

*CARBON
CAPTURE &
SEQUESTRATION
IN LOUISIANA*

*Part 1:
Permitting for rapid expansion*

June 7, 2023

Research compiled by Empower, LLC
Commissioned by the 2030 Fund



TABLE OF CONTENTS

Introduction.....	3
Planned projects.....	5
Infrastructure maps.....	9
Permitting	12
Conclusion	14
Data sources.....	15

INTRODUCTION

Carbon capture and sequestration (CCS) refers to a process by which industrial CO₂ emissions are captured, transported, and stored underground. There are not any such projects yet operating in Louisiana, though dozens of initiatives are in development following passage of the 2022 Inflation Reduction Act (IRA). The IRA will provide billions of dollars in revenue to project developers in the form of direct tax credits, paired with major grants and low-interest loans established in the 2021 Bipartisan Infrastructure Law.

In April 2023, the U.S. Environmental Protection Agency (EPA) announced its intention to grant permitting jurisdiction (“primacy”) over underground sequestration wells, which are known as Class VI injection wells, to the State of Louisiana.¹ This move, which has been supported by CCS project developers, would speed up the permitting process, according to Governor John Bel Edwards, and open the floodgates to dozens of Louisiana projects already in planning stages.²

This report, the first installment in a series of three, presents findings from research conducted on the current state of CCS development plans in Louisiana. Detailed maps of planned CCS infrastructure are accompanied by information on federal and state permitting, which has emerged as the decisive factor on which project developers now depend to drill CO₂ injection wells.

There are at least 20 planned underground CO₂ storage sites across Louisiana, 10 of which have already applied for a Class VI permit,³ in addition to thousands of miles of related CO₂ pipelines and plans for carbon capture equipment at carbon-emitting facilities. Most developers of underground sequestration wells are oil companies, including major multinationals.

Meanwhile, project developers have begun competing for land deals close to clusters of industrial emitters where underground sequestration is geologically feasible. Any such leases under state land require “pore space agreements” to be signed by the State Mineral and Energy Board, while leases on private land have similar terms but avoid the same degree of public scrutiny. A number of the planned storage reservoirs, which can be viewed in Maps 1-5 (below), are located under freshwater lakes and offshore, where leakages could provoke groundwater contamination⁴ and ocean acidification⁵, respectively.

In addition to the backlog of pending Class VI permits, pipeline transportation capacity is emerging as a systemic constraint on the development of CCS projects. Only two companies have well-developed plans

1 U.S. Environmental Protection Agency, "EPA Opens Public Comment on Proposal Granting Louisiana Primacy for Carbon Sequestration and Protection of Drinking Water Sources," 28 April 2023, www.epa.gov/newsreleases/epa-opens-public-comment-proposal-granting-louisiana-primacy-carbon-sequestration-and.

2 Rebecca Holland, "Louisiana could take control of carbon capture permits in the state. How would that work?," *The Advocate*, 8 April 2023, www.theadvocate.com/baton_rouge/the-epa-could-allow-louisiana-to-give-carbon-capture-permits/article_32447f20-cf17-11ed-8ad4-2fbf03475887.html.

3 U.S. Environmental Protection Agency, www.epa.gov/uic/class-vi-wells-permitted-epa.

4 Adriano Vinca, Johannes Emmerling, and Massimo Tavoni, "Bearing the Cost of Stored Carbon Leakage," *Frontiers in Energy Research*, 15 May 2018, www.frontiersin.org/articles/10.3389/fenrg.2018.00040/full.

5 Loi Hoan Huy Phouc Pham, Risza Rusli, and Lau Kok Keong, "Consequence Study of CO₂ Leakage from Ocean Storage," *Procedia Engineering*, Volume 18, 2016, www.sciencedirect.com/science/article/pii/S1877705816310669.

for CO₂ pipeline networks in the state. One of those companies, Denbury (NYSE:DEN), which is also developing the largest network of permanent sequestration sites in Louisiana, stands out as a key early mover in the space. In April 2023, Denbury arrived at an agreement to pay the second-largest fine ever levied by the Pipeline and Hazardous Materials Safety Administration (PHMSA) for a February 2020 CO₂ pipeline explosion in Mississippi that is connected to the same network it plans to expand across Louisiana.⁶

This report presents information on CCS permitting and project development plans in Louisiana, including detailed maps of planned infrastructure across the state. A second report will present information on project financing, which is heavily dependent on government grants and tax credits, while a third installment will present research findings on the insurance required for the considerable safety and environmental risks posed by underground CO₂ storage and transportation.

