



The Carbon Utilization and Storage Partnership of the Western US

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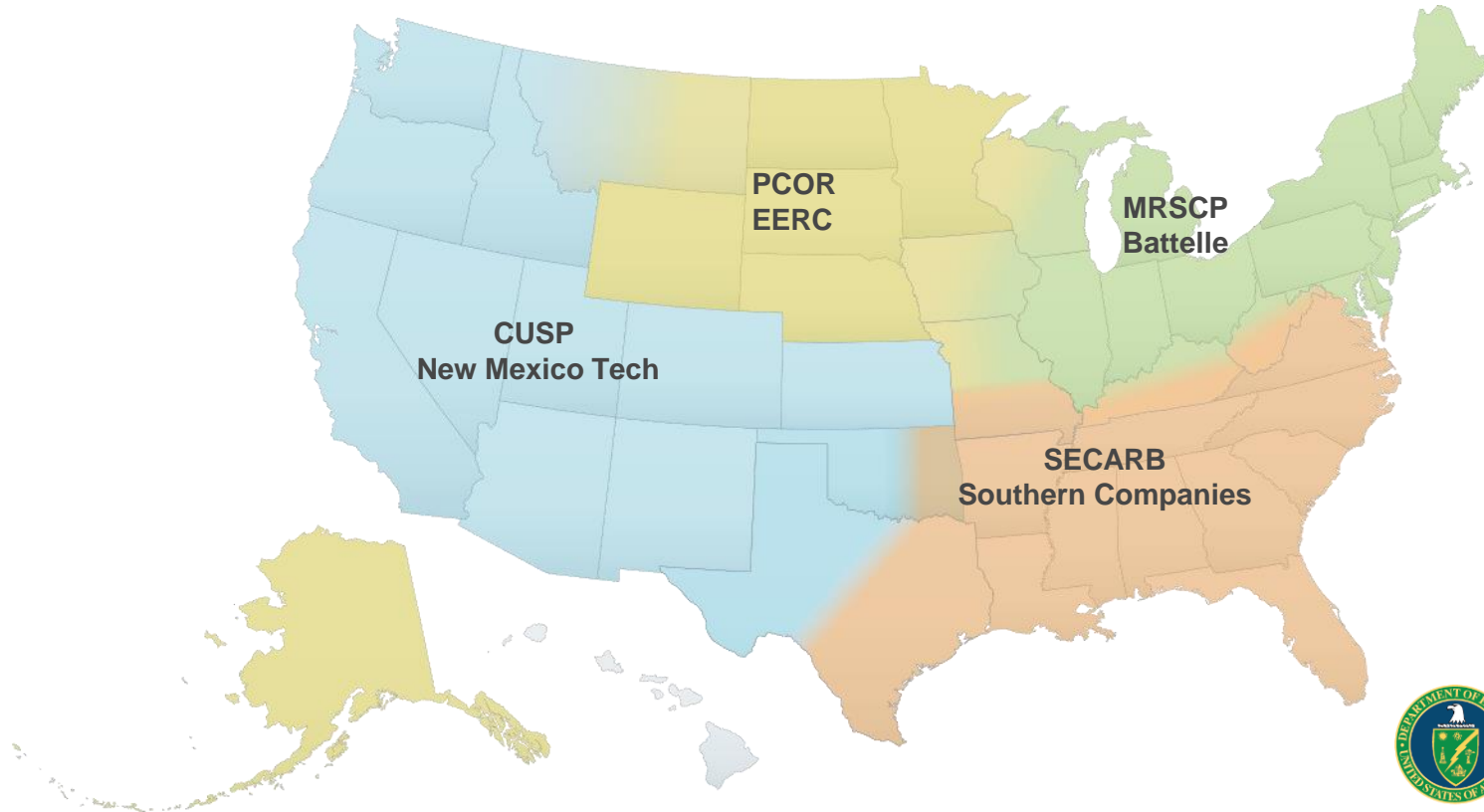
New Mexico Institute of Mining and Technology

Brian McPherson

University of Utah

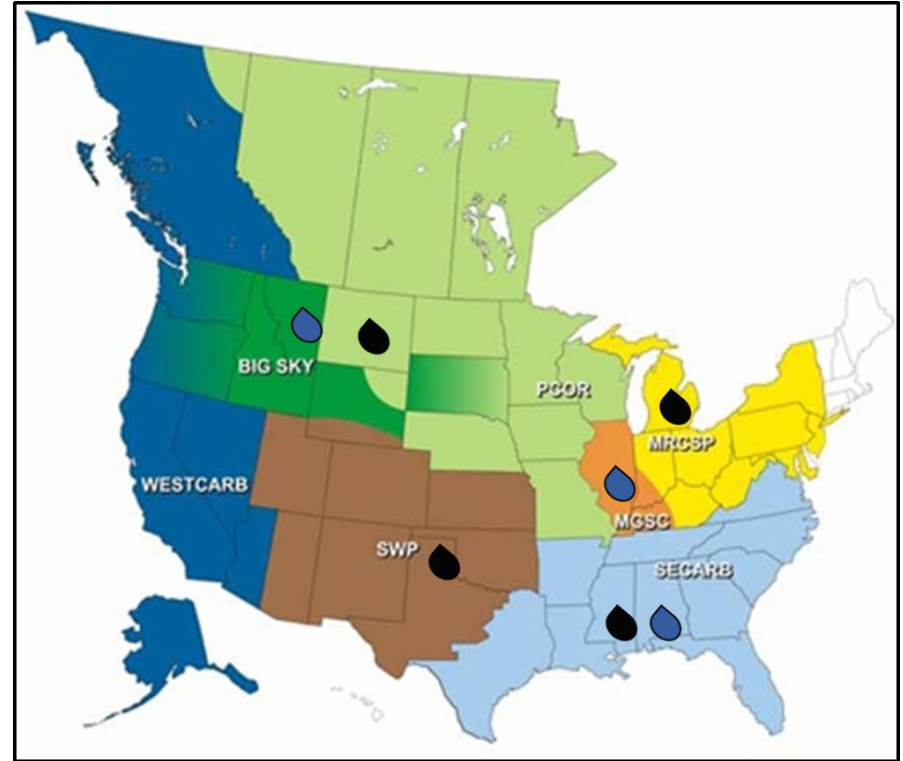
DOE Annual Carbon Meeting, August 8, 2024

Regional Initiatives to Accelerate CCUS Deployment (2019)



Successor to USA RCSP Program (2003-2022)

- US Department of Energy Regional Carbon Sequestration Partnerships
 - Seven regional partnerships
 - Dozens of pilot projects
- Each partnership tasked with demonstrating injection of at least 1,000,000 metric tons of CO₂ as a final project
- Four projects demonstrated storage in conjunction with EOR
- Developed “best practices” for storing and utilizing captured CO₂



Modified from <http://energy.gov/fe/science-innovation/carbon-capture-and-storage-research/regional-partnerships>



Who is the CUSP?



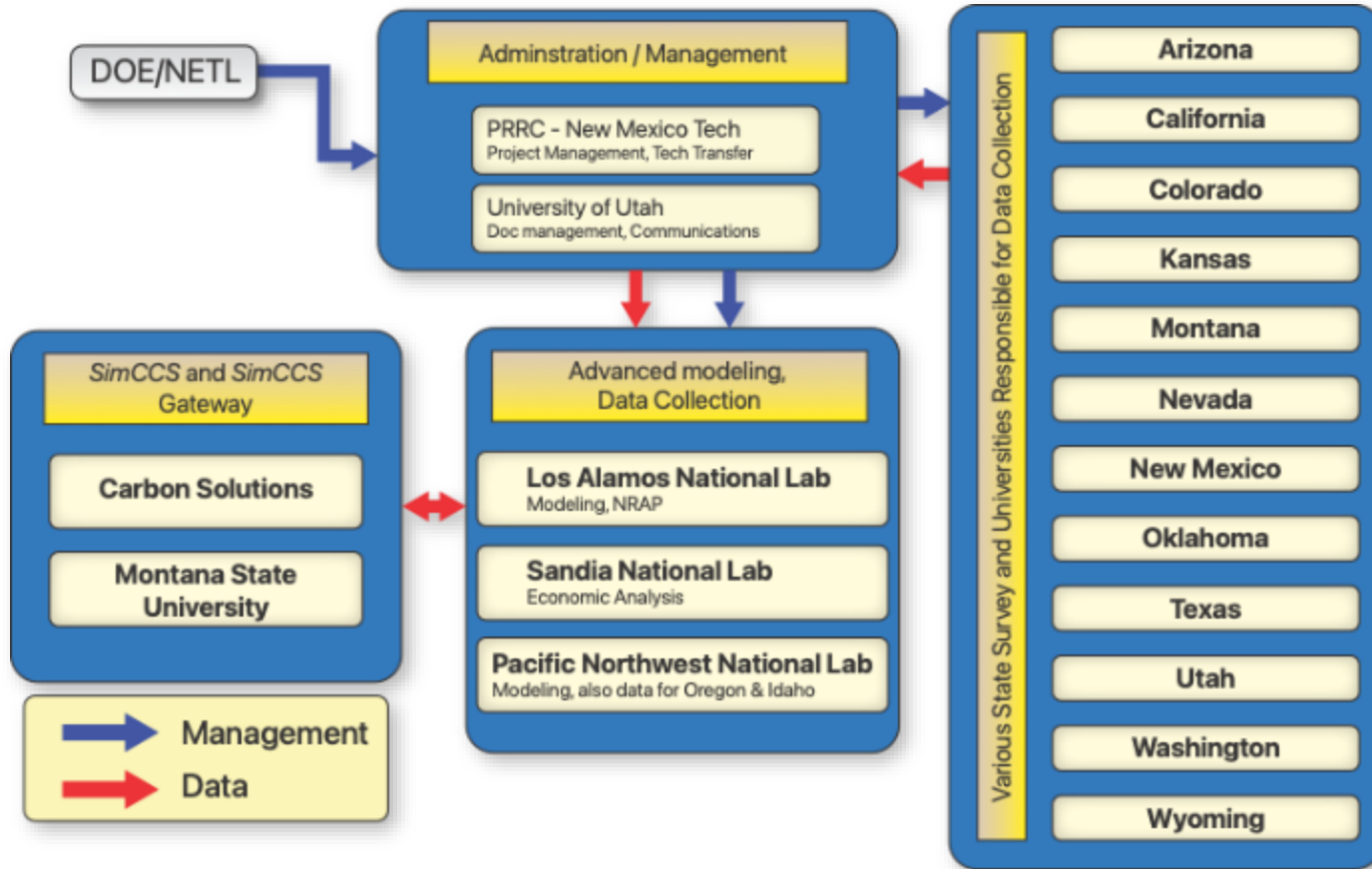
- Parts of three of the original RCSPs: SWP, WESTCARB, and Big Sky
- 15 States represented through a survey, a university, or a research institute: AZ, CA, CO, HI, ID, KS, NM, NV, MT, OK, OR, TX, UT, WA
- National Laboratories - Los Alamos, Pacific Northwest, Idaho, and Sandia



- **Has directly funded to date: 15 CCUS commercialization projects in the western US**
- **Have 14 additional projects wholly funded by industry**



Organization



CUSP – Data Objectives (Atlas)



