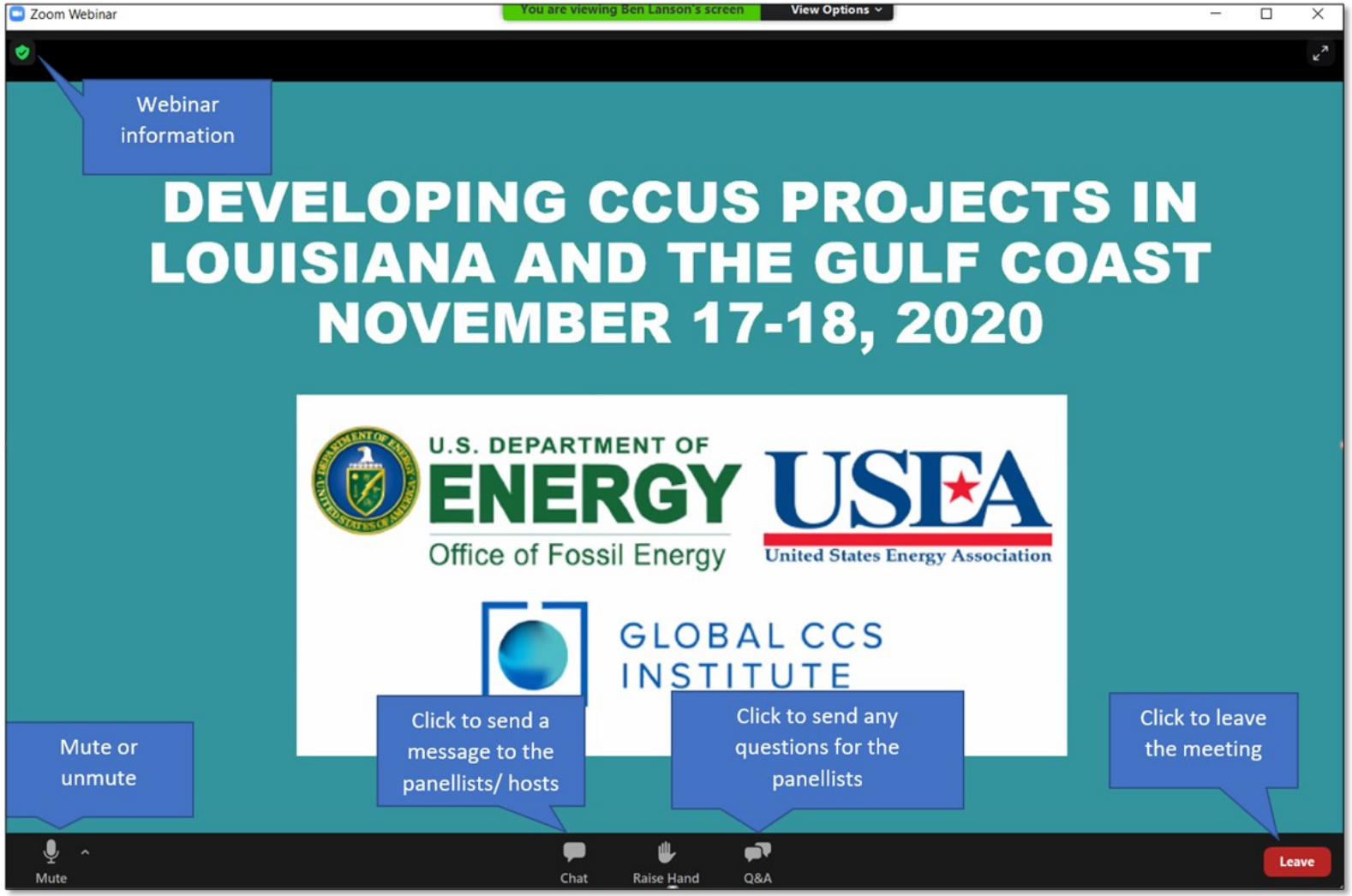
DEVELOPING CCUS PROJECTS IN LOUISIANA AND THE GULF COAST
NOVEMBER 17-18, 2020

U.S. DEPARTMENT OF ENERGY
Office of Fossil Energy

USEA
United States Energy Association

GLOBAL CCS INSTITUTE

ZOOM CONTROLS



THE GLOBAL CCS INSTITUTE

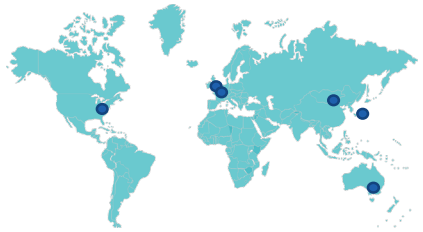
International think tank

Backed by governments, businesses and NGOs

Mission: To accelerate deployment of CCS

78 MEMBERS

6 locations



Advocacy

Intelligence

Connections

AGENDA

Day 1

1:00 – 1:10 pm CST	Welcome
1:10 – 1:30	Louisiana's Net Zero Emissions Commitment and the Role of CCUS
1:30 – 1:45	The Status of CCUS in the US and Around the World
1:45 – 2:35	How to Utilize 5Q on your CCUS Project
2:35 – 2:45	Break
2:45 – 3:30	The Louisiana Gulf Coast Environment: Industry and CO2 Sources, Geology, and Pipelines
3:30 – 4:15	Putting a Project Together: Capture, Transportation, and Storage
4:15 – 4:20	Day 1 Wrap-up and Day 2 Preview

Day 2

9:00 – 9:05 am CST	Welcome
9:05 – 9:50	Case Studies – Projects & 45Q
9:50 – 10:30	Challenges to Deployment and Strategies to Address Them
10:30 – 10:35	Wrap-up and Break-out Instructions
10:35 – 10:45	Break
Breakout Sessions – 10:45 t0 11:30 am	
Breakout Session 1	Q&A and Broader Discussion on 45Q with Keith Tracy
Breakout Session 2	Putting together CCUS Projects with Brian Hill
Breakout Session 3	Understanding the LA context regarding liability, permitting, etc. with Jason Lanclos