⁶ Pipeline Safety Trust, "Department of Transportation's PHMSA Issues Second Largest Civil Penalty in Agency History to Denbury Gulf Coast Pipeline LLC Following Disastrous 2020 CO₂ Pipeline Leak in Satartia, Mississippi," press release, 6 April 2023, pstrust.org/department-of-transportations-phmsa-issues-second-largest-civil-penalty-in-agency-history-to-denbury-gulf-coast-pipeline-llc-following-disastrous-2020-co2-pipeline-leak-in-satartia-mississippi.

PLANNED PROJECTS

This investigation identified 20 underground CO₂ storage sites in planning or development stages across Louisiana, in addition to related CO₂ pipeline networks and a number of plans for major CO₂ capture installations at new or planned carbon-emitting facilities. The number of projects can be expected to expand in the wake of the federal Inflation Reduction Act of 2022 and, potentially, once the EPA grants Class VI permitting jurisdiction to the State of Louisiana.

There are important differences between these projects, reflecting business models that variously combine three fundamental components:

- CO₂ capture at emitting facilities;
- CO₂ transportation by pipeline from the emitting facility; and
- Underground sequestration of CO₂.

Emitters generally prefer to control the capture process, meaning that this component is fragmented among many companies across Louisiana. The competitive contours of the nascent CCS industry are most evident in the race for underground "pore space" in Louisiana, which one CEO characterizes as the "Wild West".⁷ There is now heightened competition among project developers to obtain lease agreements with landowners who have capacity to store CO₂ in return for pore space payments. Most of the companies developing pore space for multi-emitter sequestration hubs are oil producers — both oil majors and Enhanced Oil Recovery (EOR) specialists —, though others have also stepped into the fray. Private equity firm Blackstone signed options to develop pore space, through an affiliated fund, in a series of unannounced 2022 deals.⁸ Some emitters are looking to capture and store their own emissions, such as liquefied natural gas (LNG) export terminals and producers of various fuels, marketed as 'clean'.

Conversely, competition for CO₂ pipeline infrastructure has thus far been limited to two key players with very different business models: Denbury and EnLink Midstream (NYSE:ENLC). Denbury plans to use and expand its existing CO₂ pipeline network to collect emissions from numerous industrial customers for storage in its own sequestration hubs, while EnLink will convert existing natural gas pipelines for transport of CO₂ and has signed transportation agreements with several oil companies developing pore space, including ExxonMobil (NYSE:XOM), ConocoPhillips (NYSE:COP), Occidental Petroleum (NYSE:OXY), and Talos Energy (NYSE:TALO).

Despite the heightened CCS activity in Louisiana since passage of the Inflation Reduction Act, progress has been slowed by a lack of existing pipeline capacity and the EPA's Class VI permitting process for permanent sequestration, which no company has yet completed. Denbury is currently the only company

⁷ Denbury, "Carbon Capture, Utilization, and Storage (CCUS) Business Outlook," Investor presentation, 13 December 2022, investors.denbury.com/investors/events-and-presentations/events/event-details/2022/CCUS-Business-Outlook-Virtual/default.aspx.

⁸ Land records purchased from Assumption, Iberville, and Ascension Parish Clerks.

capable of offering CO₂ offtake to industrial emitters, as it has over 750 enhanced oil recovery (EOR) injection wells connected to its existing CO₂ pipeline system. EOR is a type of carbon capture and utilization (CCU) by which oil producers use CO₂ to extract oil from depleted fields. This option is currently less lucrative for emitters than permanent sequestration under the newly established federal tax credit amounts but may be a transitional alternative for some Denbury customers.⁹

Tables 1, 2, and 3 (below) present basic information about all CCS projects identified in Louisiana, organized by type.

- Table 1 includes sequestration hubs positioned to potentially store emissions from multiple sources in a networked fashion.
- Table 2 includes integrated CCS projects being developed by companies primarily looking to capture and store their own CO₂ emissions.
- Table 3 includes CCS proposals from developers of emitting facilities that have not yet presented information publicly about how they will transport and store CO₂.

⁹ EOR is less lucrative assuming the cost of CO₂ remains less than \$25 per ton as paid by operators. Per ton CO₂ costs typically average 40% of the per barrel cost of oil. <https://www.pnas.org/doi/pdf/10.1073/pnas.1806504115>

