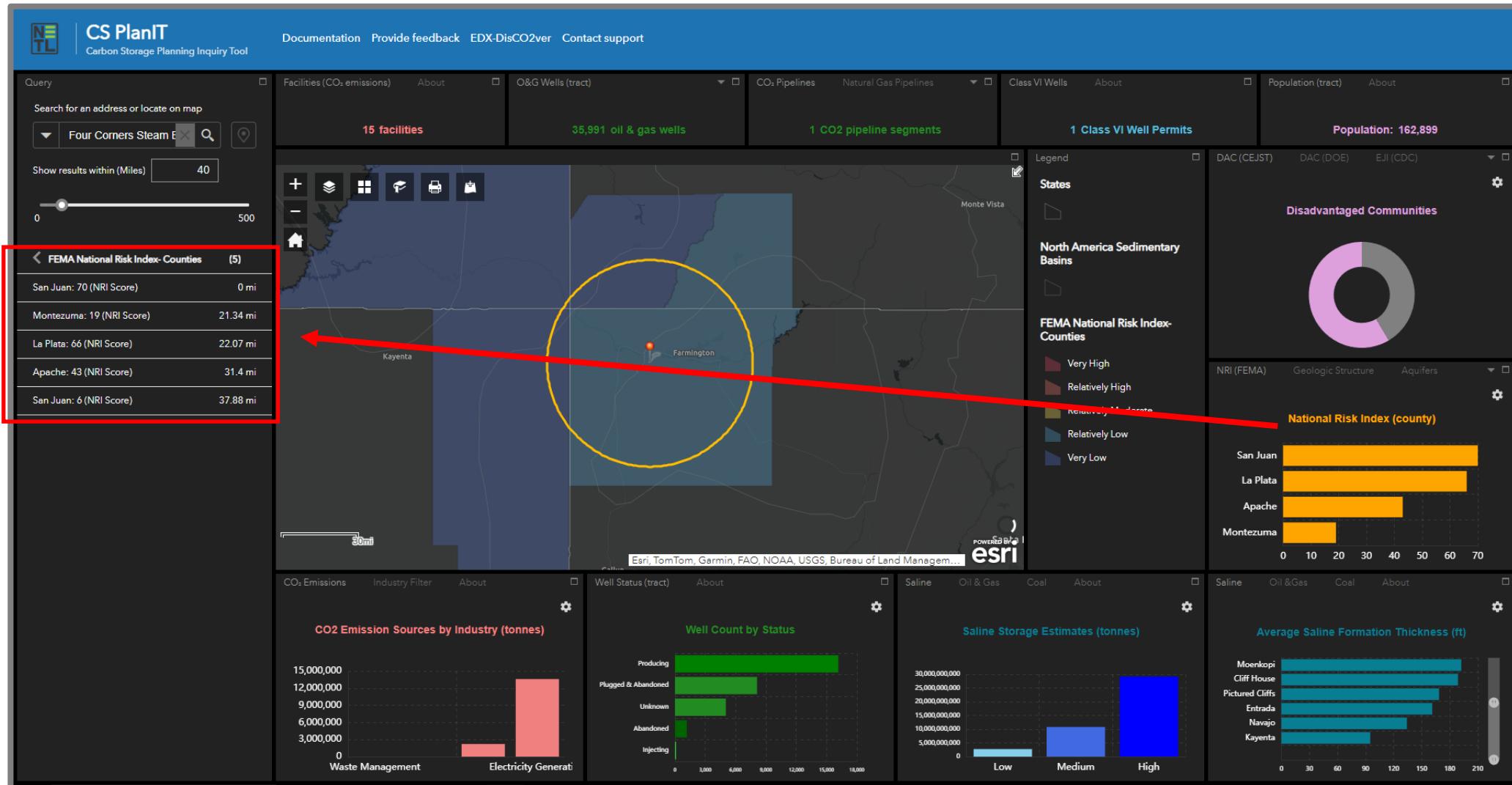
Walkthrough - Data Filtering/Interrogation