Patricia Loria, Senior Client Engagement Lead, GCCSI

LOUISIANA'S NET ZERO EMISSIONS COMMITMENT AND THE ROLE OF CCUS

SECRETARY TOM HARRIS,
CABINET SECRETARY, DEPARTMENT OF NATURAL RESOURCES, LA

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THE STATUS OF CCS

DEVELOPING CCS PROJECTS IN LOUISIANA AND THE GULF COAST
NOVEMBER 17-18, 2020

JEFF ERIKSON, GENERAL MANAGER – CLIENT ENGAGEMENT

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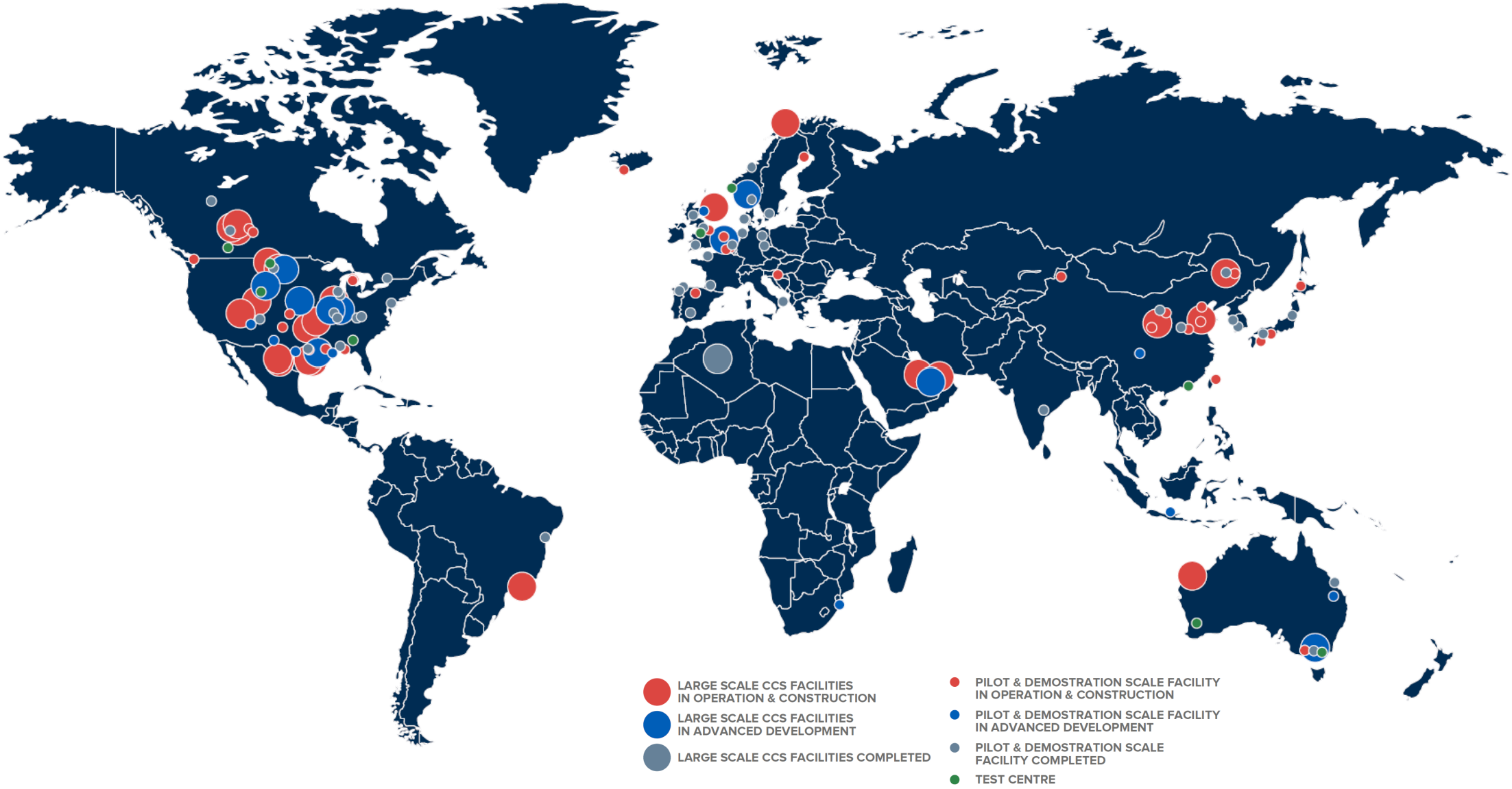
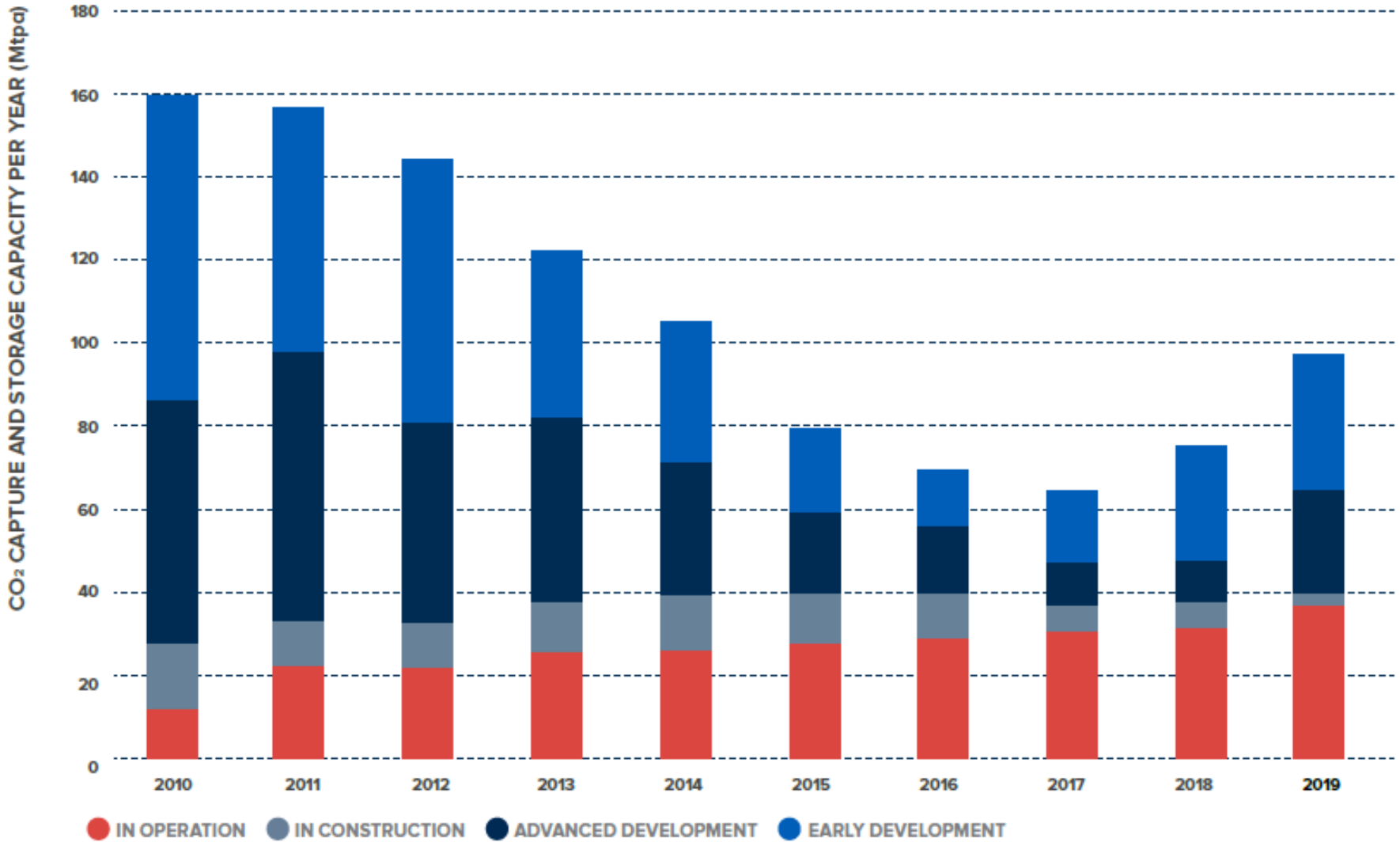
CURRENT CCS FACILITIES AROUND THE WORLD



A GROWING CCS PROJECT PIPELINE



- 40 million tpa
- 260 million tonnes to date

Source: Global CCS Institute

40 MILLION TONNES PER YEAR

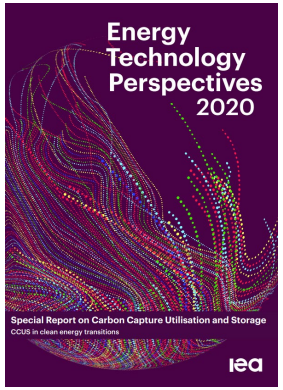
4.7 million houses

8.8 million cars

53 million acres of forest

100 Ivanpah Solar Farms

1/100th annual requirement from CCS by 2050 (IEA)