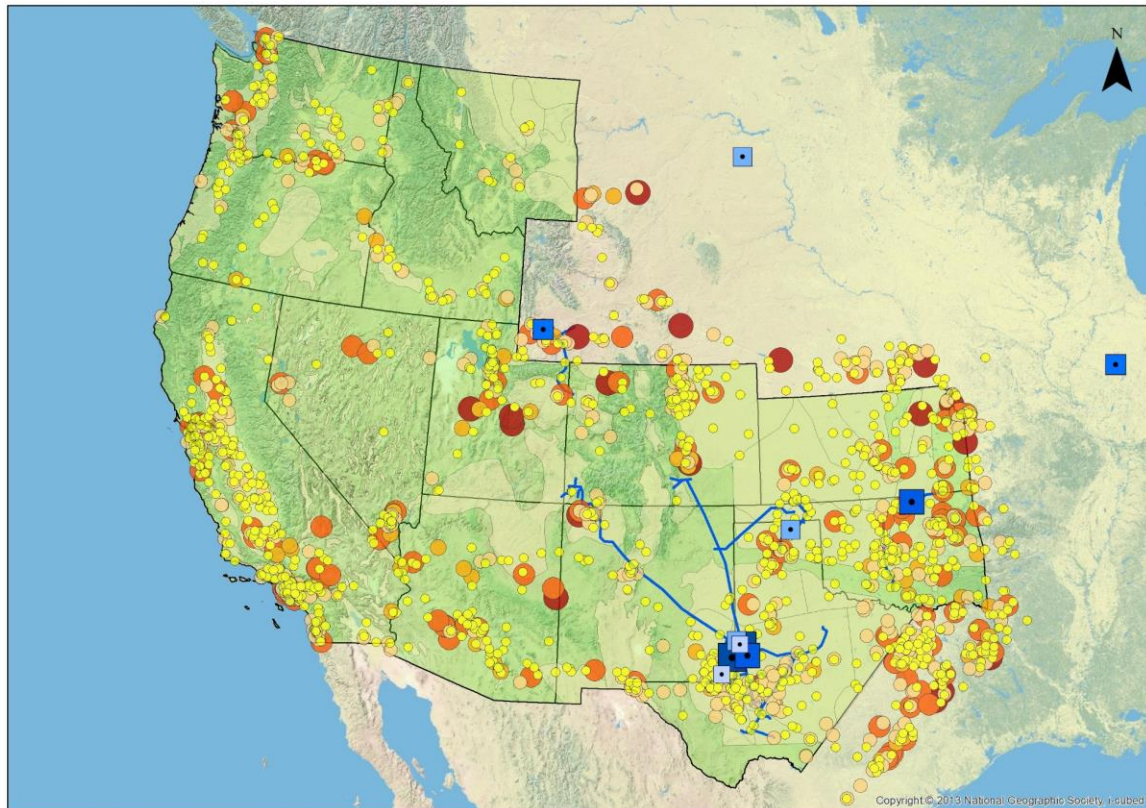
- Focus on collecting, synthesizing, and using existing data sets.
- Data to be incorporated into analytical and optimization models to evaluate CCUS potential and readiness. Goals include:
 - Identifying best prospects for commercial CCUS
 - Quantifying potential economic impacts
 - Developing Readiness Indices (w/ SimCCS) to identify best areas for short-term, mid-term, and long-term CCUS projects
- State organizations assessing, updating, augmenting, and verifying data used in data analysis and modeling
 - Geological storage complexes (saline, stacked storage, ROZs)
 - CO₂ emission sources
 - Existing infrastructure
- Strong emphasis on technology transfer and outreach



CUSP – Sources, Sinks and Transport



CO₂ emitted and sequestered (EPA GHGRP)



Legend

CO₂ Sequestration GHGRP

EPA GHGRP Total CO₂ sequestered (MMTCO₂)

- 0.0 - 0.025
- 0.025 - 0.1
- 0.1 - 0.5
- 0.5 - 1.0
- 1.0 - 3.0

EPA GHGRP 2022

Total reported direct emissions (MMTCO₂e)

- 0 - 0.1
- 0.1 - 0.5
- 0.5 - 1
- 1 - 5
- 5 - 14

CO₂ Pipeline (approx.)

CUSP

Adapted from
CCUS Map
EPA GHGRP





Data Integration and Management



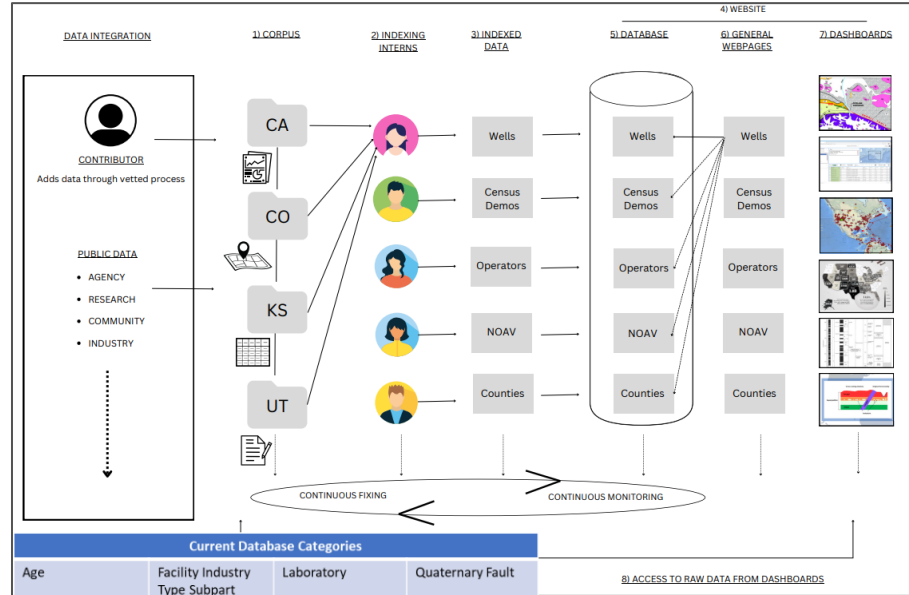
Carbon Portal Database Development



Backend

- 1) Database architectural design and development for long-term data needs
- 2) RCSP data integration: workflow design, sorting, categorization, integration complete
- 3) Data acquisition from various sources:
 - CUSP partners
 - Public data
 - Contributor page: allow user to contribute data through a verified process

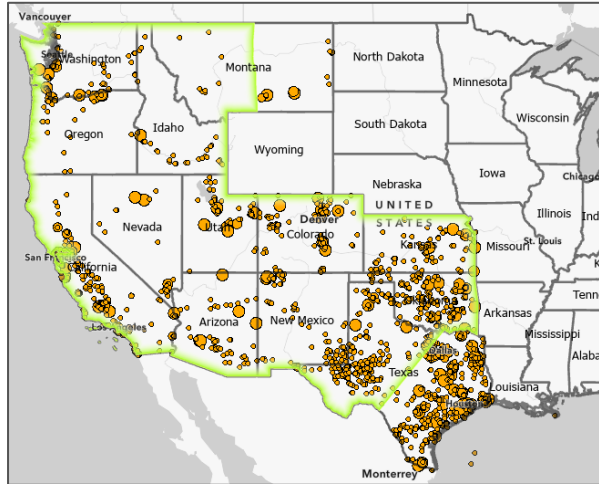
- 4) Develop and implement schema for all categories/tables
- 5) Indexing and data ingestion



Examples of Data Coverage

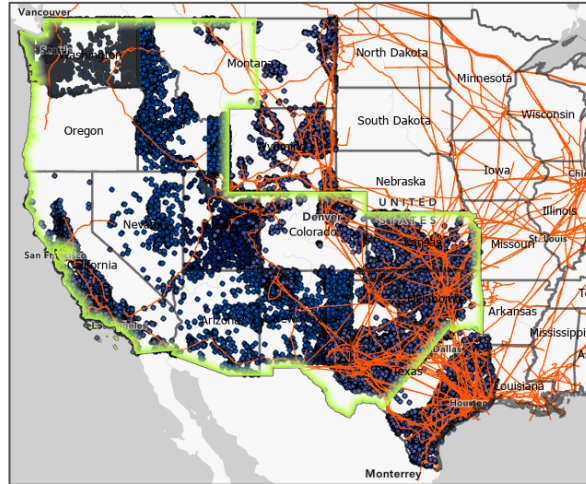


Facilities and Emissions



● Facility emissions

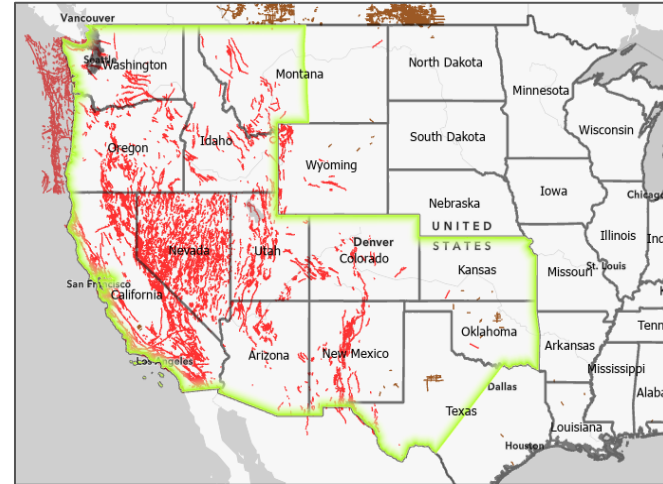
Oil and Gas



● Wells

— Pipelines

Seismic/Faults



— 2D seismic (SIGMA)

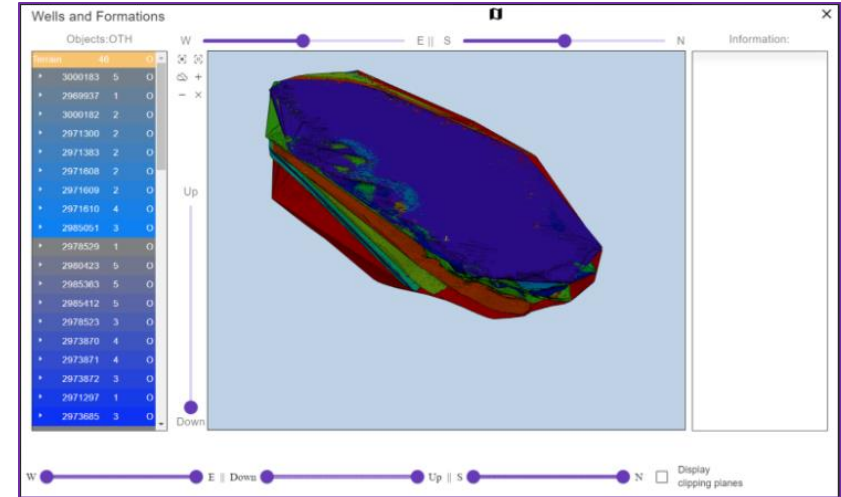
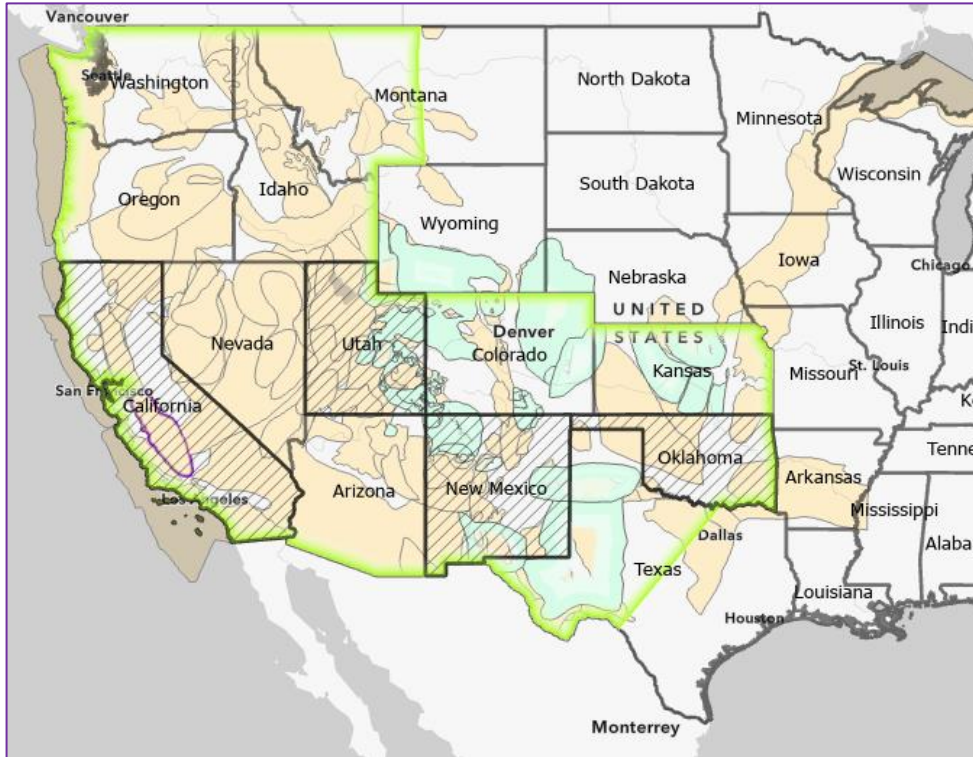
— Quaternary faults