Table 1 — CCS projects in Louisiana: sequestration hubs

Project	CO ₂ capture	Pipeline transport	Underground sequestration	Acreage
Denbury Donaldsonville storage ("Aries" and "Gemini")	Nutrien ammonia plant	Denbury	Denbury	29,000 (two sites)
Denbury storage southeast of New Orleans ("Pegasus")	Ascension Clean Energy ammonia plant (Chinese government) Lake Charles Methanol (Jeffries Financial Group)	Denbury	Denbury	84,000
Denbury southwest Louisiana storage ("Draco")	Mitsubishi ammonia plant	Denbury	Denbury	31,000
Livingston Parish Sequestration Hub	No info	EnLink Midstream	Occidental Petroleum and Rusheen Capital	30,000
West Bay Sequestration Hub	No info	No info	Occidental Petroleum and Rusheen Capital	27,000
ExxonMobil storage	CF Industries nitrogen complex (with Mitsui & Co. as 48% partner)	EnLink Midstream	ExxonMobil	125,000
River Bend CCS	No info	EnLink Midstream	Talos Energy Storegga Limited (inc. Mitsui & Co., Macquarie Group, and Singapore sovereign wealth fund)	26,000 (three sites); Option for additional 63,000 acres
ConocoPhillips storage	No info	EnLink Midstream	ConocoPhillips	25,000
Project Minerva	Climeworks AG Direct Air Capture	No info	Stream family	<100,000
Project Goose Lake	No info	No info	Stream family	No info
Central Louisiana Regional Carbon Storage Hub	Energy Transfer	Energy Transfer	CapturePoint	No info
River Parish Sequestration	No info	No info	Blackstone	No info
Project Lochridge	Geismar area emitters	Crescent Midstream	Carbon-Zero US	No info
Liberty CCUS hub	Shell facilities in Norco, Convent, and Geismar	No info	Shell	No info

Source: Data compiled from various sources.

Table 2 — CCS projects in Louisiana: integrated capture, transport, and storage

Project	CO ₂ capture	Pipeline transport	Underground sequestration	Acreage
Hackberry Carbon Sequestration Project	Sempra (50.2%) Mitsui & Co. (16.6%) TotalEnergies (16.6%) Japan LNG Investment (16.6%)	Sempra (100%)	Sempra (50.2%) Mitsui & Co. (16.6%) TotalEnergies (16.6%) Japan LNG Investment (16.6%)	No info
Air Products Blue Hydrogen CCS facility	Air Products	No info	Air Products	122,455
Venture Global CCS Cameron	Venture Global LNG	Venture Global LNG	Venture Global LNG	18,022
Venture Global CCS Plaquemines	Venture Global LNG	Venture Global LNG	Venture Global LNG	9,101
Capio Sequestration (Grön Fuels)	Fidelis New Energy, LLC	No info	Fidelis New Energy, LLC	44,511 (two sites)
Diamond Vault (Cleco Power)	Macquarie Group (53.9%) British Columbia Investment Management Corporation (36.9%) John Hancock Financial (9.2%)	No info	Macquarie Group (53.9%) British Columbia Investment Management Corporation (36.9%) John Hancock Financial (9.2%)	No info
DT Midstream CCS project	DT Midstream	DT Midstream	DT Midstream	No info

Source: Data compiled from various sources.

Table 3 — CCS projects in Louisiana: preliminary emitter proposals

Project	CO ₂ capture	Pipeline transport	Underground sequestration	Acreage
Equilon Enterprises Renewable Low Carbon Fuels Unit	Shell	No info	No info	No info
G2 Net-Zero blue ammonia plant	Charles Roemer IV	No info	No info	No info
Louisiana Green Fuels	Strategic Biofuels LLC	No info	No info	No info
New Generation Gas Gathering (NG3)	No info	M6 Midstream LLC (inc. Blackstone Credit)	No info	No info
Lake Charles Power Station Integrated CO ₂ Capture	Entergy	No info	No info	No info
Cypress Carbon Capture	Occidental	No info	No info	No info
St. Charles Clean Fuels	Copenhagen Infrastructure Partners and Sustainable Fuels Group	No info	No info	No info

Source: Data compiled from various sources.

As seen in Table 1, ten companies or joint ventures are developing 14 underground CO₂ sequestration hubs to store emissions from multiple customers. Nine of the companies are oil producers, while the other two are Blackstone, the world's largest private equity firm, and the Stream Family, a Louisiana family with major, oil-producing land holdings.