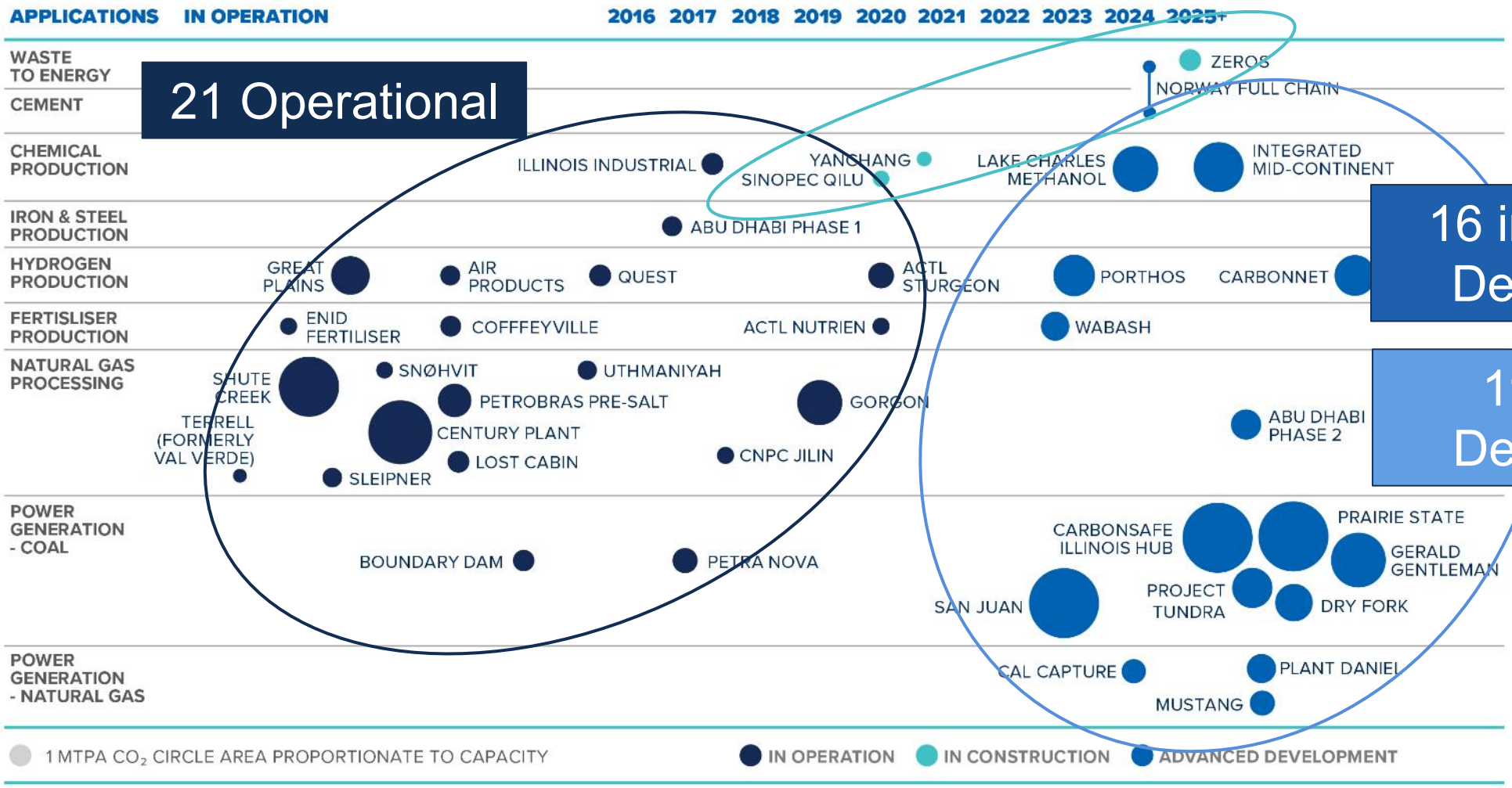
59 COMMERCIAL CCS FACILITIES

3 in Construction

21 Operational

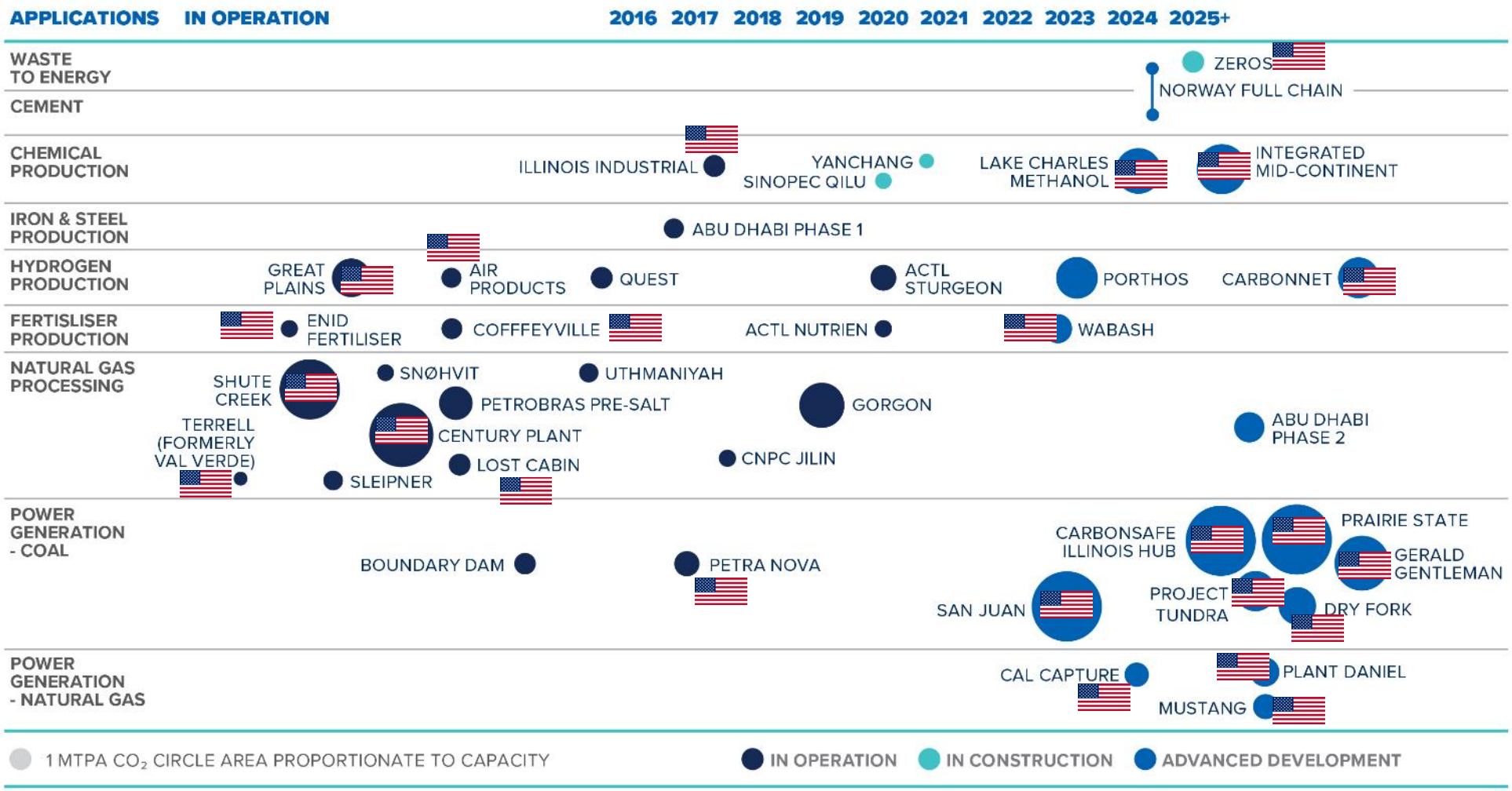
16 in Advanced Development

19 in Early Development



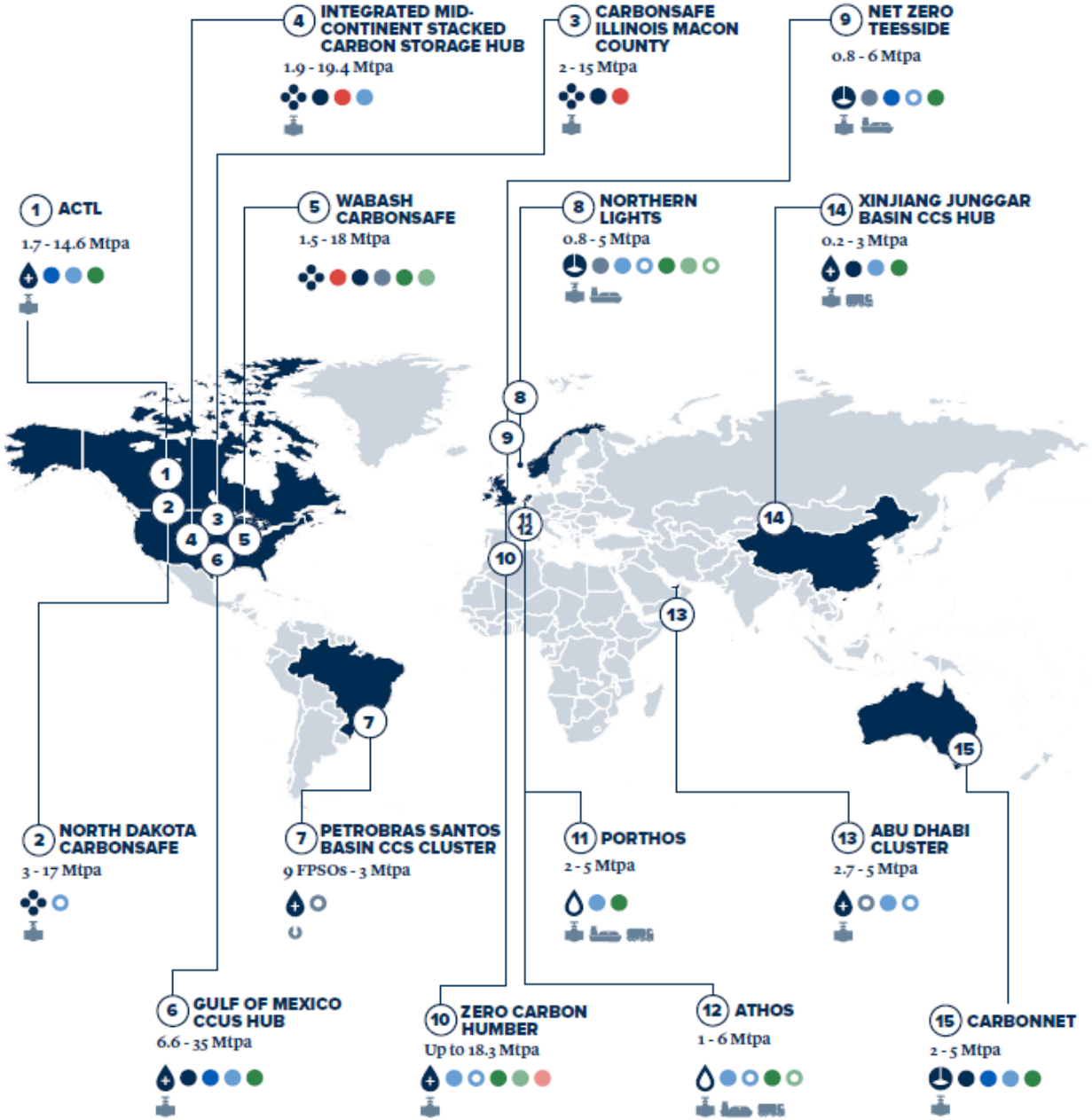
Source: Global CCS Institute

USA REMAINS THE LEADER



Source: Global CCS Institute

CCS HUBS/CLUSTERS



Source: Global CCS Institute

Carbon tax

Tax credit or emissions credit

Grant support

Provision by government or SOE

Regulatory requirement

Enhanced oil recovery

Low cost capture

Low cost transport and storage

Vertical Integration

Policies & project characteristics	Carbon tax	Tax credit or emissions credit	Grant support	Provision by government or SOE	Regulatory requirement	Enhanced oil recovery	Low cost capture	Low cost transport and storage	Vertical integration
US									
Terrell						○	●	●	
Enid Fertiliser						○	●	●	
Shute Creek					●	○	●	●	
Century Plant		●				○	●		
Air Products SMR		●	○			○			
Coffeyville		●				○	●		
Lost Cabin		●				○	●		
Illinois Industrial		●	○				●	●	●
Petra Nova		●	○			○			
Great Plains						○	●		
Canada									
Boundary Dam			○	●	●	○		●	
Quest		●	○						●
ACTL Agrium			○			○	●		
ACTL Sturgeon			○			○	●		
Brazil									
Petrobras Santos				●		○	●	●	●
Norway						○			
Sleipner	●			●			●	●	●
Snøhvit	●			●	●		●		●
UAE									
Abu Dhabi CCS				●		○		●	
Saudi Arabia									
Uthmaniyah				●		○	●	●	●
China									
CNPC Jilin				●		○	●	●	●
Sinopec Qilu*				●		○	●	●	
Yanchang*				●		○	●		
Australia									
Gorgon			○		●		●	●	●

Source: Global CCS Institute

LOOKING AHEAD

Trends	Tea Leaves
Climate change awareness	Impact of Covid/Economy
Net Zero Emissions	The future of fossil fuels
ESG	Geopolitics
Hydrogen	The color of hydrogen
Continued US leadership on CCUS	Revenue model?

The Global Status of CCS 2020

December 1

Download at globalccsinstitute.com

Jeff.Erikson@globalccsinstitute.com

202-895-2785

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45Q Overview

Keith Tracy

November 2020

Overview

45Q is a carbon capture, utilization and storage (CCUS) incentive

US federal income tax credit for physically capturing CO_2 and storing it underground or in products

Tax credits are claimed on a per metric ton basis

- The more CO_2 is captured and stored, the greater the tax credit benefits

12-year tax credit for new capture operations

Value of the credit increases each year (generally)

45Q effectively puts a price on carbon

General Checklist

The following requirements are critical to qualify for 45Q credits:

- ❑ What is captured: Must capture Qualified Carbon Oxide (essentially carbon monoxide or carbon dioxide)
- ❑ How is it captured: Must use Carbon Capture Equipment to perform the capture function
- ❑ Where is it captured: Carbon Capture Equipment must be placed in service at a Qualified Facility
- ❑ When are the timing deadlines: Must satisfy Beginning of Construction deadline for Carbon Capture Equipment/Qualified Facility
- ❑ How is it stored: captured carbon oxide must be sequestered or stored using one of the following methods:
  - Utilized – non-underground storage such as algae and cement
  - Injected – stored in Secure Geologic Storage and used as a tertiary injectant in a Qualified EOR/EGR Project, or