Carbon Storage Planning Inquiry Tool (CS PlanIT) v1.0



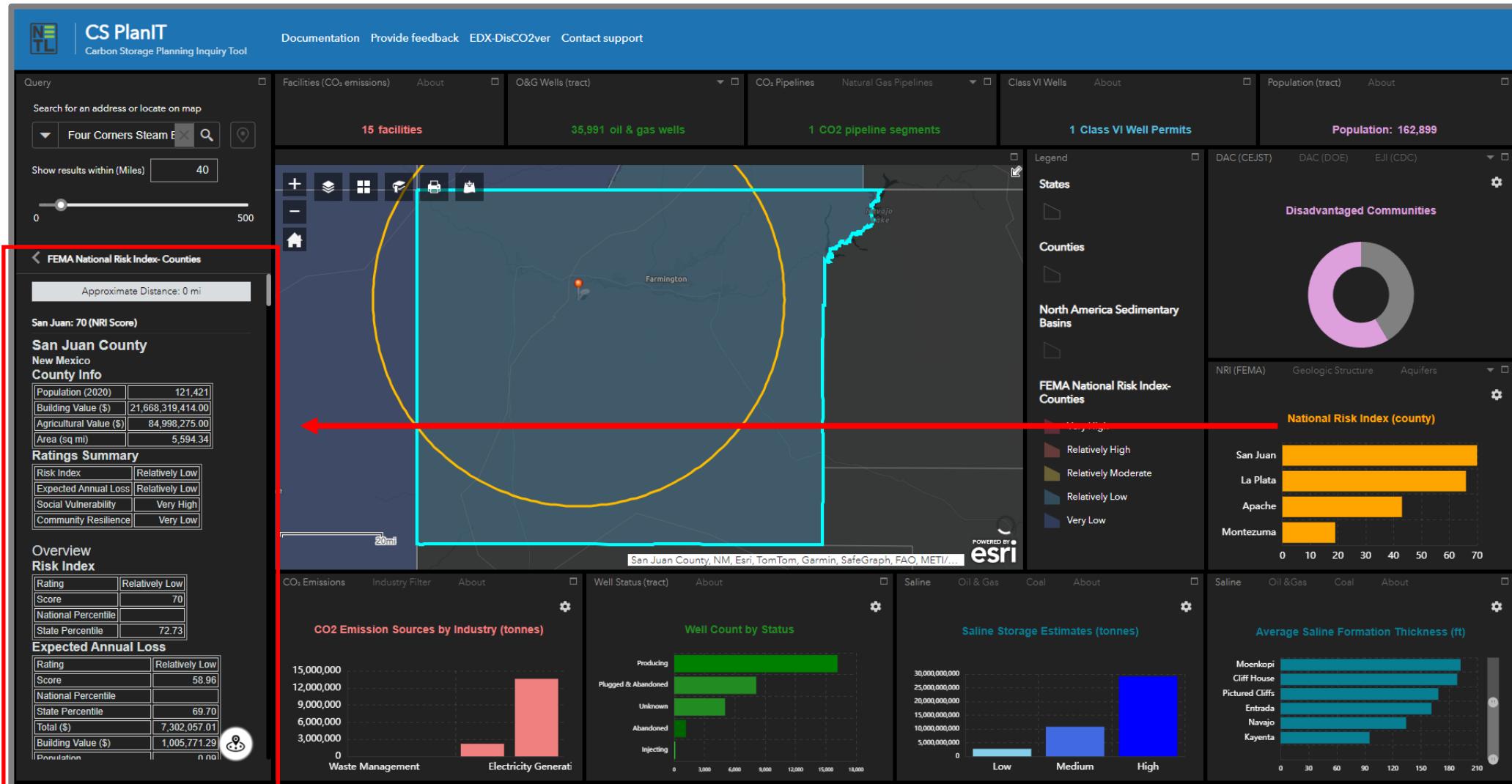
Walkthrough - Data Filtering/Interrogation