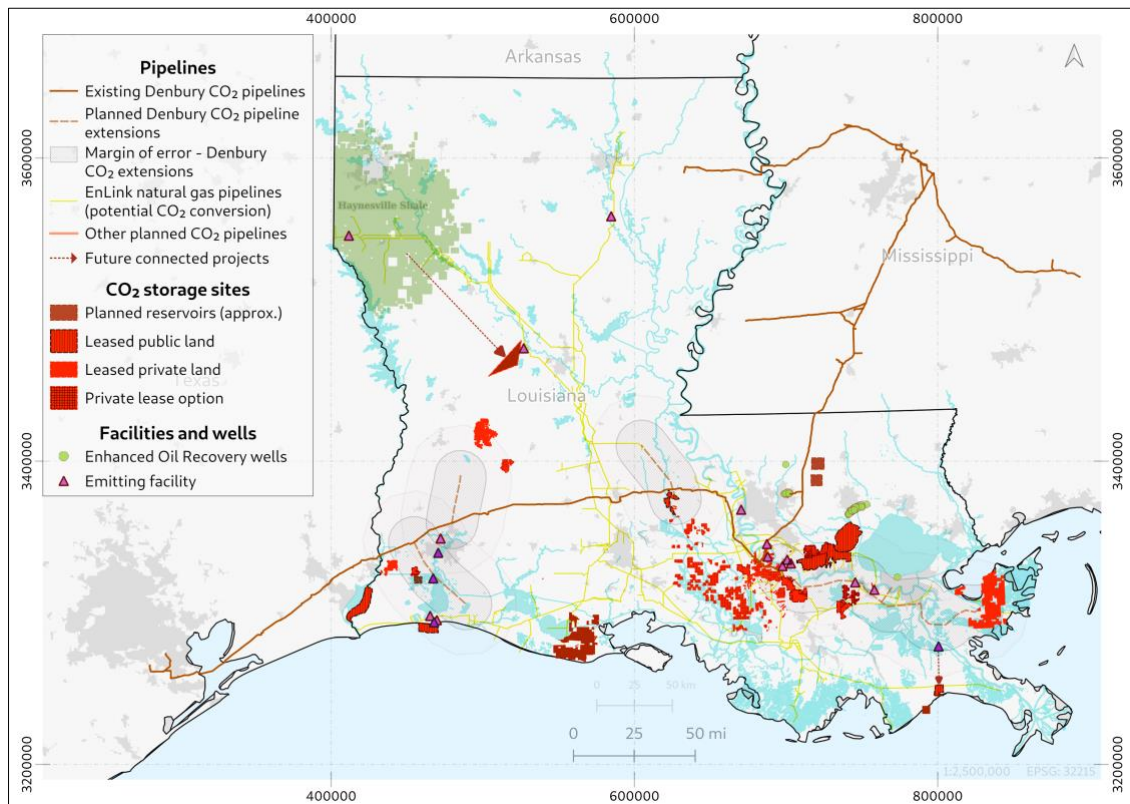
Denbury has aggressive expansion plans and a head start, due to its existing CO₂ pipeline network for enhanced oil recovery. The company has signed multiple transportation and storage agreements and is negotiating more with CO₂ emitting facilities throughout the state. The company claims that its networked model of pipelines and multiple sequestration hubs along the Gulf Coast, from Texas to Alabama — including at least four planned sites in Louisiana — allows for more efficient transportation and storage of CO₂ at scale, from multiple customers, for both permanent sequestration and enhanced oil recovery. Denbury characterizes this as a "subway" model, where CO₂ can be piped into and out of its pipeline network in discrete segments, as opposed to the "point-to-point" model of integrated CCS projects.

Denbury has CO₂ sequestration deals amounting to about 20 million tons per annum (mtpa), 18 mtpa of which are in Louisiana — far more than any other competitor — and claims to be negotiating an additional 55 mtpa. Approximately half of the projects currently in negotiations are "greenfield" (new development), while the others are "brownfield" (existing emitters).¹⁰

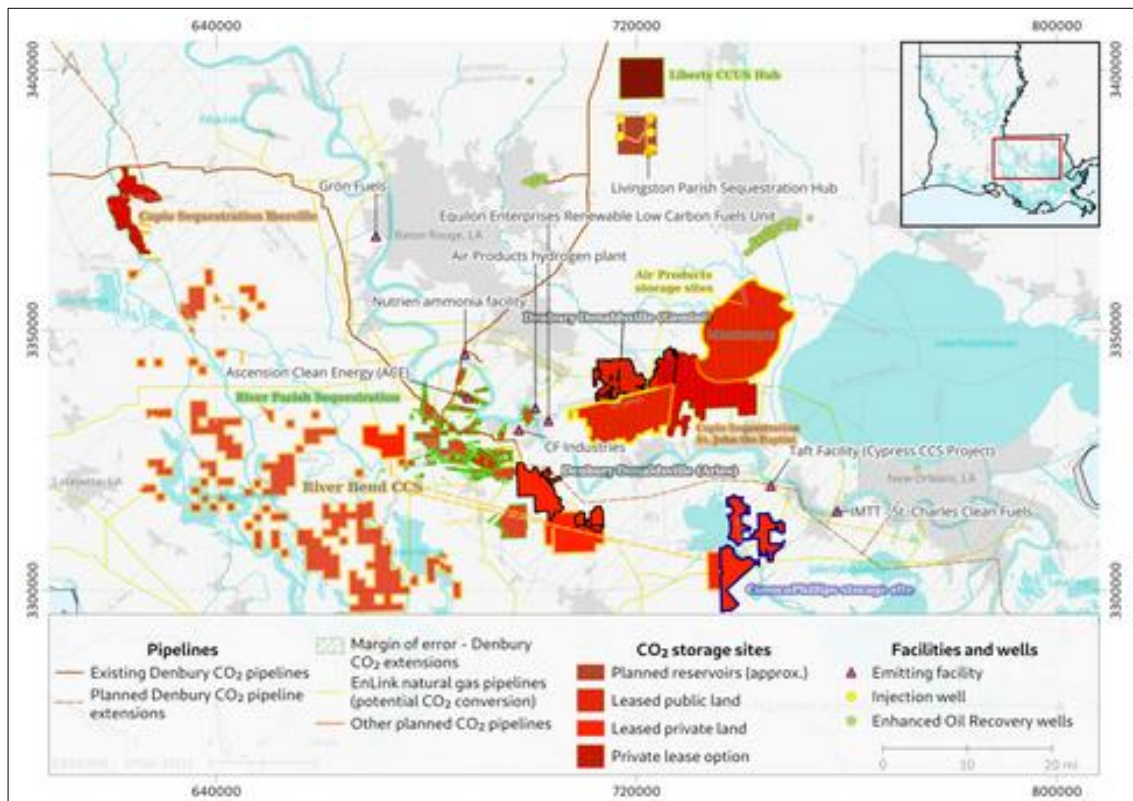
¹⁰ Denbury, Q3 2022 earnings call.