  - Disposed of – stored in Secure Geologic Storage and not used as a tertiary injectant in a Qualified EOR/EGR Project (i.e. saline aquifer)
- ❑ Who claims the credit: either the Taxpayer to whom the credit is attributable, or the Credit Claimant (if election is made)
  - How: Option to satisfy Tax Equity Partnership safe harbor
- ❑ What to avoid: avoid having the credit Recaptured by the IRS
- ❑ How Much is the credit: new Credit Value amounts for Carbon Capture Equipment placed in service on or after Feb 9, 2018

Other Considerations

What is captured

Qualified Carbon Oxide

45Q credit is limited to capture of CO_2 or CO ("carbon oxide")

- Was only CO_2 prior to February 9, 2018

Must be either an emission captured from an Industrial Facility, or direct air capture (DAC)

- Absent capture of the emission, it would have otherwise been released to the atmosphere

Must be measured at the source of capture

Must be verified where it is Utilized, Injected, or Disposed

No credit allowed for Recycle CO_2 at an EOR/EGR project

Carbon Capture

How is it captured

Carbon Capture Equipment

Must use Carbon Capture Equipment to perform the capture function

Broad definition of "Carbon Capture Equipment" in the Proposed Regulations issued in June 2020

- All components of property needed to separate, purify, dry, compress, treat, process, liquefy, pump, capture, or perform some other physical action to capture CO_2 – or to remove it from the atmosphere through DAC
- Includes all components of property used to capture or process the CO_2 until it is transported for storage
- Does not include pipelines or transport vessels to transport CO_2 to its storage location
- May include a gathering and distribution system upstream of a pipeline

Similar but not identical definition of Carbon Capture Equipment in Notice 2020-12

- Beginning of Construction guidance from Feb 2020 contains slightly different definition

Anticipate more harmonized definitions in the Final Regulations and a possible revision to Beginning of Construction guidance

Where is it captured

Qualified Facility

- Carbon Capture Equipment must be placed in service at a Qualified Facility
- Qualified Facility must be one of the following:
  1. Industrial Facility is a facility that produces CO_2 from
     - a fuel combustion source or fuel cell, or
     - a fugitive CO_2 emission source, or
     - a manufacturing process (manufacture of any product other than CO_2 that is intended to be sold at a profit or used for a commercial purpose)
     - Excludes a CO_2 production well that produces from a natural CO_2-bearing formation
  2. Electricity Generating Facility is a facility subject to MACRS Asset Class 49.11, 49.13 or 49.15 (i.e. generating power for sale)
  3. Direct Air Capture (DAC) Plant is a facility that uses Carbon Capture Equipment to remove CO_2 directly from ambient air or atmosphere
- Must capture minimum amount of CO_2 to qualify (annual threshold):
  - Power plant selling power on the grid: 500,000 metric tons/year
  - Special rule for utilization: 25,000 metric tons/year, if Qualified Facility emits ≤500,000 metric tons/year
  - Any other facility: 100,000 metric tons/year
  - Annualization is permitted for first year of operations

Applicable Facility

- Qualified Facility placed in service before Feb 9, 2018, and
- No 45Q was claimed for any captured CO2 prior to 2018