Examples of Data Coverage



Reservoirs and Saline Aquifers



-  Saline Formations (SWP)
-  San Joaquin Basin Formations
-  Acquired formation top/bottom data
-  Sedimentary Basins (CUSP)

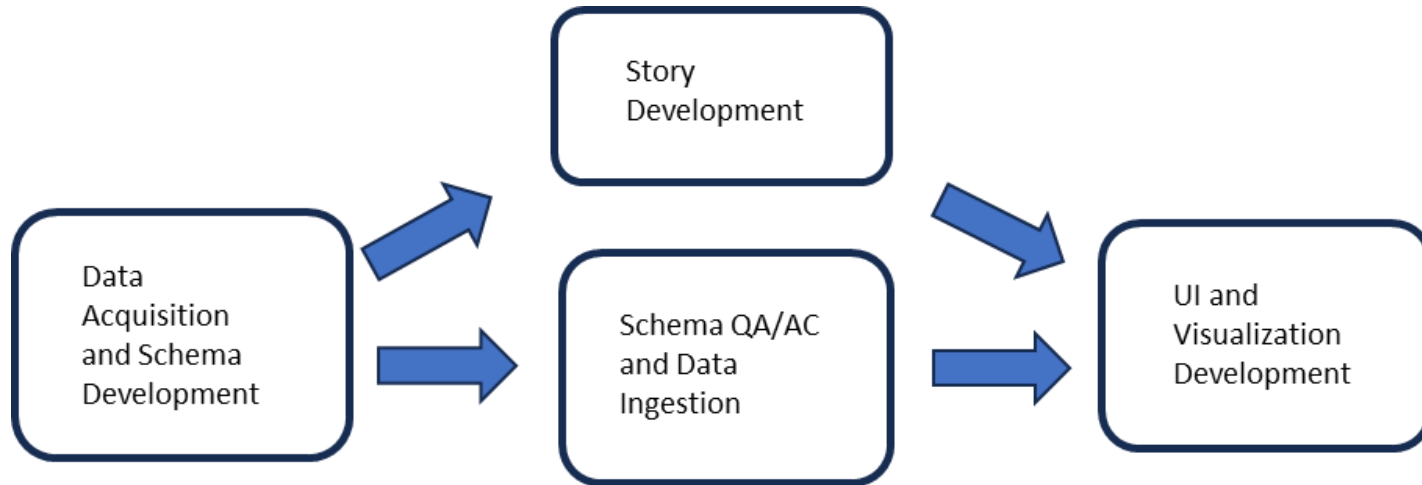


Carbon Portal UI/UX Development



Frontend

- Created pages to access/retrieve and visualize data
 - Considering the type of data acquired and potential users, stories were developed to help aid in the design of dashboards and panels
- Backend to frontend workflow:



Future of Carbon Portal



Looking ahead

- Research and development of toolkits/dashboards
- Continue the data acquisition process
- Implement user testing and feedback

[Carbon Portal](#) video



Toolkits/ Dashboards

- Class VI
- MRV
- Geologic
- Community
- Capture Tech

Relevant Data

- Wells
- Geology
- Well logs
- Hydrology
- Atmospheric
- Pipeline
- Oil & gas fields
- Operator
- Facilities
- Emissions
- Secondary emissions
- Tribal tracts
- Dis. Communities
- Land Ownership
- Workforce
- Secondary emissions
- Capture technology





CUSP Regional Project Support



CUSP – Project Support Objectives



Each year since 2019, the CUSP has also sought to leverage experiences and resources in the region to assist in commercialization projects

- 2020 Funds allocated to CUSP from DOE were set aside to jumpstart three 45Q ready projects in the region
- 2021 DOE allocated funds were used to select 12 additional focus projects, selected by the management team, from 26 internally generated proposals
- 2022, Congressionally allocated funds were not given directly to the Regional Initiatives, rather DOE released a RFP to attract projects

Five Projects awarded to CUSP members (\$8 Million)



CUSP Related Industry Projects

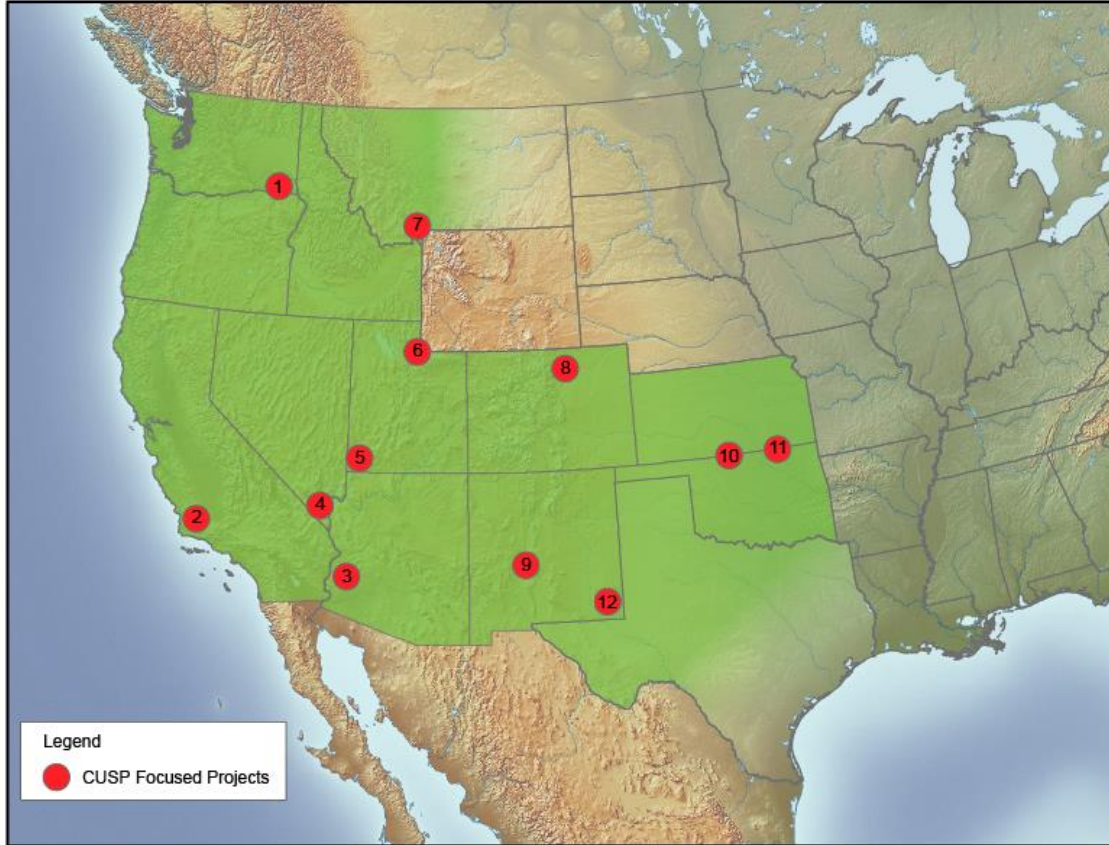


CUSP team members can provide regional and state level expertise to Industry sponsored projects, and have expanded their footprints regionally

- Those teams also can access specific expertise from other areas in the region
- Currently CUSP members are directly engaged with industry in at least:
 - 2 hydrogen projects
 - 10 Midstream company projects, 7 MRV's and 3 well permits
 - 4 more pending projects!
 - 1 EOR/Storage company
 - 1 DAC company
- CUSP management is also engaged with **Stockton LEAP** which is helping to study the applicability of storage projects near Oakland California
 - CUSP provided all subsurface modeling for SF Delta and Sacramento
 - This included well blowout and fault leakage scenarios
 - Currently working on surface hydrologic risk analyses



CUSP 2024 Regional Footprint

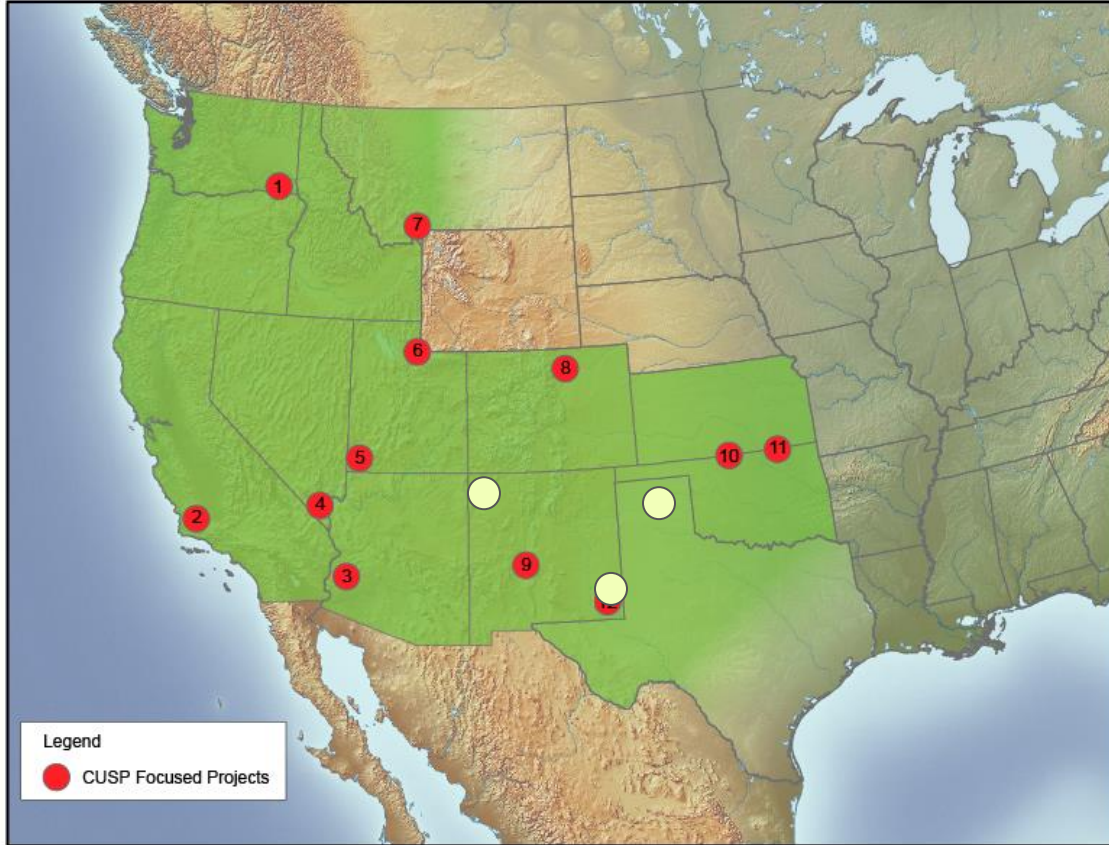


Current footprint of CUSP related projects

- 2020 – 3 Projects CUSP funded
- 2021 – 12 Projects CUSP funded
- 2022-2023 – Associated projects Funded
- 2023 – Associated projects pending
- Includes development of regional Storage Hubs