CCS AND CO₂ INFRASTRUCTURE MAPS

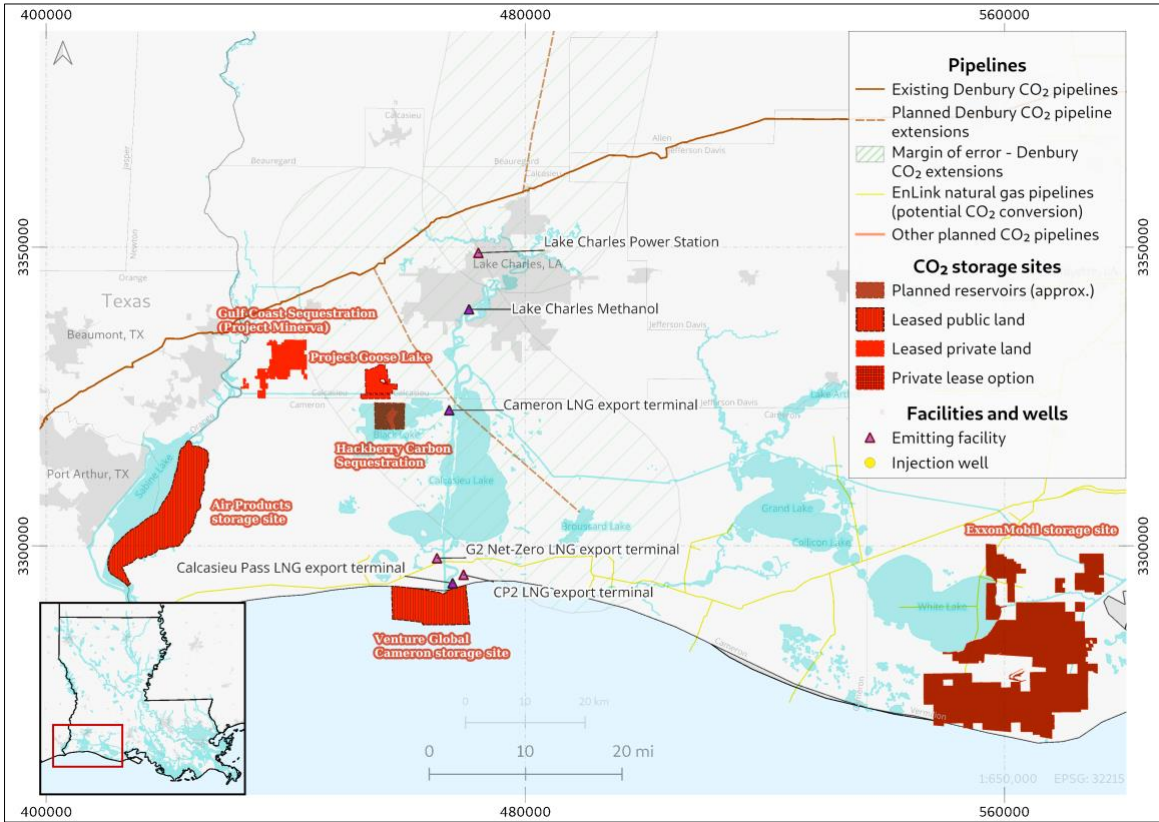
Map 1 – Statewide CO₂/CCS Infrastructure