Applicable Facility Election

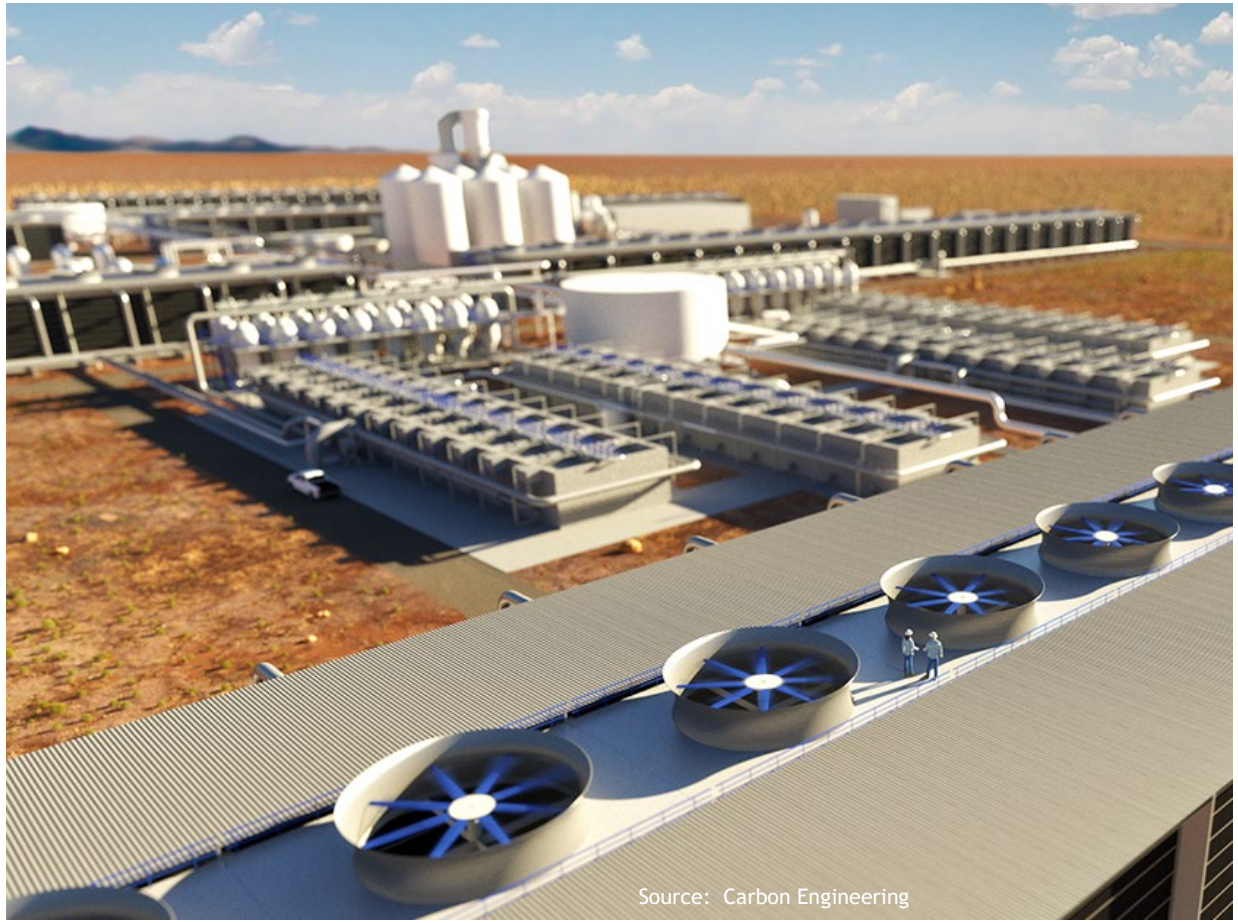
- In any tax year where facility captures ≥500,000 metric tons, election can be made to deem facility as placed in service on Feb 9, 2018 (effectively qualifying for high value tax credits)


Source: NRG

Where is it captured

45Q and Direct Air Capture (DAC) Plants

Direct Air Capture Facility



- DAC Plant must use Carbon Capture Equipment to remove CO_2 directly from ambient air or atmosphere
  - Must exclude facilities that capture CO_2 using natural photosynthesis or CO_2 that was deliberately released from the subsurface
- Must meet the requirements of a Qualified Facility
- Must capture at least 100,000 metric tons/year
- CO_2 must be measured at the source of capture
- CO_2 must be verified where it is Utilized, Injected, or Disposed

When are the timing deadlines

Beginning of Construction Requirement

Construction must begin on the Qualified Facility before Jan 1, 2024

Construction must begin on the Carbon Capture Equipment before Jan 1, 2024 – unless the original planning/design of that Qualified Facility includes installation of Carbon Capture Equipment

IRS Notice 2020-12 contains many details on "beginning of construction" requirements, and answers 3 important questions:

1. What must be done to "begin" construction?
   - Construction can begin by doing physical work of a significant nature (Physical Work Test), or by paying/incurring 5% or more of the total cost of the Qualified Facility or Carbon Capture Equipment (5% Safe Harbor)
2. Once construction is commenced, what is the deadline by which the equipment/facility must be operational?
   - Construction must continue to completion with limited excusable disruptions, or the facility/equipment must be placed in service within the "6 Year Safe Harbor"
3. Can multiple units of equipment or facilities be combined as a "single project" for purposes of beginning of construction? Can they later be disaggregated so that at least some can meet the 6 Year Safe Harbor?
   - Yes, and yes

Carbon Capture Equipment

Source: Bloomberg

How is it stored – Option 1

Utilization

- 45Q credits are available if the minimum amount of captured CO_2 is stored through Utilization
- Utilization – Captured CO_2 must be utilized in one of the following ways:
  - Growing of algae or bacteria or other fixation through photosynthesis or chemosynthesis
  - Chemically converting CO_2 to a material or chemical compound where the CO_2 is securely stored
  - Use of the CO_2 for any other purpose for which a commercial market exists

Utilization Process


Source: SkyMine

Utilization - LCA

- Amount of CO_2 utilized is determined based on a lifecycle GHG analysis (LCA) of CO_2 isolated or displaced
- LCA report requirements:
  1. Performed by or verified by a 3rd party
  2. Be consistent with ISO 14044:2006
  3. Technical review by DOE
  4. Must be approved by the IRS, in consultation with DOE and EPA
  5. Full product lifecycle analysis required (proposed regulations)
- What remains to be clarified by the IRS:
  - Whether the LCA requirement implies an extension of "utilization" to GHGs other than CO_2
  - Whether utilization allows for 45Q credits when CO_2 is used to make a product but is not captured or stored
  - More definition concerning the "commercial market" catchall provision, such as (a) whether it includes transportation fuels, (b) whether it is limited to a product (instead of a service); and (c) the process for commercial markets to be approved by IRS
  - Whether the LCA requirement only serves the function of verifying the amount of capture CO_2, and only serves to ensure the utilization process does not emit more GHGs than the amount of CO_2 captured in the first place
  - Details regarding the LCA report: whether approved LCA reports will be made public, whether LCA reports of others can be relied upon, and what are the baselines and boundaries of the LCA
  - How is additional Carbon Capture Equipment capacity determined in the utilization context

How is it stored – Option 2

Injection or Disposal

- 45Q credits are available if captured CO_2 is stored through Injection or Disposal
  - Approved locations include oil and gas reservoirs, deep saline formations, and unminable coal seams
- Both Injection and Disposal require CO_2 to be placed in <u>Secure Geologic Storage</u> so that CO_2 does not escape into the atmosphere
  - Injection:
    - Use the captured CO_2 as a tertiary injectant in a qualified EOR/EGR Project and disposing of it in secure geologic storage
    - Secure Geologic Storage Requirement: Must comply with EPA GHGRP Subpart RR, or ISO Standard 27916:19
  - Disposal:
    - Dispose of the captured CO_2 in secure geologic storage and not using it as a tertiary injectant in a qualified EOR/EGR Project
    - Secure Geologic Storage Requirement: Must comply with EPA GHGRP Subpart RR
- Annual certification and documentation:
  - If using Subpart RR, taxpayer may self-certify amount of CO_2 claimed
  - If using ISO Standard 27916:19, documentation must be certified by independent qualified engineer or geologist
  - Complete documentation and certification must be provided to the IRS annually

CO_2 Injection Well

Source: Houston Chronicle

Who claims the credit – Part 1

Taxpayer or Credit Claimant

- Credits are claimed by the Owner of the Carbon Capture Equipment
  - Exception: if Carbon Capture Equipment was placed in service before Feb 9, 2018, then credit is claimed by the person who performs the capture (and that Capture Operator might be different than the Owner)

- Owner (or Capture Operator) must physically or contractually ensure the capture and the Utilization, Injection or Disposal of the CO_2
  - A contract ensuring Utilization, Injection or Disposal must be a "binding written contract", which must:
    - Provide for enforcement of other party's obligation of Utilization, Injection or Disposal
    - Obligate the Injector/Disposer to comply with applicable Regulations regarding Secure Geologic Storage
    - Obligate the Injector/Disposer to promptly inform Owner (or Capture Operator) of all information pertinent to any recapture event
  - Whether contract can include liquidated damages provision will likely be clarified
  - Contract information must be reported to IRS

- OPTION: Credit Claimant Election – 45Q(b)(3)
  - Owner (or Capture Operator) may elect to allow the credit be claimed by the "Credit Claimant" – the person who does the Utilization, Injection or Disposal (Credit Claimant)
  - Election may be partial or full amount of the credit, and may involve multiple Credit Claimants
  - New elections required annually, using Form 8933
  - Reporting Requirements