Carbon Storage Planning Inquiry Tool (CS PlanIT) v1.0



Walkthrough - Data Filtering/Interrogation



Carbon Storage Planning Inquiry Tool (CS PlanIT) v1.0



Walkthrough - Map Controls/Widgets

The screenshot shows the CS PlanIT v1.0 dashboard with a map of the Four Corners region. A red arrow points to the map's control bar, which includes icons for zoom in, zoom out, full screen, print, and add data. A callout box highlights these features with the following list:

- Layer list
- Bookmark extent
- Print (export map)
- Add data

On the left, a sidebar lists various data layers: Saline resources (10km grids), Coal resources (10km grids), Carbon Dioxide Pipelines, Natural Gas Compressor Stations, POL Pumping Stations, Natural Gas Interstate and Intrastate Pipelines, Crude Oil Trunk Pipelines, Petroleum Products Pipelines, and Hydrocarbon Gas Liquids (HGL) Pipelines. The main map displays several data layers, including CO2 pipeline segments, oil & gas wells, and EPA Class VI permits. To the right of the map are several data visualization widgets: a pie chart for Disadvantaged Communities, a bar chart for National Risk Index (county), a bar chart for Average Saline Formation Thickness (ft), and various charts for CO2 Emissions, Well Status, and Saline Storage Estimates.

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Walkthrough - External Links

- Documentation
- Feedback form
- EDX-DisCO₂ver homepage
- Form to contact EDX support



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Carbon Storage Planning Inquiry Tool (CS PlanIT) v1.0



Walkthrough - External Links

- CS PlanIT documentation web page
- ArcGIS Story map with 4 sections:
 - **About**
 - **Layout**
 - **Functionality**
 - **Data Catalog**

The screenshot shows the CS PlanIT web application interface. At the top, there are navigation links: About, Layout, **Functionality**, and Data Catalog. Below this, the 'Functionality' section is titled 'General widget interaction'. It includes a diagram of a pipeline network with numbered callouts: 1 points to a text box stating '2,014.1 km of NGP segments'; 2 points to a zoomed-in view of the pipeline network; 3a points to a map of North America with a red circle around a point in the Great Lakes region; 3b points to a pie chart titled 'Disadvantaged Communities'; 4 points to the top right corner of the screen. The main content area displays various data visualizations: a map of the United States and Canada with data overlays, a bar chart for 'CO2 Emission Sources by Industry (tonnes)', a bar chart for 'Well Count by Status', and a bar chart for 'Saline Storage Estimates (tonnes)'. A legend for 'OSI' is also visible.

Carbon Storage Planning Inquiry Tool (CS PlanIT) v1.0



Walkthrough - External Links

- CS PlanIT Feedback Form
- Users can rate and comment on aspects of the tool

The image shows a screenshot of the CS PlanIT Feedback Form overlaid on the Carbon Storage Planning Inquiry Tool's interface. The feedback form is titled 'CS PlanIT Feedback Form' and contains fields for 'Name*', 'Organization*', 'Date*', 'List or describe data/statistics preferences*', 'Responsiveness' (with a 5-star rating), 'Layout' (with a 5-star rating), and 'General comments/issues/suggestions*'. A 'Submit' button is at the bottom. The background shows the map of North America with data overlays for facilities and wells, and various charts and tables related to carbon storage planning.