CUSP 2024 Regional Footprint

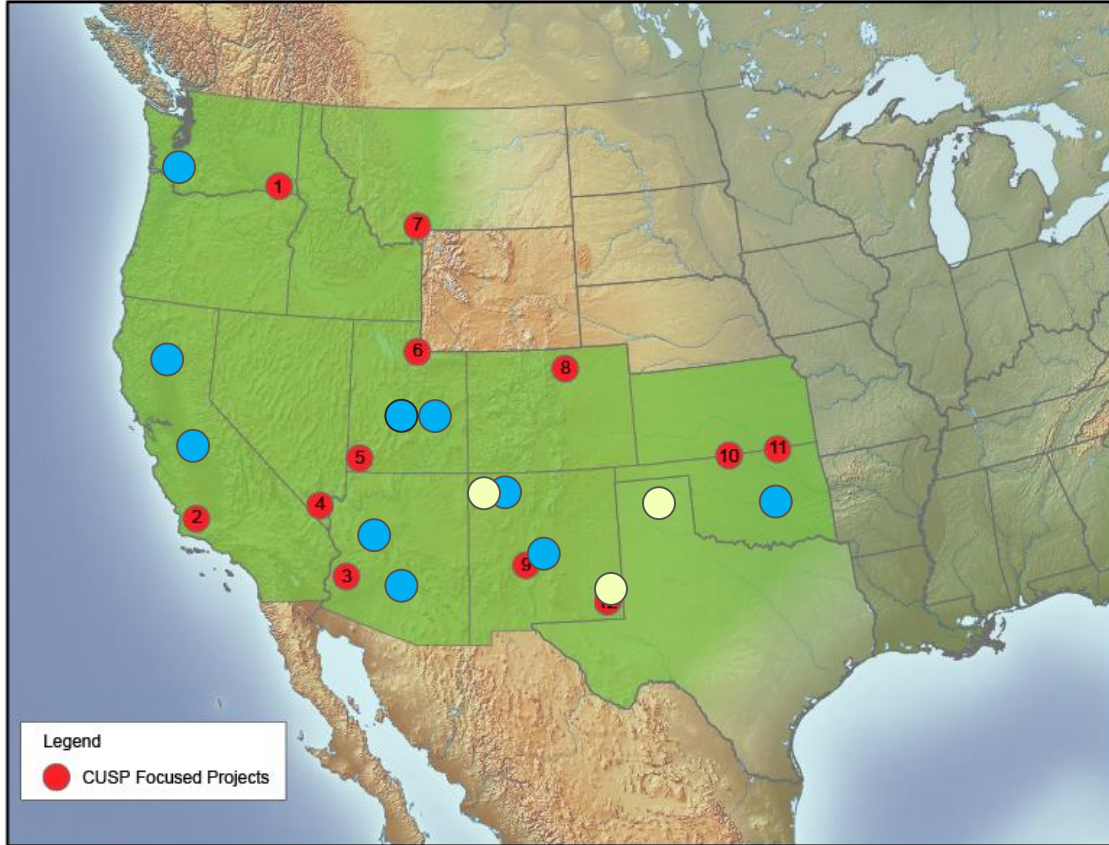


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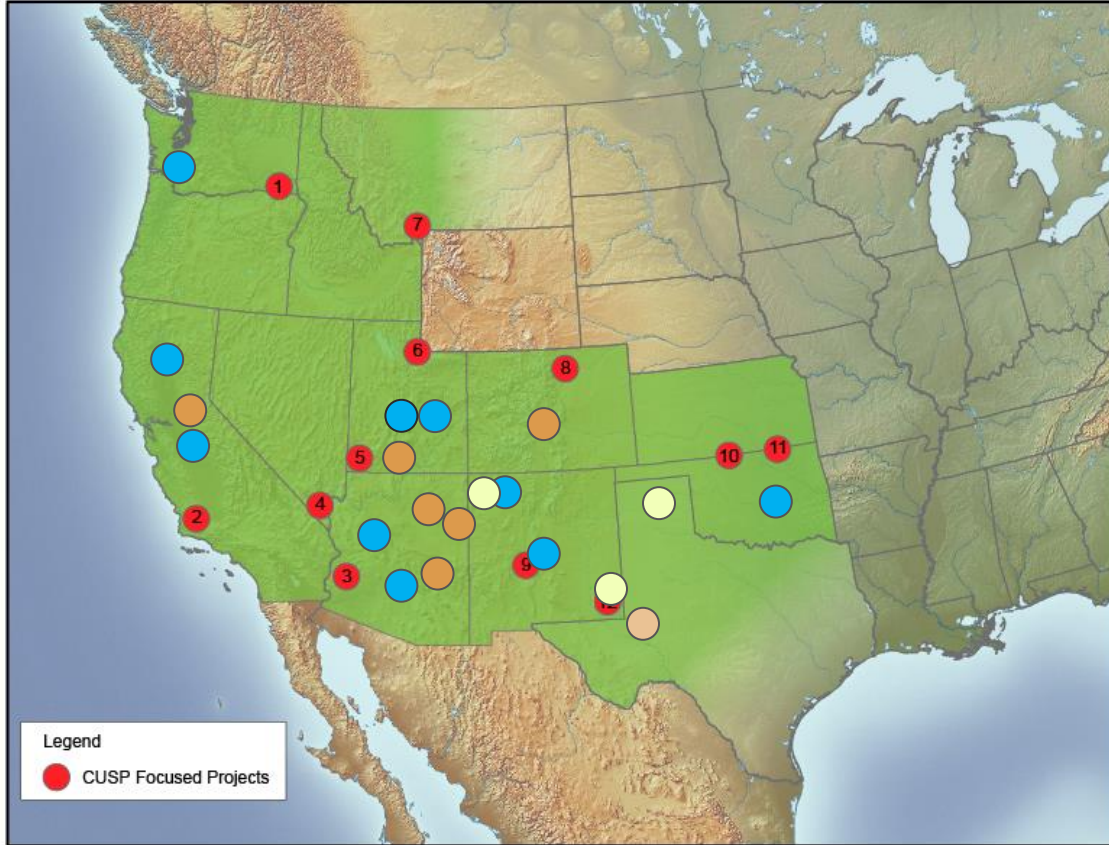


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CUSP 2024 Regional Footprint



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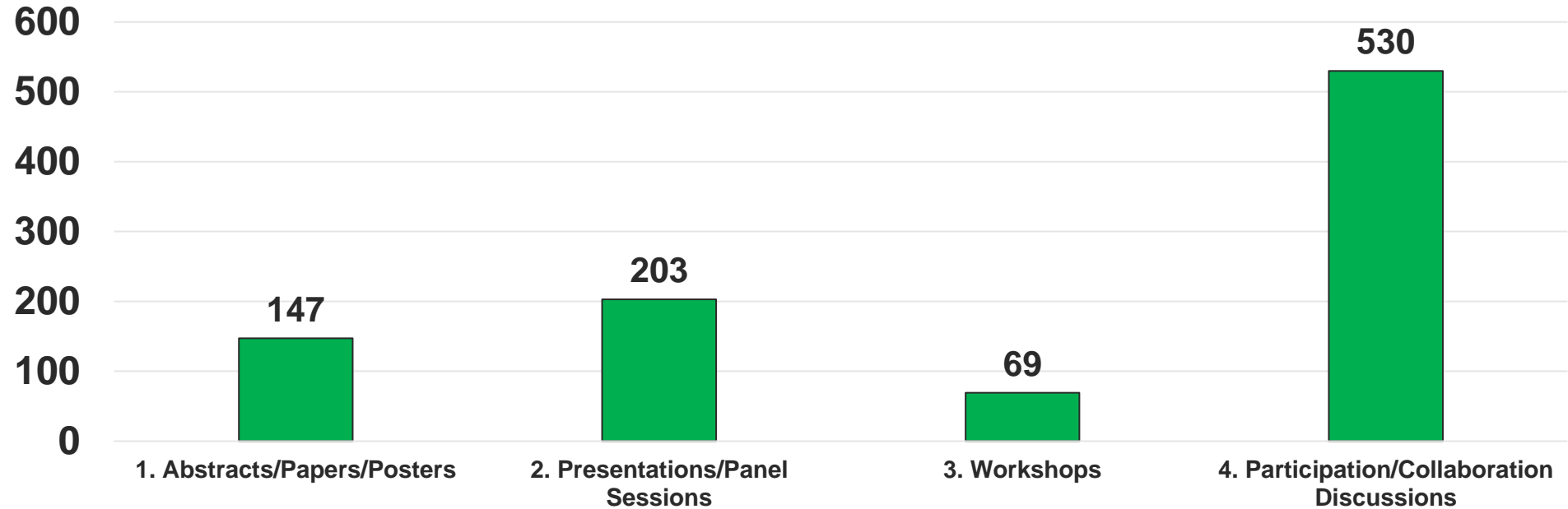
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CUSP Outreach and Engagement



CUSP – Total Through June 2023



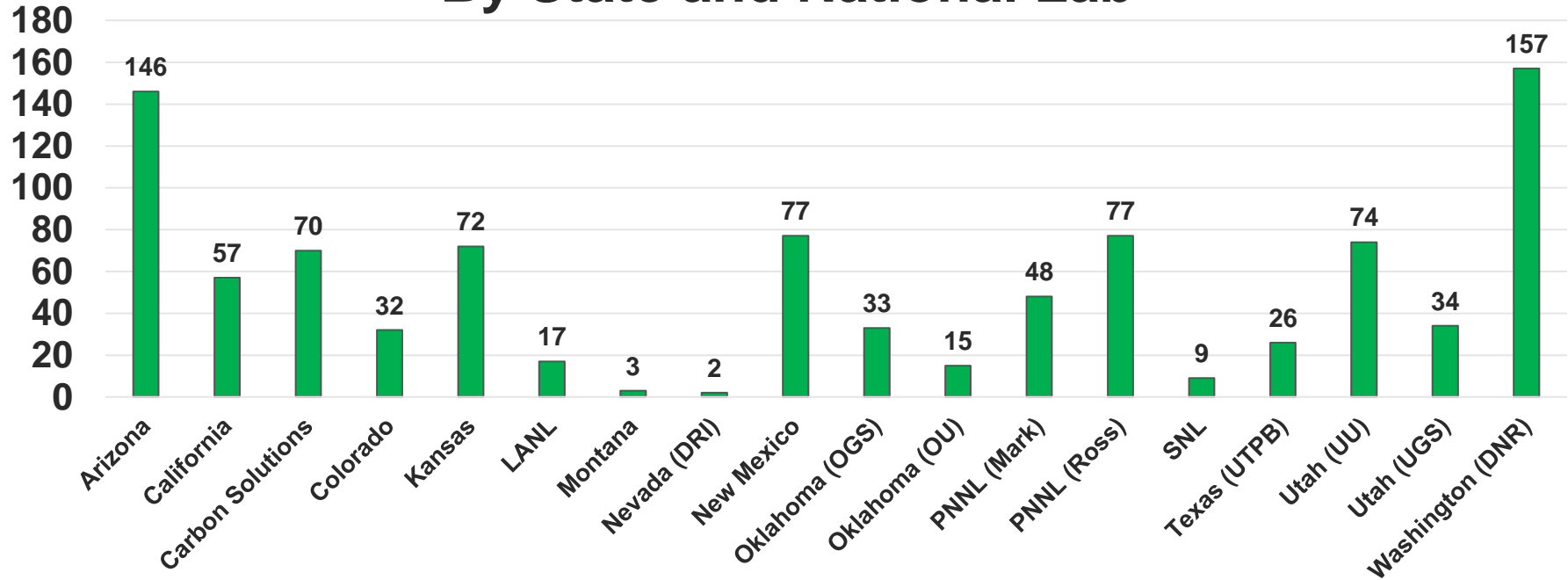
At Least 949 Stakeholder Interactions



CUSP High Regional Participation



By State and National Lab





CUSP Outreach and Engagement



Outreach/Engagement Priorities



Tribal Nations

- 263 Tribes within CUSP region
- Tribal reservations in proximity to CCS storage locations
- Chapter meetings and workshops planned

Southern Ute
Red Willow
CCUS Facility



President Buu Nygren
of Navajo Nation with
CUSP team

Community & Legislative

- Four Corners community outreach
- Class VI Primacy
- Interactive Displays, fact sheets, posters
- Website improvements

CUSP booth materials
distributed at community
education events



Informational sessions to
county commission boards,
Tribal Chapter officials, etc.