Who claims the credit - Part 2

Tax Equity Partnerships

- Significant tax credit amounts require an investor that has large tax appetite to take advantage of the tax credit
- Tax Equity Partnership Flip Structure – highlights:
  - Revenue Procedure 2020-12 "safe harbor", like wind energy production credits but more favorable in some areas
  - Investor/Partner needs to be an equity holder rather than secured lender or credit purchaser
  - Project Company (or Partnership) would own the Carbon Capture Equipment and claim the credits
  - Tax items (including 45Q tax credits) may (and will) be allocated different than cash
  - Investor must make up-front Unconditional Investment of at least 20% of total expected investment
  - Up to 50% of Investor's consideration may be contingent ("Pay-Go")
    - Operating expenses are not treated as part of contingent investments
  - Developer cannot have Call/Purchase Rights
  - Investor may have Put/Sale Rights at FMV
  - Many guarantees are permitted, including:
    - Performance of any act necessary to claim the credit, such as guarantee of Injection or Disposal
    - Avoiding any act that would result in Recapture
  - Long-term take-or-pay, take all, supply-or-pay, supply all, and store-or-pay contracts are allowed
  - Allocation guidance appears to authorize (for the first time ever) a Project Company to operate without revenue other than receipt/distribution of the tax credits (i.e. Disposal)

	Developer		Investor	
	Cash	Income/Loss, and 45Q Credits	Cash	Income/Loss, and 45Q Credits
Period 1	100%	≥1%	0%	≤99%
Period 2	0%	≥1%	100%	≤99%
Period 3	≤95%	≤95%	≥5%	≥5%

- Period 1 lasts until date certain, or date Developer receives $x cash return
- Period 2 lasts until "Flip Point", when Investor has achieved agreed-upon IRR (after-tax). Flip Point could possibly occur before Period 1 ends

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What to avoid

Recapture

- "Recapture" is where Qualified CO_2 is Captured, Injected or Disposed and 45Q credits are claimed as a result, but then the Qualified CO_2 later leaks or ceases to be Captured, Injected or Disposed
  - "Leaked Amount of Qualified CO_2" is the amount of CO_2 that ceases to be Captured, Injected or Disposed, and the quantity is the amount that leaked to the atmosphere as determined by how Secure Geologic Storage is demonstrated (i.e. MRV Plan)
- "Recapture Event" only occurs if there is an instance of Recapture Qualified CO_2 in a tax year during the Recapture Period
  - "Recapture Qualified CO_2" is the amount by which the Leaked Amount of Qualified CO_2 that year exceeds the Qualified CO_2 Injected or Disposed that year
  - *Current Year Offset Principle* prevents some potential recapture instances because potential for Recapture only emerges if the Leaked Amount of Qualified CO_2 in a tax year exceeds the amount of Qualified CO_2 Injected or Disposed in that same year
  - The "Recapture Period" is the time period between (a) the date of first injection or disposal of the Qualified CO_2 and (b) the earlier of (i) the date the monitoring period ends under the secure geologic storage rules (i.e. the MRV Plan) and (ii) 5 years after the last taxable year in which a 45Q credit was claimed
- "Recapture Amount" is the value of the 45Q credit recaptured, calculated on a last-in-first-out (LIFO) basis
- Recapture Amount is taken into account in the tax year when the leak is identified and reported
  - Exception: Recapture Event occurs in the year Qualified CO_2 is deliberately removed from a Secure Geologic Storage Site
- Recapture Amount is allocated pro rata if there are multiple taxpayers or multiples units of Carbon Capture Equipment involved

How Much is the Credit

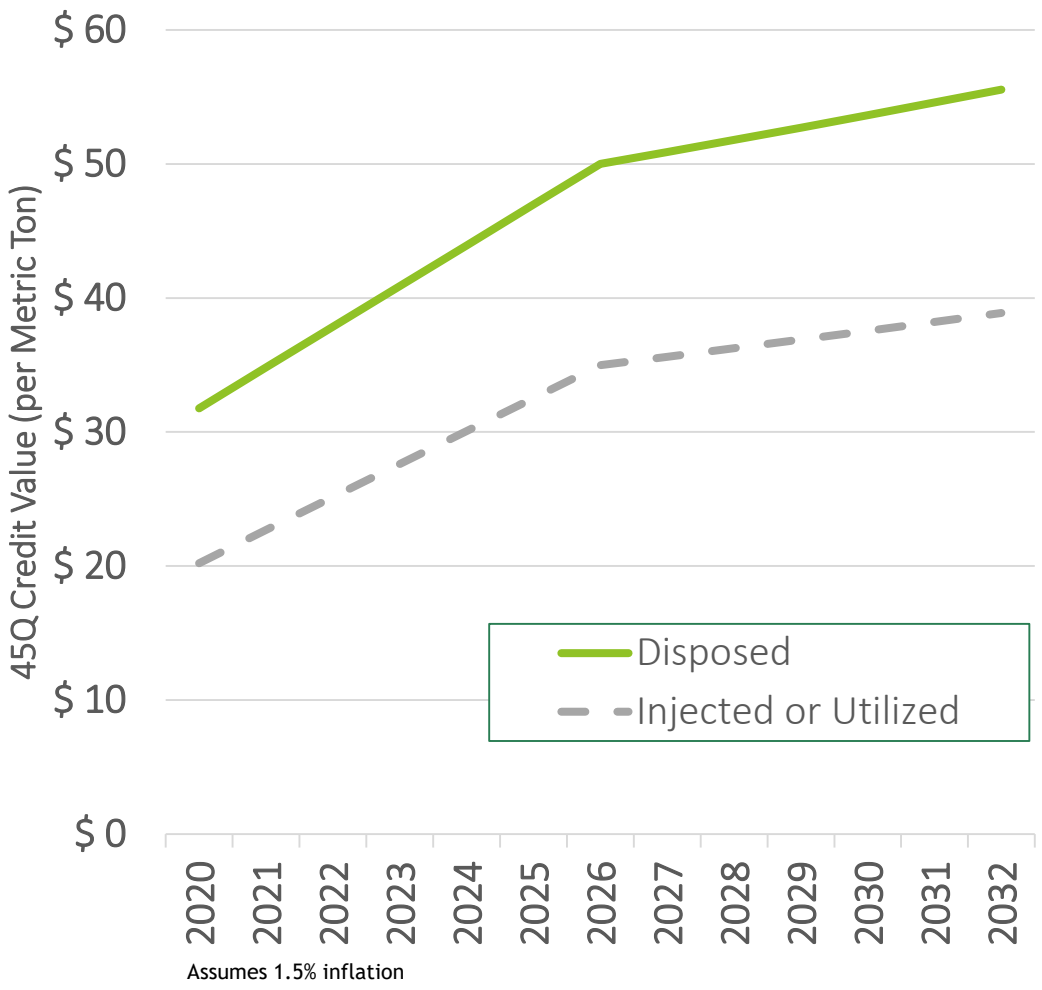
45Q Tax Credit Value

- Value of 45Q tax credit increases annually (per metric ton)
  - $20.22 (in 2020) up to $35 (in 2026) if Injected or Utilized
  - $31.77 (in 2020) up to $50 (in 2026) if Disposed
- Values in 2027 and beyond are inflation adjusted

Examples:

- 100,000 metric ton/yr capture project placed in service in 2021, tax credits over 12 years totaling:
  - ~$40 million, if Injected or Utilized
  - ~$57 million, if Disposed
- 500,000 metric ton/yr capture project placed in service in 2021, tax credits over 12 years totaling:
  - ~$198 million, if Injected or Utilized
  - ~$287 million, if Disposed