Carbon Storage Planning Inquiry Tool (CS PlanIT) v1.0



Walkthrough - External Links

CS PlanIT
Carbon Storage Planning Inquiry Tool

Documentation Provide feedback **EDX-DisCO2ver** **Contact support**

Query Search for an address or locate on map

Facilities (CO₂ emissions) About O&G Wells (tract) CO₂ Pipelines Natural Gas Pipelines Class VI Wells About Population (tract) About

6,951 facilities 5,045,093 oil & gas wells 66 CO₂ pipeline segments 212 Class VI Well Permits Population: 328,267,709

Show results within (Miles) 0

Find address or place

EDX discover

Home About Data Tools Bibliography DOE Programs News External Programs

disco₂ver alpha

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The EDX-hosted disco2ver platform connects the carbon transport and storage community to publicly available data resources in support of the U.S. Department of Energy (DOE), Office of Fossil Energy and Carbon Management's (FECM) mission and goals.

EDX disco2ver is a central hub for all things carbon storage, making it easier for stakeholders to execute diverse carbon capture and storage (CCS) projects. Funded by the bipartisan infrastructure law (BIL), disco2ver host tools, datasets, geospatial data, dashboards, and search capabilities (both within and outside EDX) to support users across disciplines and backgrounds find the right resources to meet their needs within carbon storage research.

The U.S. DOE FECM's Carbon Transport and Storage Program has been supporting the preservation and public availability of CCS data products, such as data, models, and tools, for over a decade on the EDX system. This has resulted in the preservation and publishing of millions of dollars worth of research project products, ensuring their present availability for validation and reuse to accelerate the Program's present objectives and goals by federal researchers, academia, and industry.

EDX, first launched in 2011, now curates an ever-growing collection of FECM products from many programs. disco2ver aims to help Carbon Transport & Storage (CTS) program stakeholders connect to the resources most relevant to them by increasing visibility of CTS research products available to the public. disco2ver also includes links to publicly available resources from authoritative resources outside DOE FECM's program products.

CONTACT US

CO₂ Injection Ethanol Plant

Well Status (tract) About Well Count by Status

Plugged & Abandoned Producing Unknown Abandoned Injecting

10,000,000,000,000 5,000,000,000,000 0 0 300,000 600,000 900,000 1,200,000 1,500,000

Low Medium High

Big Valley Beaverhill Lake Group Bangor Limestone Astoria-Nehalem

EDX. NETL's Energy Data eXchange

Search Contribute Groups Portfolios Workspaces Tools EDX Spatial

Contact Us

The EDX web application was developed and is maintained by NETL. We welcome your comments or feedback on the EDX. Specific questions on this EDX application and suggested corrections or revisions should be submitted to the EDX Team by:

- Filling out the form on this page (recommended)
- Sending an Email to: EDXSupport@netl.doe.gov
- Mail to:
Attn: EDX Support
3610 Collins Ferry Road
P.O. Box 880
Morgantown, WV 26507-0880

Email EDX Support
Fill out the following form to contact EDX Support.