Workforce Development

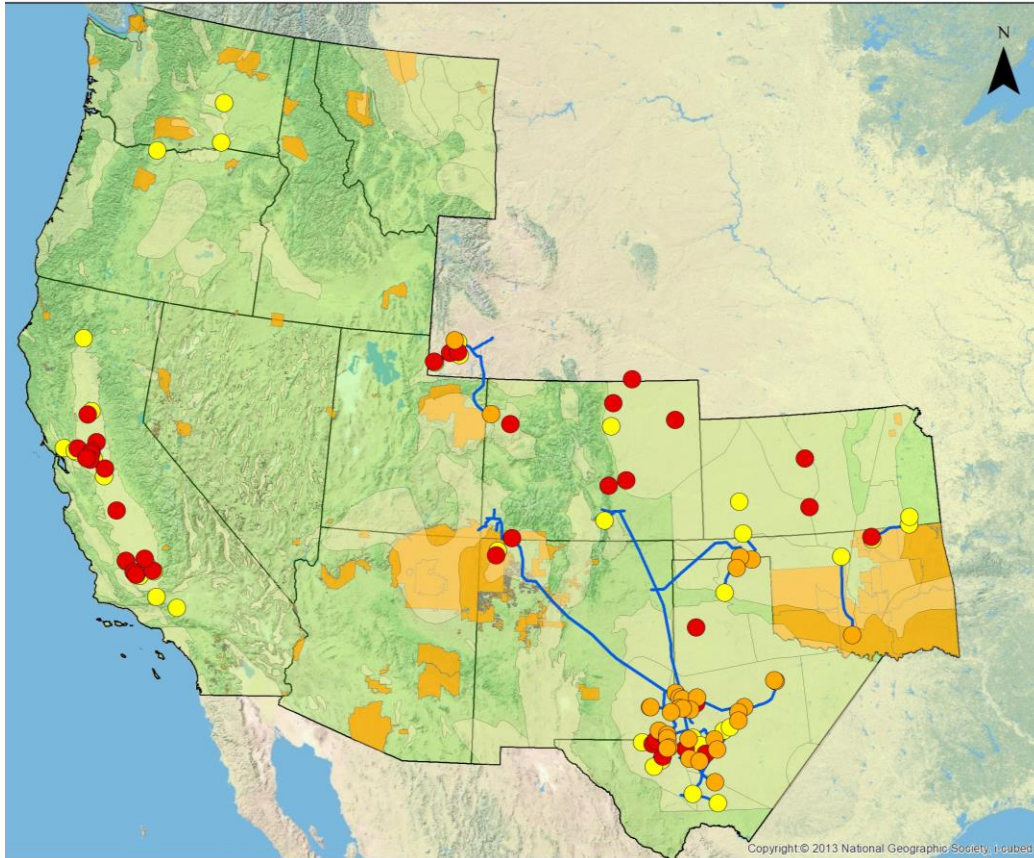
- Community college partnerships
- Certification programs
- Industry outreach



Presentations to
industry-focused
groups for CCUS



Tribal Sovereignty and CCS Potential



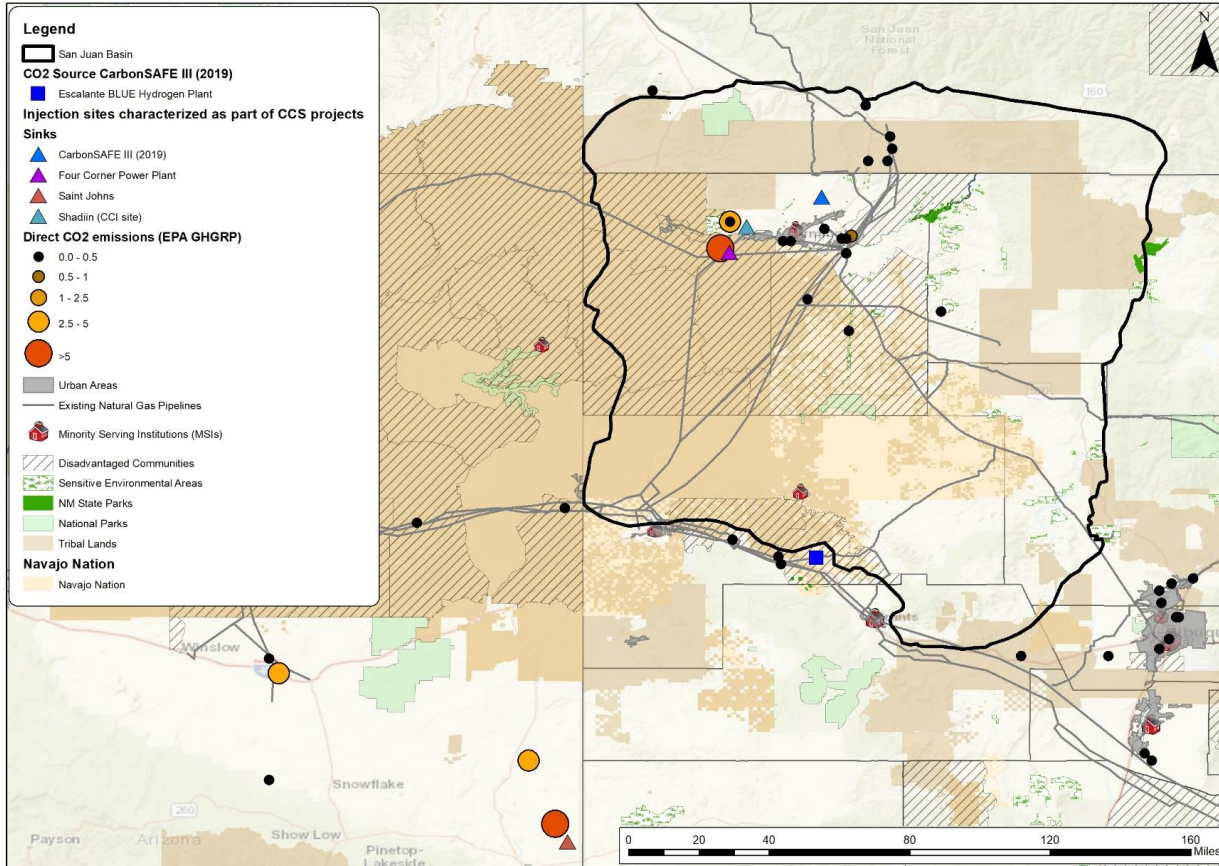
- 263 tribes within the CUSP region (representing 46% of all U.S. tribes)
- Great opportunity for Tribes within CUSP, notably in the Four Corners, Northeast Utah and Oklahoma
- Sustainable future, energy security and economic revitalization
- Notable to decarbonize energy production in Nations reliant on fossil fuel (for example, Navajo Nation)

Legend

- Class II MRV
- Class VI Projects
- Capture projects
- CO2 Pipeline (approx.)
- CUSP
- Sedimentary Basin
- Tribal Land



Focus: Four Corners, Navajo Nation

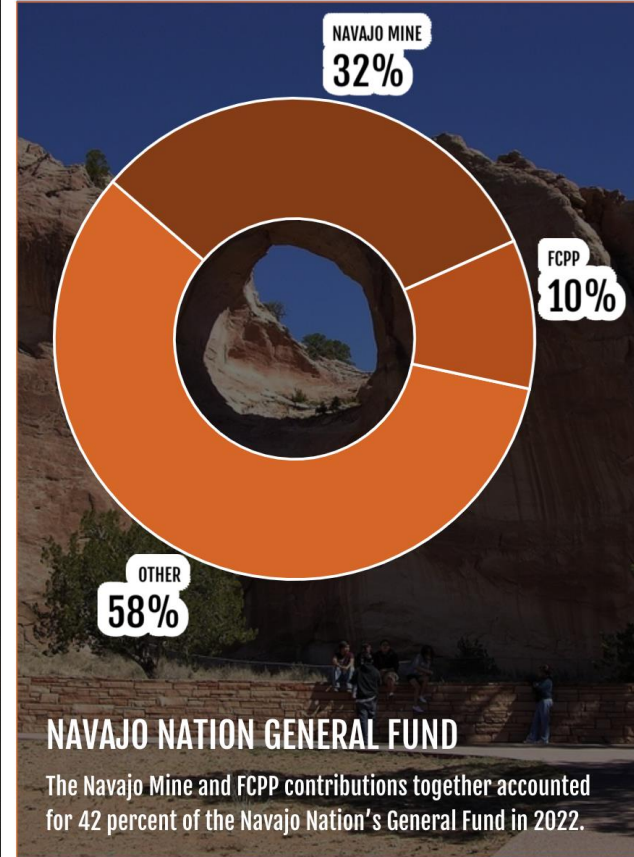
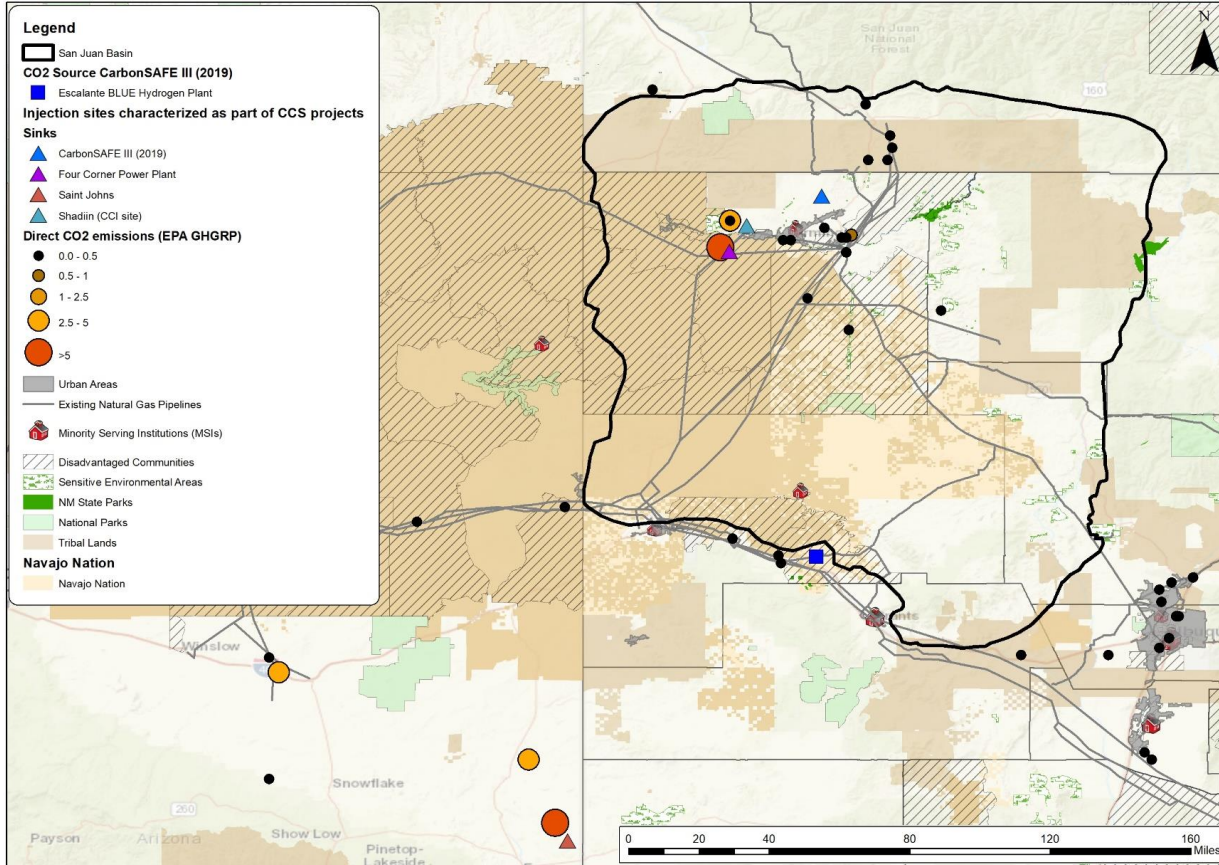