Projected 45Q Credit Values



Assumes 1.5% inflation

Elysian VENTURES

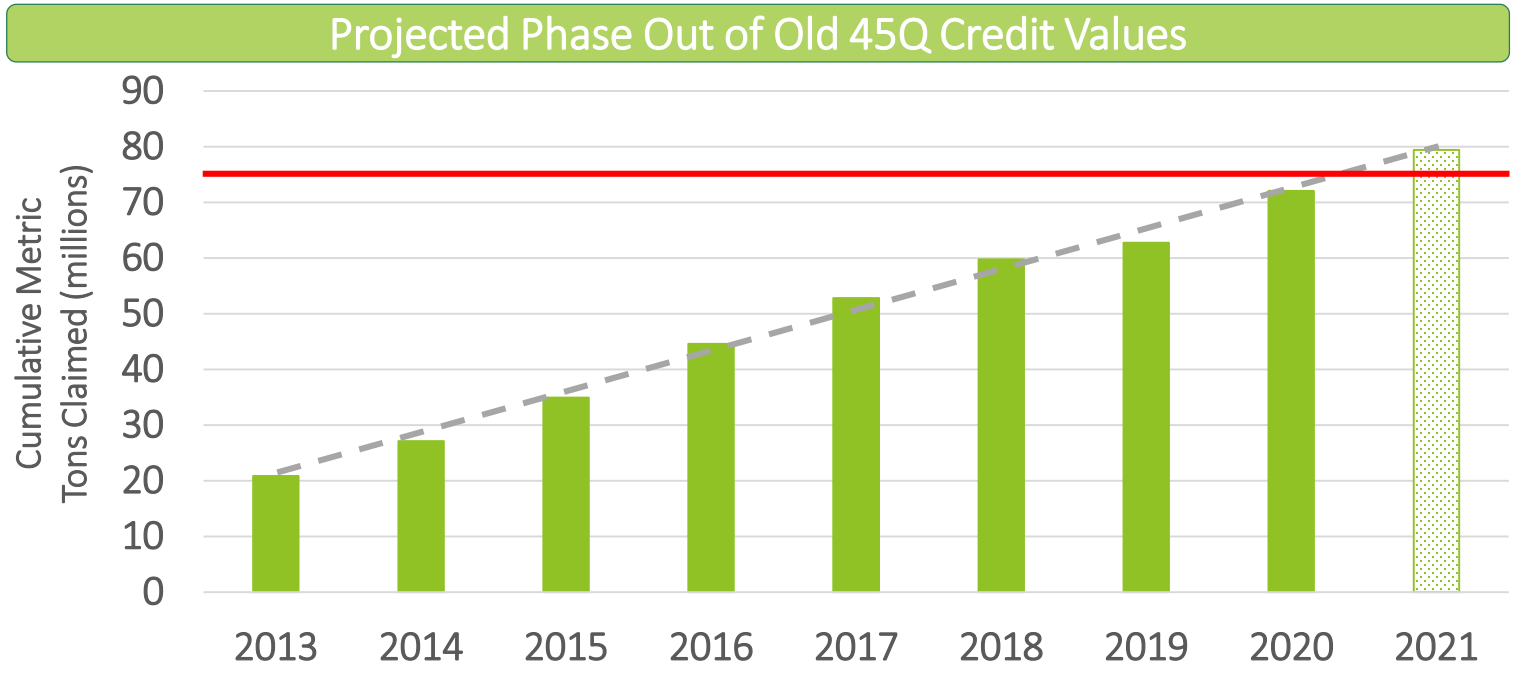
Older Facilities

At an older facility, if additional Carbon Capture Equipment is installed on or after Feb 9, 2018:

- The newer values apply ($35/50), but only to the extent the total amount of Qualified CO_2 exceeds the CO_2 capture capacity of the older Carbon Capture Equipment
- 80/20 Rule applies to a retrofit of the older Carbon Capture Equipment
  - Retrofit qualifies if Fair Market Value of used components does not exceed 20% of the total value

Credits for Carbon Capture Equipment placed in service before Feb 9, 2018 are at lower values ($10/20)

- Credits will phase out when a total of 75 million metric tons of Qualified CO_2 have been taken into account
- Current projection: phase out at end of 2021



Reporting Requirements

Proposed Regulations contain numerous reporting requirements. Examples include:

- The taxpayer who claims the 45Q credit must report the name and location of each Qualified Facility at which the Qualified CO_2 was captured
- Each party to a binding written contract must report the existence of the contract, the names and tax ID numbers of the parties involved, the amount of Qualified CO_2 involved with each party, EPA GHGRP e-GGRT ID number of the storage site, etc.
- Credit Claimant, and electing taxpayer who transfers credit to Credit Claimant, must both report significant details of their actions to allow IRS to trace the transfers
- Any taxpayer who claims the 45Q credit must report a recapture event that occurs during a project's recapture period, along with the recapture amount, the quantity of leaked Qualified CO_2, the credit rates involved and a statement providing details regarding the leak

45Q credits will not be allowed to a taxpayer that fails to timely provide all required information, documentation and certifications

45Q Proposed Regulations

34050 Federal Register / Vol. 85, No. 106 / Tuesday, June 2, 2020 / Proposed Rules

DEPARTMENT OF THE TREASURY

Internal Revenue Service

26 CFR Part 1

[REG–112339–19]

RIN 1545–BP42

Credit for Carbon Oxide Sequestration

AGENCY: Internal Revenue Service (IRS), Treasury.

ACTION: Notice of proposed rulemaking.

SUMMARY: This document contains proposed regulations regarding the credit for carbon oxide sequestration under section 45Q of the Internal Revenue Code (Code). These proposed regulations will affect persons who physically or contractually ensure the capture and disposal of qualified carbon oxide, use of qualified carbon oxide as a tertiary injectant in a qualified enhanced oil or natural gas recovery project, or utilization of qualified carbon oxide in a manner that qualifies for the credit.

DATES: Written or electronic comments and requests for a public hearing must be received by August 3, 2020. Requests for a public hearing must be submitted as prescribed in the "Comments and Requests for a Public Hearing" section.

ADDRESSES: Commenters are strongly encouraged to submit public comments electronically. Submit electronic submissions via the Federal eRulemaking Portal at *www.regulations.gov* (indicate IRS and REG–112339–19) by following the online instructions for submitting comments. Once submitted to the Federal eRulemaking Portal, comments cannot be edited or withdrawn. The IRS expects to have limited personnel available to process public comments that are submitted on paper through mail. Until further notice, any comments submitted on paper will be considered to the extent practicable. The Department of the Treasury (Treasury Department) and the IRS will publish for public availability any comment submitted electronically, and to the extent practicable on paper, to its public docket.

Send paper submissions to: CC:PA:LPD:PR (REG–112339–19), Room 5203, Internal Revenue Service, P.O. Box 7604, Ben Franklin Station, Washington, DC 20044.

FOR FURTHER INFORMATION CONTACT: Concerning the proposed regulations, Maggie Stehn of the Office of Associate Chief Counsel (Passthroughs & Special Industries) at (202) 317–6853; concerning submissions of comments and/or requests for a public hearing, Regina L. Johnson at (202) 317–5177 (not toll-free numbers).

SUPPLEMENTARY INFORMATION:

Background

This document contains proposed amendments to the Income Tax Regulations (26 CFR part 1) under section 45Q of the Code (proposed regulations).

Section 45Q was enacted on October 3, 2008, by section 115 of Division B of the Energy Improvement and Extension Act of 2008, Public Law 110–343, 122 Stat. 3765, 3829, to provide a credit for the sequestration of carbon oxide. On February 17, 2009, section 45Q was amended by section 1131 of Division B of the American Recovery and Reinvestment Tax Act of 2009, Public Law 111–5, 123 Stat. 115, 325. Section 45Q was further amended on December 19, 2014, by section 209(j)(1) of Division A of the Tax Increase Prevention Act of 2014, Public Law 113–295, 128 Stat. 4010, 4030, and most recently on February 9, 2018, by section 41119 of Division D of the Bipartisan Budget Act of 2018 (BBA), Public Law 115–123, 132 Stat. 64, 162, to encourage the construction and use of carbon capture and sequestration projects.

On May 20, 2019, the IRS published Notice 2019–32, 2019–21 I.R.B. 1187. The notice requested general comments on issues arising under section 45Q, as well as specific comments concerning secure geological storage, the measurement of qualified carbon oxide, the recapture of the benefit of the credit for carbon oxide sequestration, the types of utilization that qualify for the credit, the beginning of construction, partnership arrangements, definitions of terms, and other issues related to the credit. The IRS received 116 comments from industry participants, environmental groups, and other stakeholders.

In response to comments submitted pursuant to Notice 2019–32, on March 9, 2020, the Treasury Department and the IRS published Revenue Procedure 2020–12, 2020–11 I.R.B. 511, and Notice 2020–12, 2020–11 I.R.B. 495. Revenue Procedure 2020–12 provides a safe harbor under which the IRS will treat partnerships as properly allocating the section 45Q credit in accordance with section 704(b). Notice 2020–12 provides guidance on the determination of when construction has begun on a qualified facility or on carbon capture equipment that may be eligible for the section 45Q credit. As requested by commenters, the safe harbor in Revenue Procedure 2020–12 and the rules in Notice 2020–12 are similar to those provided in prior guidance.

Pursuant to section 45Q(h), the Secretary of the Treasury or his delegate (Secretary) may prescribe such regulations and other guidance as may be necessary or appropriate to carry out section 45Q, including regulations or other guidance to (i) ensure proper allocation under section 45Q(a) for qualified carbon oxide captured by a taxpayer during the taxable year ending after the date of the enactment of the BBA, and (ii) determine whether a facility satisfies the requirements under section 45Q(d)(1).