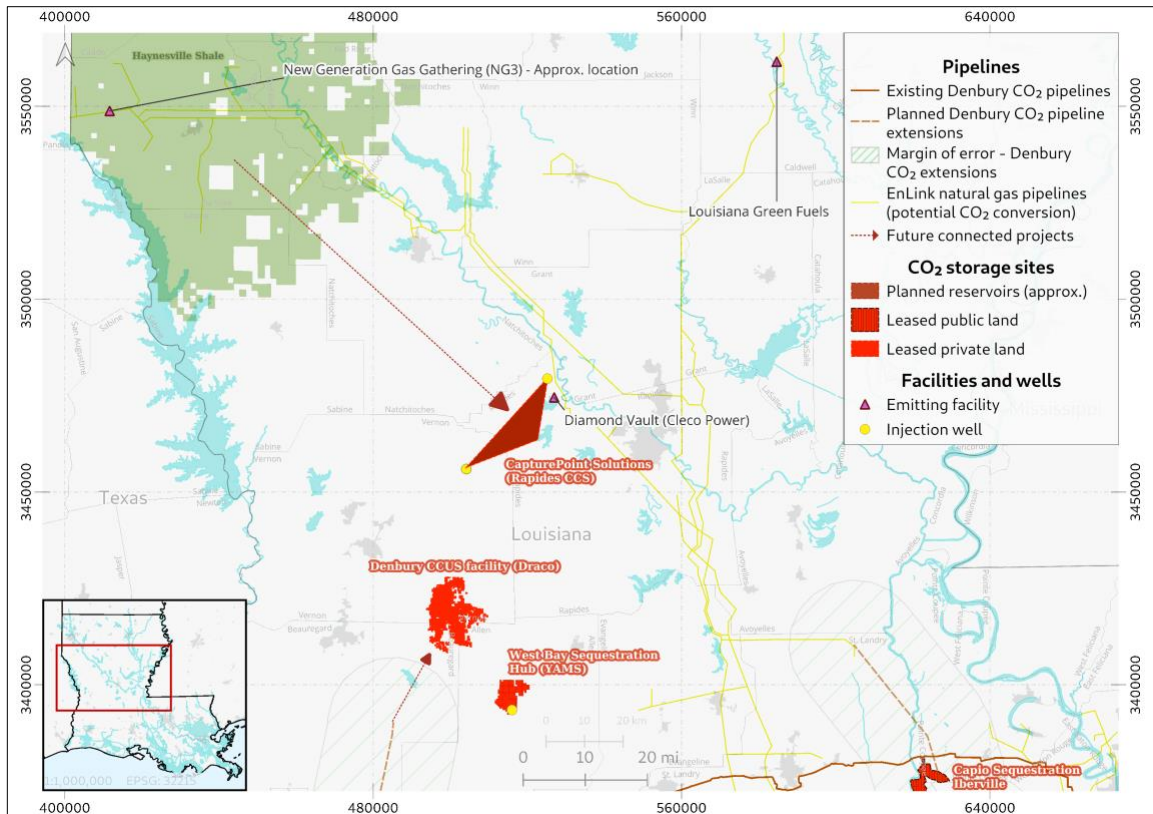
Map 2 – CO₂/CCS Infrastructure: Baton Rouge to New Orleans



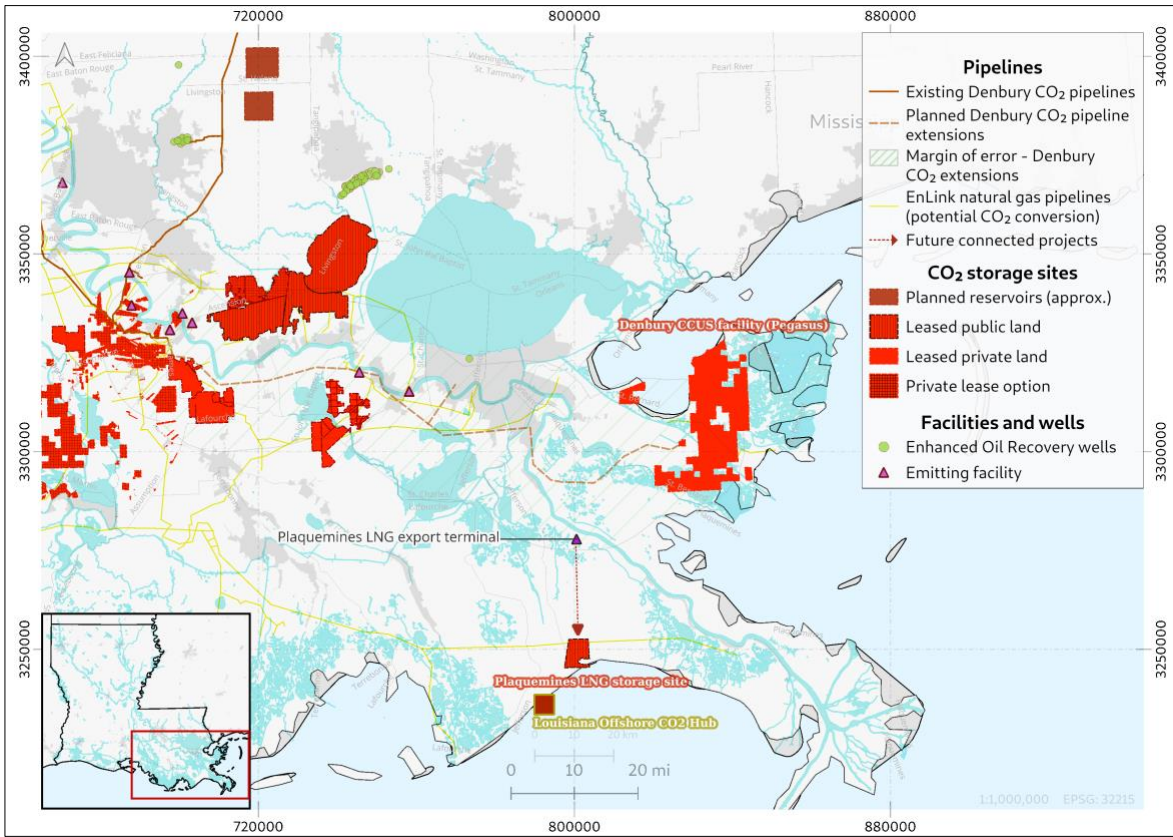
Map 3 – CO2/CCS Infrastructure: Southwest Louisiana