Reason for Contact:
Please Select

Full Name:
John Doe

Position:
Energy Researcher

Organization:
National Energy Technology Laboratory

Your email address:
me@example.com

Comments:
Leave your feedback

Email EDX Support

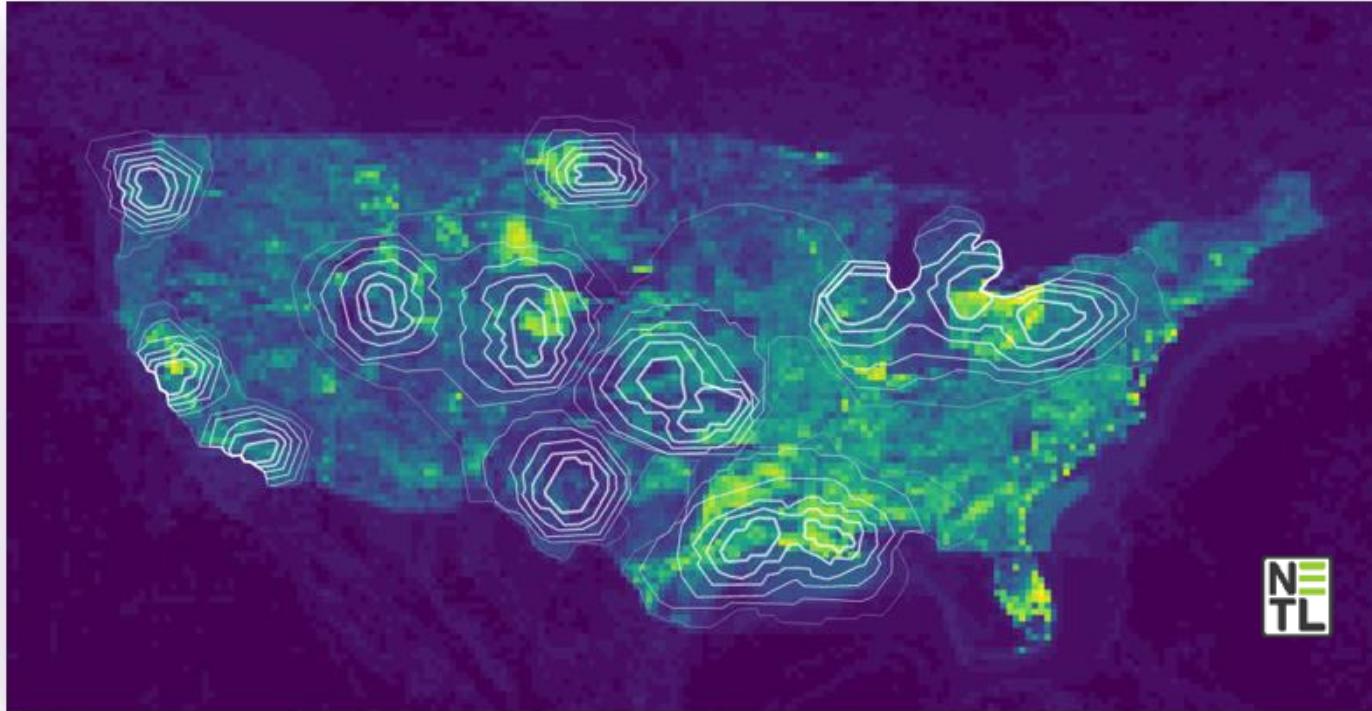


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Next Steps and Challenges



Carbon Storage Technical Viability Assessment (CS TVA) data density analysis (brighter green, higher data density) overlaid by white contour lines highlighting Great Plains Institute Carbon Storage Hub locations (Abramson, 2022). Analysis performed using the CSIL (Cumulative Spatial Impact Layers) tool (Romeo et al., 2019).

- Next steps/Challenges:
 - Evaluating and integrating key data from CS TVA (Carbon Storage Technical Viability Assessment) database (EDX4CCS portfolio)
 - Build out and adjusting tool layout and functionality
 - **Release of CS PlanIT v2.0 (April 2025)**