- Reduction of carbon emissions from Coal plants
- Energy security and sovereignty
- Economic stability and job creation
- Funding and investment opportunities



Source: Courtesy of NTEC

Focus: Four Corners, Navajo Nation



Source: Courtesy of NTEC

CUSP 2023 Annual Meeting



- More than 100 CCS stakeholders at 2023 meeting in Lawrence KS
- Excellent reviews and feedbacks
- Next meeting is September 10th - 11th in Santa Fe, NM

CUSP Annual Meeting
September 10-11
Santa Fe, NM



CUSP 2023 Annual Meeting



CUSP Annual Meeting
September 10-11
Santa Fe, NM



CUSP 2023 Annual Meeting



Check out the feedback received from a few attendees

 Rating: Excellent! ★★★★★

"Extremely progressive and positive thinking atmosphere. Venue was completely appropriate. Ideal for networking in the CCS space. CUSP team obviously put a lot of effort into the meeting. Overall the content, venues for socializing, and field trips were excellent. Attendees and presentations were of very high quality."

 Rating: Fantastic Conference ★★★★★

"Great meeting. The best part was the amount of time allotted for networking and conversations. There were many interesting talks too. I appreciate the organizers' attention to detail in facilitating conversations (allowing breaks, providing meals and informal spaces to converse while eating, providing transportation from conference locations to dinner/social hour locations, booking a block of hotel rooms, and more)."

 Rating: Wonderful ★★★★★

"I think the meeting was laid out well. The first day provided a more broad overview of the mission and state of CCUS. I really appreciated the discussion panel that included Steven Grey, I think input like what he provided are going to be key to implementing projects and infrastructure development with the acceptance and participation from traditionally marginalized groups. The second day proved a good variety of speakers from academia, state, and industry. The social events and poster session were very good opportunities for networking and discussion."

 Rating: Wonderful ★★★★★

"This was one of the best run conference's I've ever attended! Well done Jean-Lucien and Jenn."

 Rating: Superb Meeting ★★★★★

"Excellent! Given the uncertainty over BP3, I was blown away with the success. imagine how many people will sign up next year from across the US. KGS (Jenn and others) did a great job hosting. I would not even object to do the same arrangements again"

 Rating: Outstanding! ★★★★★

"This is a well run and organized event. I thought the team from Kansas did a super job."

CUSP Annual Meeting September 10-11 Santa Fe, NM

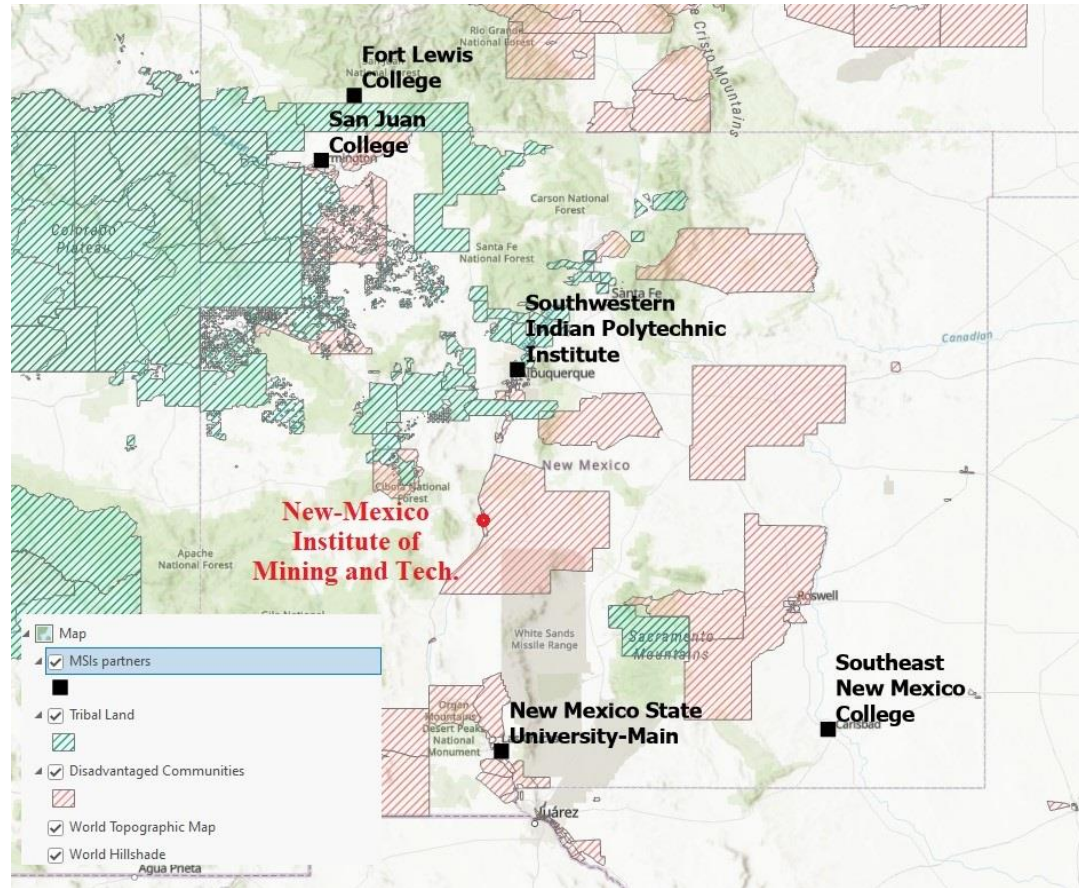


TRAINING AND RESEARCH (DOE-UTR)



The Southwest CCUS Training and Research Partnership (CCUS-STRP)

- Develop and sustain a university training and research consortium focused on (CCUS).
- Bridge the gap for under-represented students from minority-serving institutions to the clean energy technology market.
- Develop research on CCUS community benefits, energy equity, and economic/workforce implications.



TRAINING AND RESEARCH (DOE-UTR)



- Duration: 36 Months
- Funding: \$1.5M
- Host 33 undergraduate/graduate students from underrepresented minorities in STEM

Research Areas:

- I. Scaling Criteria for CO₂ Injection to Prevent Damaging Seismicity
- II. CO₂-Induced Chemomechanical Alteration in Reservoir Rock
- III. Risk Assessment Using Machine Learning Technique
- IV. CO₂ Trapping Mechanisms
- V. CCUS Energy equity and workforce implication



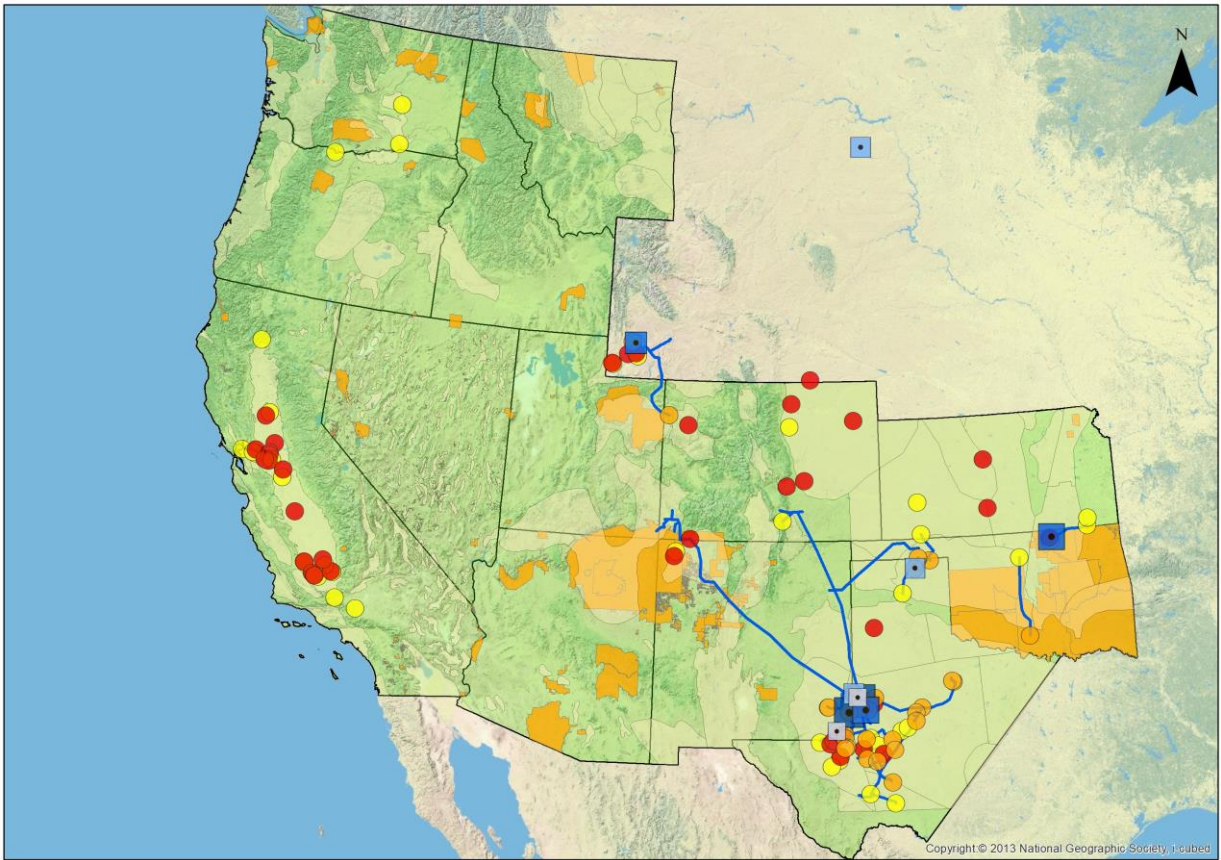
Table 1: Summary of partner HBCU-MSI

Institution Name	City	State	Type/ Control	MSI Type
Southwestern Indian Polytechnic Institute	Albuquerque	NM	Public 2yr	TCCU
Southeast New Mexico College	Carlsbad	NM	Public, 2-year	HSI
San Juan College	Farmington	NM	Public, 2-year	NASNTI
Prairie View A & M University	Prairie View	TX	Public, 4-year or above	HBCU
New Mexico State University	Las Cruces	NM	Public, 4-year or above	HSI