Map 4 – CO2/CCS Infrastructure: Central Louisiana



Map 5 – CO₂/CCS Infrastructure: Southeast Louisiana



PERMITTING

CCS projects in Louisiana are subject to the state's Geologic Sequestration of Carbon Dioxide Act of 2009. The Act grants jurisdiction over the CCS permitting process to the Louisiana Department of Natural Resources (LDNR) Commissioner of Conservation, which, after a public hearing, issues a certificate of public convenience and necessity authorizing the use of eminent domain to acquire property and subsurface rights for pipelines and underground storage reservoirs.

Operators leasing land for underground storage generally sign a carbon dioxide sequestration agreement with landowners, whether with the State of Louisiana or private parties. The Louisiana State Mineral and Energy Board has already signed seven carbon dioxide storage agreements with four companies for underground CO₂ reservoirs on state land.¹¹ Other agreements have been signed with private landowners.¹²

In addition to approval of the storage facility, the operator must also receive approval from the EPA for Class VI CO₂ injection wells. LDNR already has jurisdiction over Class I–V wells and the State of Louisiana has an application pending for jurisdiction ("primacy") over Class VI wells, which will be governed by Statewide Order No. 29-N-6.

For Class VI permit applications, one CEO anticipates a timeline of about a month for the EPA to do a completeness review and a full year after that for the full evaluation¹³. After another six months to one year, if successful, the company will receive a permit to inject. In the meantime, the company can drill stratigraphic test wells, which require a Class V permit, as a precursor to Class VI permitting for commercial CO₂ injection.¹⁴ When the EPA grants primacy to the State of Louisiana, the Class VI permitting process may speed up.¹⁵

There are a number of additional permits and regulatory consultations required for CCS projects in Louisiana, as outlined in Table 5, which presents information from the CCS project associated with Venture Global's CP2 LNG export terminal. Offshore projects have some additional regulatory requirements, as reflected in the table.

11 Louisiana Department of Natural Resources, Office of Mineral Resources, Special Notices and Announcements, www.dnr.louisiana.gov/index.cfm/page/168.

12 Land records purchased from Parish Clerks.

13 Denbury, "Carbon Capture, Utilization, and Storage (CCUS) Business Outlook," Investor presentation recording, 13 December 2022, investors.denbury.com/investors/events-and-presentations/events/event-details/2022/CCUS-Business-Outlook-Virtual/default.aspx. See also: Denbury, Q1 2023 earnings call.

14 Ibid.

15 Rebecca Holland, "Louisiana could take control of carbon capture permits in the state. How would that work?," *The Advocate*, 8 April 2023, www.theadvocate.com/baton_rouge/the-epa-could-allow-louisiana-to-give-carbon-capture-permits/article_32447f20-cf17-11ed-8ad4-2fbf03475887.html.