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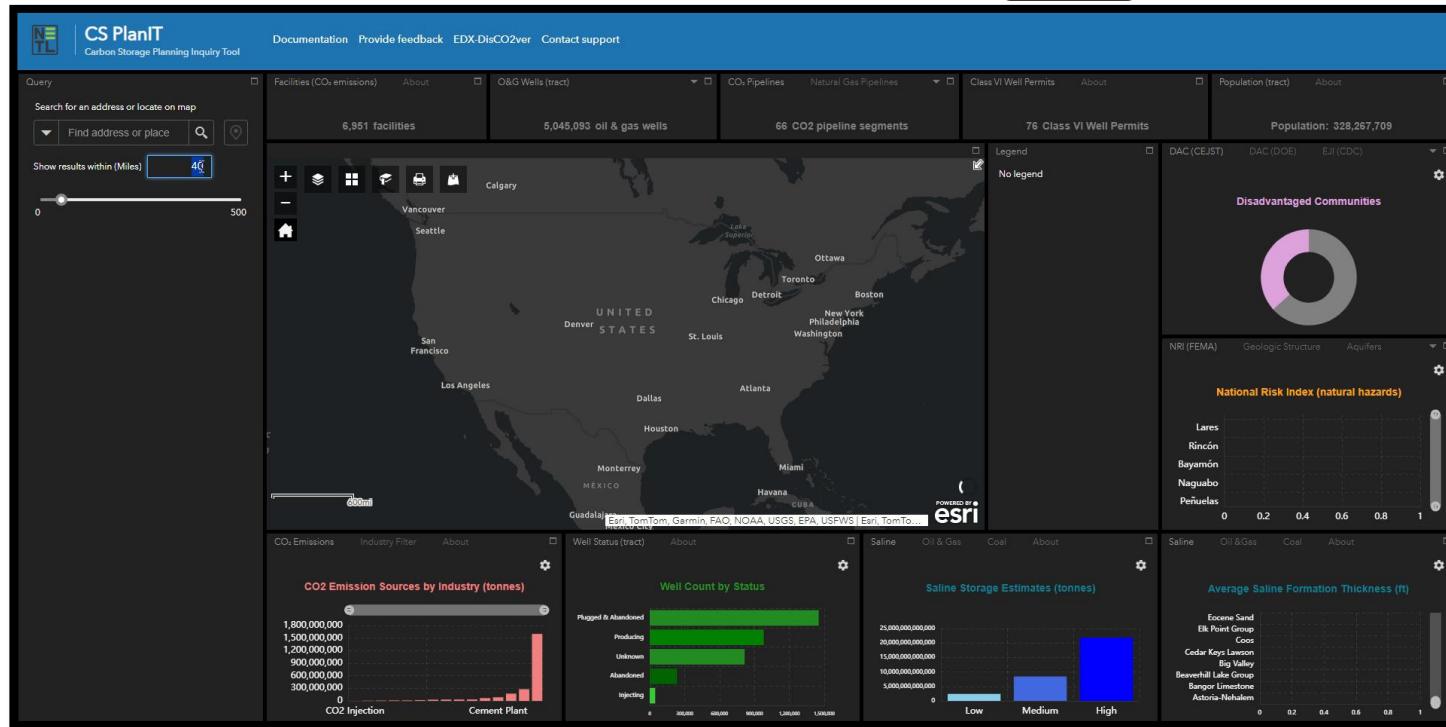


Ultimate Outcomes

- Version 1 available as of 6/30/2024
- Version 2 with data integrated from the CS TVA (Carbon Storage Technical Viability Assessment) database (release April 2025)

Stakeholder Benefit

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



<https://edx.netl.doe.gov/dataset/cs-planit-carbon-storage-planning-inquiry-tool>