Storage in the CUSP Region

Capture, Class II & Class VI wells, Active and Planned



- Class II and Class VI Wells/permits within the CUSP Region
- CUSP region had 6.75 Mt stored in 2022 (all Class II)

Legend

- Class II MRV
- Class VI Projects
- Capture projects
- CO2 Pipeline (approx.)
- Sedimentary Basin
- Tribal Land
- CUSP

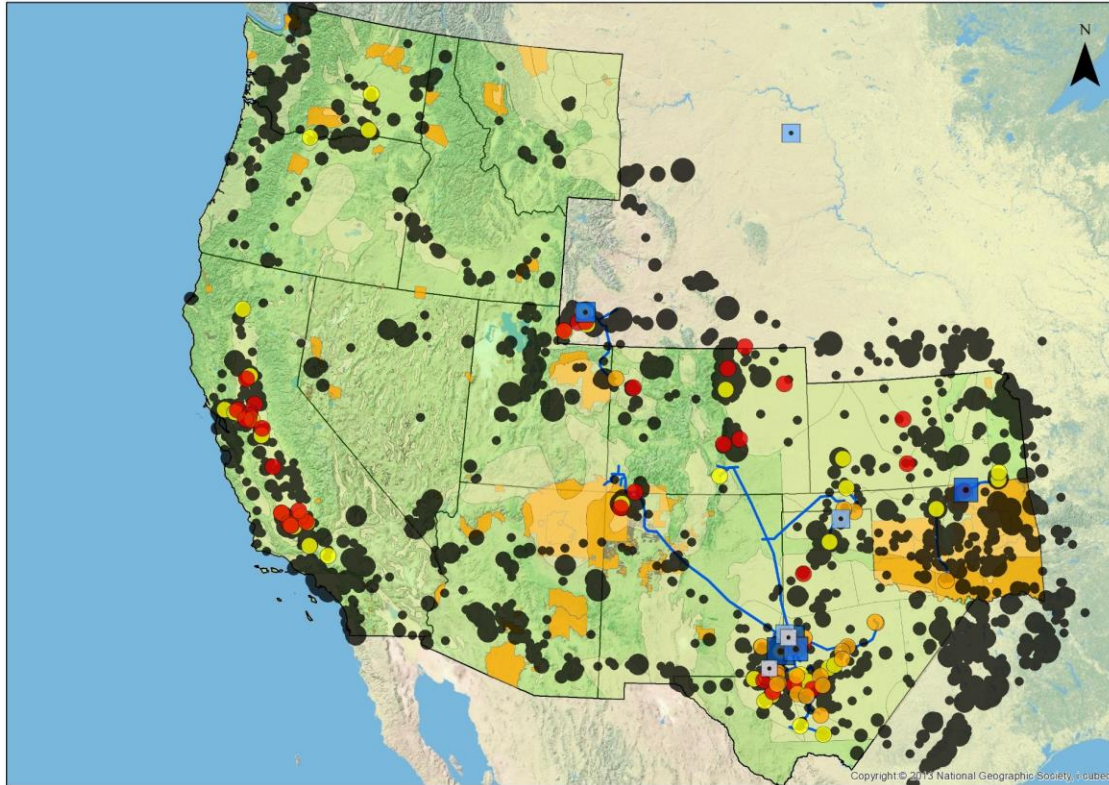
Adapted from CCUS Map

CO2 Sequestration GHGRP

EPA GHGRP Total CO2 sequestered (MMTCO2)

- 0.0 - 0.025
- 0.025 - 0.1
- 0.1 - 0.5
- 0.5 - 1.0
- 1.0 - 3.0

CUSP – Capture, Class II & VI, Sequestration



Legend

- Class II MRV
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EPA GHGRP 2022

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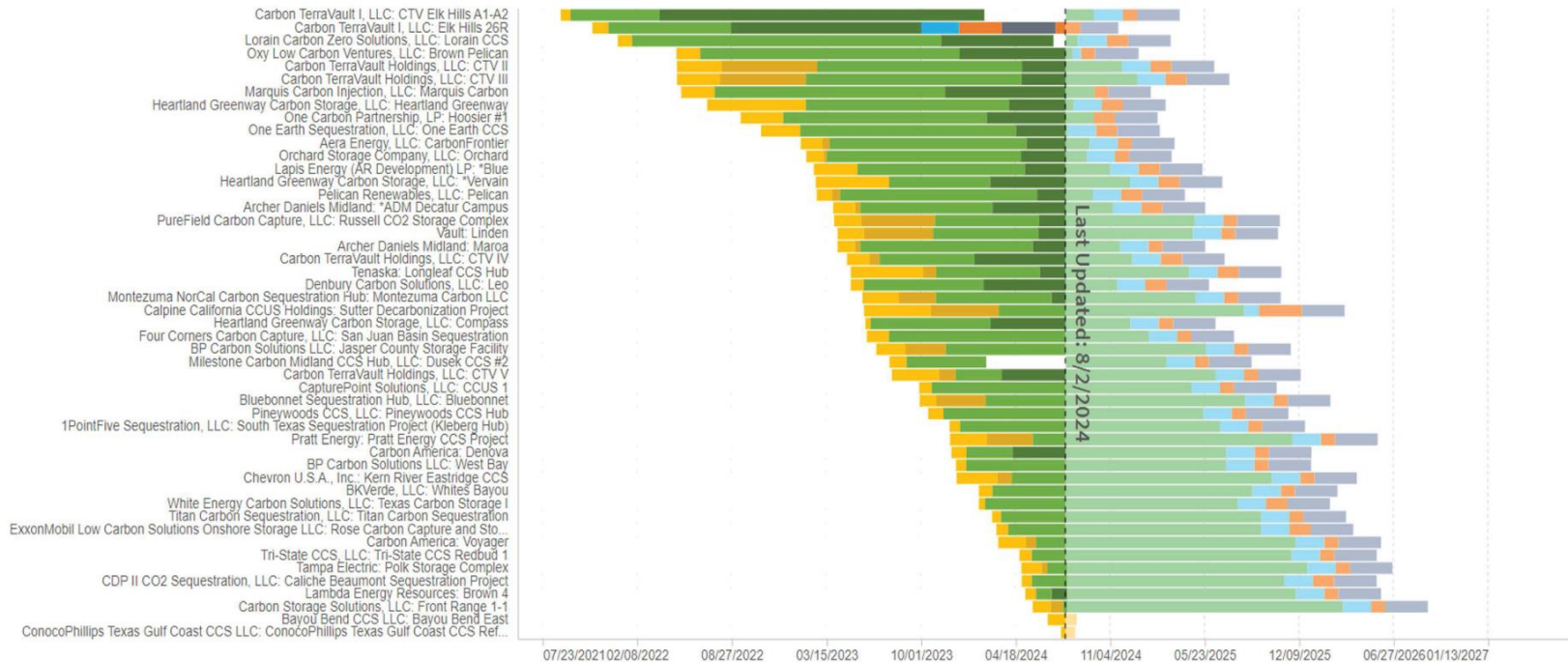
Adapted from
CCUS Map



Permitting: EPA Class VI Permit Tracker



UIC Class VI Permit Tracker



- Completeness Review¹
(est. 30 days)
- Technical Review^{2,3}
(est. 18 months)
- Prepare Draft Permit
(est. 60 days)
- Public Comment Period
(est. 30-45 days)
- Prepare Final Permit Decision⁴
(est. 90 days)

- Cumulative portion of Completeness Review waiting on applicant response¹
- Cumulative portion of Technical Review waiting on applicant response²
- Cumulative portion of Technical Review on applicant requested hold

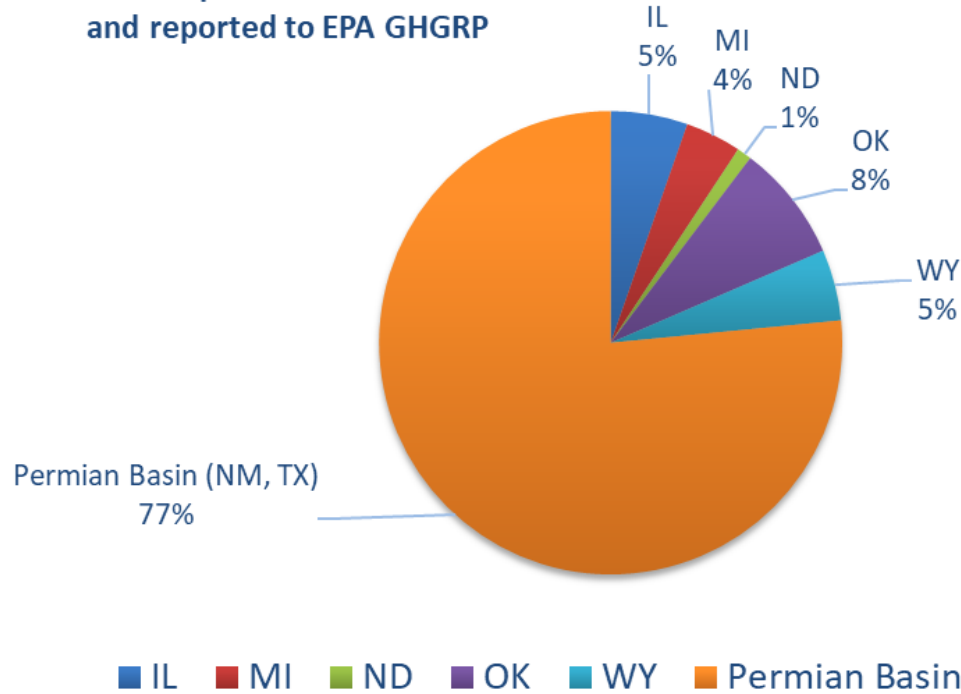
- Notice of Deficiency (NOD) Sent¹
- ▲ Request for Additional Information (RAI) Sent²
- Applicant response time to NODs and RAIs^{1,2}



Where is CO₂ Sequestered Today?