Table 5 — Louisiana regulatory framework for offshore CCS projects

Agency	Permit / Approval	Authorization/ Interaction Required
U.S. Environmental Protection Agency (EPA) – Region VI, Dallas, TX	Underground Injection Control Class VI Permit	Permit and consultation
	Consultation role to the Louisiana Department of Environmental Quality on air emissions permitting	
	Floodplain management and protection of wetlands (44 CFR 9)	
	Review of wetlands impacts for U.S. Army Corps of Engineers (USACE) Clean Water Act Section 404 permit	
	Clean Water Act, Section 402 National Pollutant Discharge Elimination System	
U.S. Army Corps of Engineers – New Orleans	Clean Water Act Section 404 Permit for impacts on waters of the United States, including wetlands (33 USC § 1344), a Joint Permit Application with the Louisiana Department of Natural Resources (R.S. 49:214.25) for work within the Louisiana Coastal Zone	Permit
	Rivers and Harbors Act Section 10 Permit for construction and operation of structures in and across federally navigable waters (33 USC § 403)	
U.S. Department of Commerce, National Oceanic and Atmospheric Administration, National Marine Fisheries Service	Marine Mammal Protection Act Consultation (16 USC § 1382)	Consultation
	Endangered Species Act (ESA) Section 7 Consultation (16 USC § 1856 et seq.)	
	Magnuson-Stevens Fishery Conservation and Management Act Consultation Essential Fish Habitat (EFH) Consultation (50 CFR 600)	
	Fish and Wildlife Coordination Act Consultation (16 USC § 661 et seq.)	
U.S. Fish and Wildlife Service, Southwest Region 2	ESA Section 7 Consultation (16 USC § 1536)	Consultation
	Migratory Bird Treaty Act (16 USC § 703 et seq.)	
	Fish and Wildlife Coordination Act Consultation (16 USC § 661 et seq.)	
Louisiana Department of Environmental Quality – Water Permits Division	Section 401 Water Quality Certification (33 USC 1341)	Permits
	Louisiana Pollutant Discharge Elimination System - Hydrostatic Test Water Discharge General Permit (LA R.S. 30:2001 et seq.)	
Louisiana Department of Environmental Quality – Air Permits Division	Title V and Prevention of Significant Deterioration (PSD) Air Permits (40 CFR 70)	Permits
Louisiana Department of Natural Resources –Office of Coastal Management	Coastal Use Permit (CUP), a Joint Permit Application with the USACE (R.S. 49:214.25)	Permit
Louisiana Department of Wildlife and Fisheries	State-Listed Species Clearance	Clearance
Louisiana Department of Culture, Recreation and Tourism, Division of Archaeology	Consultation under Section 106 of the National Historic Preservation Act (36 CFR 800)	Clearance
Louisiana Office of State Lands – Land and Waterbottom Management Section	Permit and Lease for State Water Bottoms (LA R.S. 41:1701-1714)	Permit and Lease

Sources: Venture Global CP2 LNG, LLC and Venture Global CP Express, LLC, Response to FERC Environmental Information Request, 22 July 2022.

Currently, there are at least 27 pending Class VI permit applications with the EPA, 10 in Louisiana.¹⁶ A number of other projects in advanced planning stages aim to submit Class VI applications in 2023, such as Denbury's four planned Louisiana storage facilities.¹⁷ Other project developers that have not yet filed a Class VI permit application with the EPA for planned Louisiana projects include ExxonMobil, ConocoPhillips, Talos Energy, Venture Global Partners, and Air Products.

¹⁶ U.S. Environmental Protection Agency, www.epa.gov/uic/class-vi-wells-permitted-epa.

¹⁷ Denbury, Q1 2023 earnings call.

CONCLUSION

The EPA is on the verge of granting Class VI injection well permitting to the State of Louisiana, which would open the floodgates to a wave of new CCS project development for the first time. It is important that the public be informed of the specific plans — and the potential consequences — for underground CO₂ storage and transportation across the state. This report has presented an overview of where planned infrastructure would be located, if approved, with the aim of presenting key data in a comprehensive fashion for the benefit of local communities and the Louisiana public. Part 2 in this series of public research reports will look more closely at the financial interests backing new CCS infrastructure and the billions of dollars in federal funding required to make it profitable. Part 3 will examine some of the risks inherent in the rapid expansion of this new industry, the insurance policies being developed to cover those risks, and the potential liabilities to which Louisianans may be exposed.

DATA SOURCES

Sources used for project scoping included the EPA, from which Class VI injection well permit application documents for permanent underground sequestration, as well as data on Class I-V permits, were requested via FOIA and consulted. Other sources included corporate filings from project developers, research from the Deep South Center for Environmental Justice, data from the Clean Air Task Force, the Global CCS Institute Facilities Database, and the Oil & Gas Climate Initiative's CCUS Hub.

Once an initial list of projects was compiled, public records requests were submitted for all project application documents filed with the Louisiana Department of Environmental Quality (LDEQ) and the Department of Natural Resources (LDNR), which are responsible for various CCS permitting procedures.

Additional project data was derived from the LDNR SONRIS Data Portal and LDEQ Electronic Document Management System (EDMS), together with background documents on relevant permitting and regulatory processes from LDEQ, LDNR, EPA, and the Federal Energy Regulatory Commission (FERC).

CCS infrastructure mapping was based on carbon dioxide storage agreements and other related land records accessed through public records systems at the Louisiana state and parish levels.