Live Tool Demos on Tuesday Evening

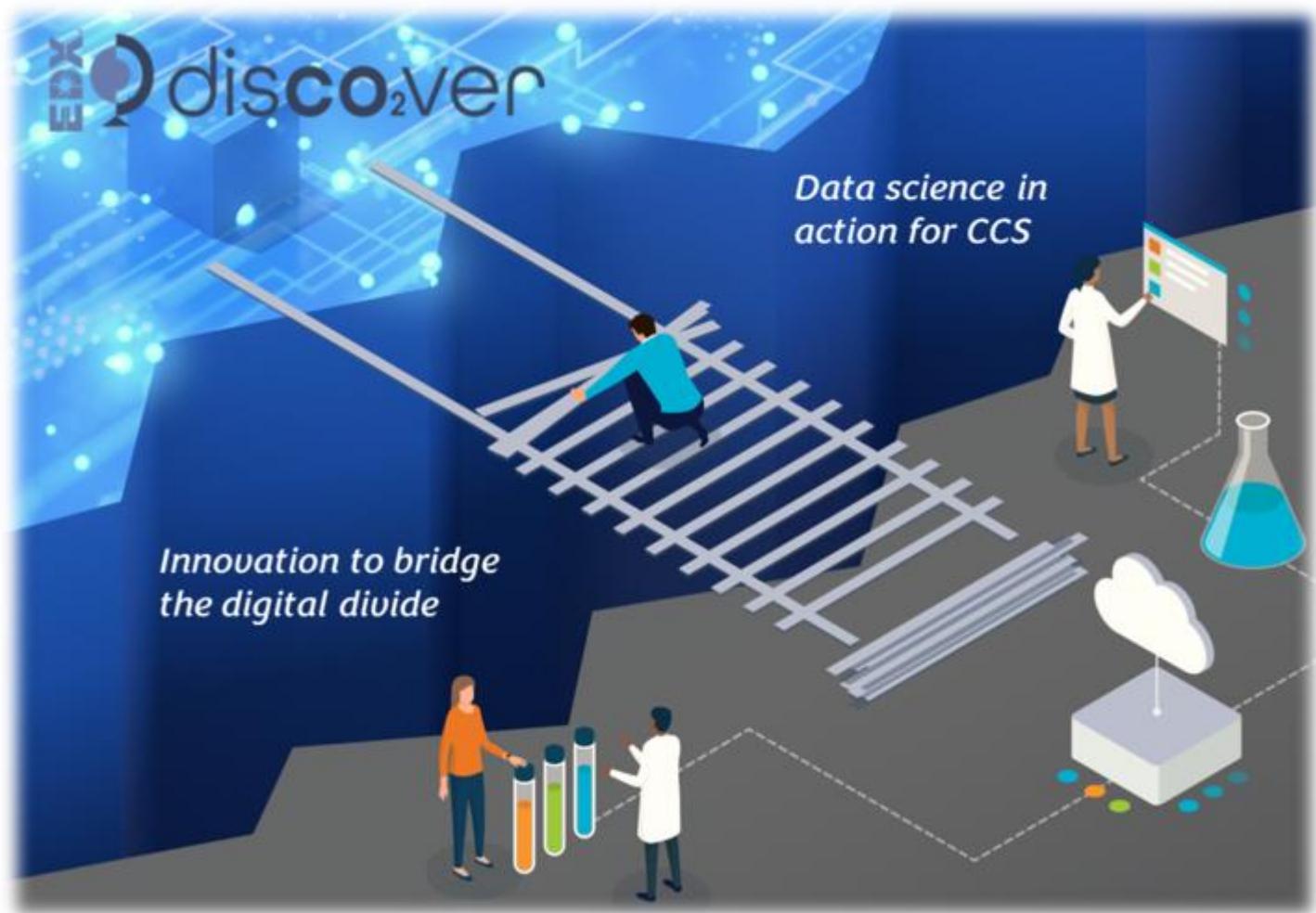


What: EDX4CCS and other carbon storage data and tool demos

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

Where: The Ballroom Foyer and East/West Atriums

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



References



Abramson et al. (2022) An Atlas of Carbon and Hydrogen Hubs for United States Decarbonization. Great Plains Institute,

https://scripts.betterenergy.org/CarbonCaptureReady/GPI_Carbon_and_Hydrogen_Hubs_Atlas.pdf

Romeo, L., Nelson, J., Wingo, P., Bauer, J., Justman, D., & Rose, K. (2019). Cumulative spatial impact layers: A novel multivariate spatio-temporal analytical summarization tool. *Transactions in GIS*, 23(5), 908-936.

Justman, D., Pantaleone, S., Sharma, M., Romeo, L., Morkner, P. (2024) CS PlanIT (Carbon Storage Planning Inquiry Tool) , 6/28/2024, <https://edx.netl.doe.gov/dataset/cs-planit-carbon-storage-planning-inquiry-tool>, DOI: 10.18141/2377953

Acknowledgments



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NETL RESOURCES

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