Share of CO₂ sequestered in the U.S. in 2022 and reported to EPA GHGRP



As of 8/18/2023, **76%** of the CO₂ sequestered in the US is in the Permian basin

Source: EPA GHGRP



EPA GHGRP Data



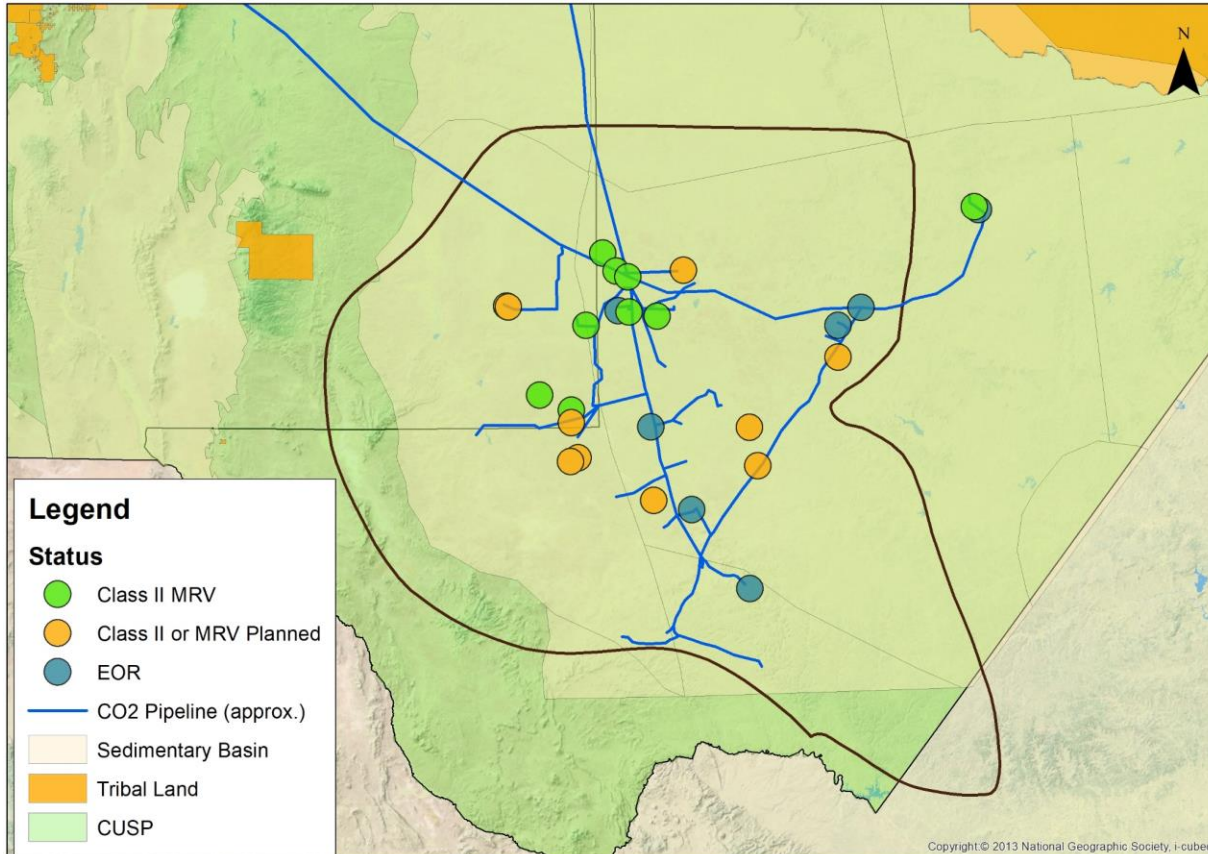
This data was reported to EPA by facilities as of 8/18/2023

Facility Name	City	State	County	Industry Type (subparts)	Total Mass of CO2 Sequestered (metric tons of carbon dioxide equivalent)
30-30 Gas Plant	Plains	TX	YOAKUM COUNTY	C,PP,RR (RPT),W-PROC	12,354.6
Archer Daniels Midland Co.	DECATUR	IL	Macon	C,II,PP,RR (RPT)	428580.4
Campo Viejo Gas Processing Plant	Plains	TX	YOAKUM COUNTY	C,PP,RR (RPT),W-PROC	76,658.3
Core Energy Otsego County EOR Operations	Gaylord	MI		RR (RPT),W-ONSH	311307.6
Denver Unit	Denver City	TX	YOAKUM COUNTY	RR (RPT)	2,849,399.5
Farnsworth Unit CO2 Flood	Farnsworth	TX	OCHILTREE COUNTY	RR (RPT)	92,201.1
Hobbs Field	Hobbs	NM	LEA COUNTY	RR (RPT)	2,276,827.9
North Burbank Unit	Webb City	OK	OSAGE COUNTY	RR (RPT)	652,430.2
Petra Nova West Ranch	Vanderbilt	TX		RR (RPT)	-16,814.5
RED TRAIL ENERGY, LLC	RICHARDTON	ND	STARK COUNTY	C,PP,RR (RPT)	81,963.8
Red Hills Gas Processing Plant	Jal	NM	LEA COUNTY	C,PP,RR (RPT),W-PROC	23,775
Shute Creek Facility	KEMMERER	WY	LINCOLN COUNTY	C,PP,RR (RPT),W-PROC	395,332.2
West Seminole San Andres Unit	Seminole	TX	GAINES COUNTY	RR (RPT)	768,740.6

CUSP region (yellow) had 6.75 Mt “officially” stored



The majority through Class II wells in the Permian



- EOR
- Class II or MRV planned
- Active Class II with MRV (45Q)





Focus on Midstream CCS



Focus on Midstream/Class II AGI Wells



- CUSP has worked with 5 midstream companies on well permits and MRV applications for AGI wells in the Permian basin
- Targa is by far the most active with:
 - Dozens of sweet gas amine units in the field with planned decommissioning and that CO₂ will instead be brought to processing plants and ultimately sequestered

“In the old days, operators would separate the oil and gas from the produced water and dump the produced water on the ground and down arroyos. We learned a better practice and injected the separated produced water safely into formations. Sweet gas separation captures 100% CO₂ at its source and then vents it directly into the atmosphere - millions of tonnes of CO₂ every year - which is legal. My vision is that 10 years from now, young engineers will say “can you believe that industry, supported by regulators, used to separate the CO₂ and then just dump it into the atmosphere?””

- Matt Eales, Targa



Class II AGI & Class VI Comparison



	Class II (AGI + MRV)	Class VI
Primary purpose	Disposal of acid gases (CO ₂ and H ₂ S) to protect air quality	Specifically designed for the long-term storage of CO ₂
Regulatory Oversight	State permits, emphasis on protection of USDW and permanent containment	Federal permitting, emphasis on permanent storage and USDW protection.
Data acquisition	Easier thanks to existing geological knowledge and infrastructure from oil and gas operations	Less data availability
Well design	Most could pass as Class VI	
Operation	Long-term disposal. CO ₂ injected may vary based on the volume and composition of the acid gas, opportunity to reduce sweet gas CO ₂ venting	Long-term sequestration. Injection must maximize trapping
Monitoring	Focused on USDW protection but H ₂ S monitoring provides robust CO ₂ monitoring by proxy	CO ₂ specific monitoring

Benefits of Class II AGI + MRV

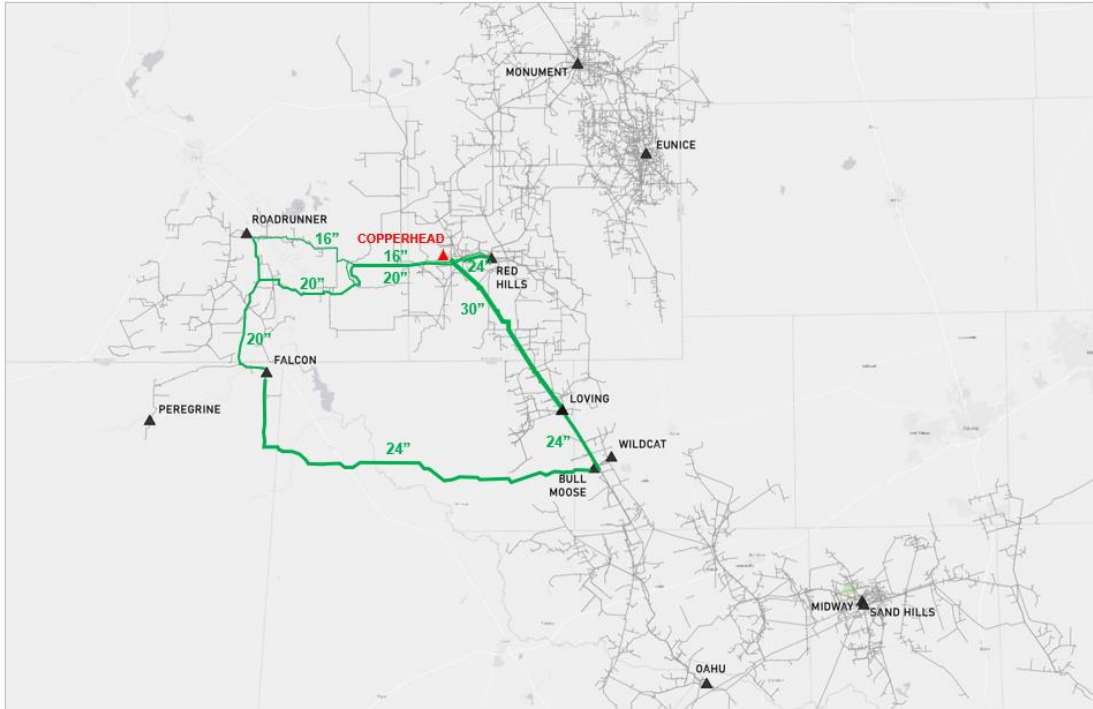


Closing field sweet amine units and developing AGI brings advantages to mid-stream operators and to the environment:

- **Increased efficiency:** Central AGI wells improve operational and cost efficiencies
- **Reduced environmental impact:** Advanced emission control technologies, air quality improvement and greenhouse gases storage.
- **Reduced operational costs**
- **Strategic storage and utilization of CO₂**
- **Logistical advantages (transport)**
- **Future flexibility (market and regulation)**



Targa Permian Gas Gathering and Plant Processing



Gathering and Processing - Currently processing 3 BCF/D natural gas, Forecasting 5 BCF/D in 2028

Acid Gas Injection: Historic focus environmentally-safe processing of H₂S. Gas stream typically consists of 15% H₂S / 85% CO₂

- **45Q Incentivizing sweet amine processing capture**
- **Acid Gas Injection Wells:**
 - Monument (one @ 13MMSCFD)
 - Eunice (one @ 13MMSCFD)
 - Red Hills (two @ 26MMSCFD)
 - Copperhead (one pending @ 20MMSCFD)
 - Wildcat (one @ 26 MMSCFD)
 - Bull Moose (one pending @ 20 MMSCFD)
 - Midway (one @ 10MMSCFD)
- **MRV Plans and annual sequestration potential:**
 - Red Hills (>150,000 tons)
 - Wildcat (>150,000 tons)
 - Bull Moose (>150,000 tons)
 - Copperhead (>100,000 tons)

Red Hills Complex

AGI #1 – Injecting

AGI #2 – Drilling

AGI #3 – Injecting



Red Hills Complex Capacity Overview			
Plant	Nameplate Capacity (MMcf/d)	Intalled Treating (GPM)	Date Commissioned
Red Hills I	60 ①	350	Jun-13
Red Hills II	200 ②	800	May-17
Red Hills III	200 ③	800	Aug-18
Red Hills IV	230 ④	1,600	Nov-19
Red Hills V	230 ⑤	1,800	Nov-20
Red Hills AGI	- ⑥	350	May-18
Total	920	5,700	



CUSP Partnership Value to Targa



Targa's Viewpoint

- The CUSP enables Targa to better perform the permitting work to convert Targa's existing and future AGI wells at Red Hills and many other processing plants to EPA Subpart RR and, subsequently, IRS' 45Q
- Specifically, the CUSP partnership brings the following:
 - Proven knowledge of EPA Subpart RR and IRS' 45Q regulations
 - Formation modeling expertise
 - Monitoring, Reporting and Verification (MRV) plan development expertise
 - Top-level relations with regulatory representatives
- A successful sequestration project delivers a significant reduction to Targa's carbon oxide footprint
- Investors understand the value of a strong ESG program and are supportive in our demonstrating leadership in this arena, inclusive of carbon oxide emissions reductions



CUSP Take-Aways



- The CUSP has databases of useful information necessary to create robust geologic models, flow models, and economic studies
- Has access to Intelligent computer applications and National Lab products which can optimize connecting sources and sinks, and long range development and economic analyses of projects
- Has experience in generating CO₂ storage models, MRV applications, and in engaging with stakeholders
 - **Built a team specifically for permitting Class VI and MRV's region wide**
- The CUSP is actively seeking opportunities to help companies access 45Q and has built regional expertise to address local issues