Summary of Comments and Explanation of Provisions

1. General Credit Provisions

a. Credit Amount in General

Section 45Q(a)(1) allows a credit of $20 per metric ton of qualified carbon oxide (i) captured by the taxpayer using carbon capture equipment which is originally placed in service at a qualified facility before the date of the enactment of the BBA (February 9, 2018); (ii) disposed of by the taxpayer in secure geological storage; and (iii) neither used by the taxpayer as a tertiary injectant in a qualified enhanced oil or natural gas recovery project nor utilized in a manner described in section 45Q(f)(5).

Section 45Q(a)(2) allows a credit of $10 per metric ton of qualified carbon oxide (i) captured by the taxpayer using carbon capture equipment which is originally placed in service at a qualified facility before February 9, 2018; and (ii) either (A) used by the taxpayer as a tertiary injectant in a qualified enhanced oil or natural gas recovery project and disposed of by the taxpayer in secure geological storage; or (B) utilized by the taxpayer in a manner described in section 45Q(f)(5).

Section 45Q(a)(3) allows a credit of the applicable dollar amount (as determined under section 45Q(b)(1)) per metric ton of qualified carbon oxide (i) captured by the taxpayer using carbon capture equipment which is originally placed in service at a qualified facility on or after February 9, 2018, during the 12-year period beginning on the date the equipment was originally placed in service; (ii) disposed of by the taxpayer in secure geological storage; and (iii) neither used by the taxpayer as a tertiary injectant in a qualified enhanced oil or natural gas recovery project nor utilized in a manner described in section 45Q(f)(5).

Section 45Q(a)(4) allows a credit of the applicable dollar amount (as determined under section 45Q(b)(1)) per

Potential Business Relationships Needed for Carbon Capture Projects

- Equity investor and debt
- Tax equity investor
- Law Firm
  - Tax Opinion
  - Transaction documents
  - Environmental permitting
- EPC Contractor
- O&M Provider
- CO_2 Transporter
- CO_2 Offtaker (for Utilization, Injection or Disposal)
- Secure Geologic Storage Consultant
  - For MRV Plan development and EPA approval process
  - For ISO Standard certifications
- Insurance for 45Q qualification, recapture insurance, etc
- Developer to put the whole carbon capture project together
- Possibly others

Applicability/Effective Dates

45Q amendments enacted Feb 8, 2018

- Effective tax years after Dec 31, 2017

IRS Notice 2019-32
May 2, 2019

- Request for comments by July 4, 2019

IRS Rev. Proc. 2020-12
Feb 19, 2020
(Tax equity partnerships)
and IRS Notice 2020-12
Feb 19, 2020
(Beginning of construction)

IRS Proposed Regulations
June 2, 2020

- Request for comments by Aug 1, 2020
- Optional temporary rules, but only applicable to tax years after Feb 9, 2018

IRS Final Regulations [likely in 2021]

- Only applicable to tax years beginning after the final regulations are published (i.e. 2022)

45Q Legislative History

- Originally enacted on October 3, 2008:
  - $10/metric ton for EOR (now increased)
  - $20/metric ton for non-EOR (now increased)
  - Had to capture at least 500,000 metric tons/year (now reduced)
  - Expired once 75 mm metric tons of CO_2 were stored
  - Effective for CO_2 captured after October 3, 2008
- Amended on February 17, 2009:
  - CO_2 injected for EOR must go into "secure geologic storage"
  - Effective for CO_2 captured after February 17, 2009
- Amended on February 9, 2018:
  - "FUTURE Act" amendments were in Bipartisan Budget Act of 2018
  - Increased credit values, reduced minimum volume threshold, expanded to include CO and "utilization", eliminated nationwide aggregate limit of tax credits available going forward, etc
  - Effective to tax years beginning after December 31, 2017

45Q Legislative Proposals (2019-2020)

- Extend 45Q beginning of construction deadline:
  - 1 year: HR 5156 (Sewell); HR 7579 (Burgess); S 4041 (Cornyn)
  - 2 years: HR 2 (DeFazio – Moving Forward Act - passed the House); HR 7330 (Thompson – GREEN Act of 2020)
  - 5 years: HR 7516 (DeGette); S Amdt 1374 to S 2657 (Capito, Whitehouse, Barrasso & Cramer)
  - Eliminate deadline: HR 5883 (Schweikert)
- Direct Pay or increased efficiency by providing option to treat the 45Q credit as estimated tax:
  - At 85% level: HR 7330 (Thompson – GREEN Act); HR 2 (DeFazio – Moving Forward Act - passed the House)
    - NOTE - Election is made by regulations that IRS must later adopt
  - At 90% level: HR 7896 (Bergman - RECOUPS Act): NOTE - Election is made by statute, not regulation
  - At 100% level (no discount): HR xxxx [anticipated]
- Adjust minimum annual thresholds:
  - HR 5883 (Schweikert): decrease the annual minimum threshold level of 100,000 metric tons/year to 50,000 (& increase credit values for DAC plants)
  - HR xxxx [anticipated]: eliminate annual minimum threshold amounts of carbon oxide
- Other:
  - S 2263 (Hoeven – CO2 Regulatory Certainty Act): relaxing EOR/EGR and Secure Geologic Storage definitions
  - S 3032 (Bennet – Renewable Energy Transferability Act): enhanced transferability of 45Q credit to numerous parties
  - S 1288 (Wyden - Clean Energy for America Act): erasing power plants from 45Q and eliminating sections 43 and 48A and 48B, and establishing new production and investment credits under new 45T and 48D as well as Clean Energy Bonds
  - HR 7781 (Omar – End Polluter Welfare Act):
    - Eliminate the 45Q program by not allowing credits for Qualified CO_2 captured after the date the bill is enacted
    - Adopt exemption to taxpayer privacy rules and require IRS to report who received how much 45Q credits during the program

Table of Contents of 45Q statute, IRS regulations, and IRS guidance

Significant 45Q-Related Topics	45Q statute section	IRS regulation section (or guidance)
Qualified Carbon Oxide	45Q(c)	1.45Q-2(a) and (b)
Carbon Capture Equipment	45Q(b)(2)	1.45Q-2(c) and 1.45Q-1(g)
Qualified Facility	45Q(d) and (f)(6)	1.45Q-2(d), (e), (f), and (g)
Beginning of Construction		See IRS Notice 2020-12
Utilization	45Q(f)(5)	1.45Q-4
Secure Geologic Storage	45Q(f)(2)	1.45Q-3
Tertiary Injectant and Qualified EOR/EGR Project	45Q(e)	1.45Q-2(h)
Who can claim the credit	45Q(f)(3)	1.45Q-1(h)
Tax Equity Partnership safe harbor		See IRS Rev. Proc. 2020-12
Recapture	45Q(f)(4)	1.45Q-5
Amount of Credit	45Q(a), (b)(1), and (f)(7)	1.45Q-1(a), (b), (c), (d), and (e)
Phase out of old credits	45Q(g)	1.45Q-1(f)

Contact.

ktracy@elysian.cc

BREAK

U.S. DEPARTMENT OF ENERGY
Office of Fossil Energy
USEA
United States Energy Association
GLOBAL CCS INSTITUTE

THE GULF COAST ENVIRONMENT: INDUSTRY AND CO2 SOURCES, GEOLOGY, AND PIPELINES

ELIZABETH ABRAMSON, *RESEARCH ANALYST, GREAT PLAINS INSTITUTE*
BRIAN SNYDER, *ASSISTANT PROFESSOR, DEPARTMENT OF ENVIRONMENTAL SERVICES, LSU*
DAN COLE, *DENBURY, VICE PRESIDENT OF COMMERCIAL DEVELOPMENT AND GOVERNMENT RELATIONS*

U.S. DEPARTMENT OF ENERGY
Office of Fossil Energy
USEA
United States Energy Association
GLOBAL CCS INSTITUTE

Regional Carbon Capture and Transport Opportunities for Storage in Louisiana

November 17, 2020

Elizabeth Abramson
Research Analyst
Great Plains Institute

GREAT PLAINS INSTITUTE | Better Energy. Better World.

Regional CO_2 Transport Infrastructure Study

Study Components

1. Identify near-term opportunities for CO_2 capture retrofit
2. Locate areas of CO_2 storage and use
3. Model optimized CO_2 transport infrastructure to maximize capture and storage

Primary Partners:

REGIONAL CARBON CAPTURE DEPLOYMENT INITIATIVE

Los Alamos NATIONAL LABORATORY EST. 1943

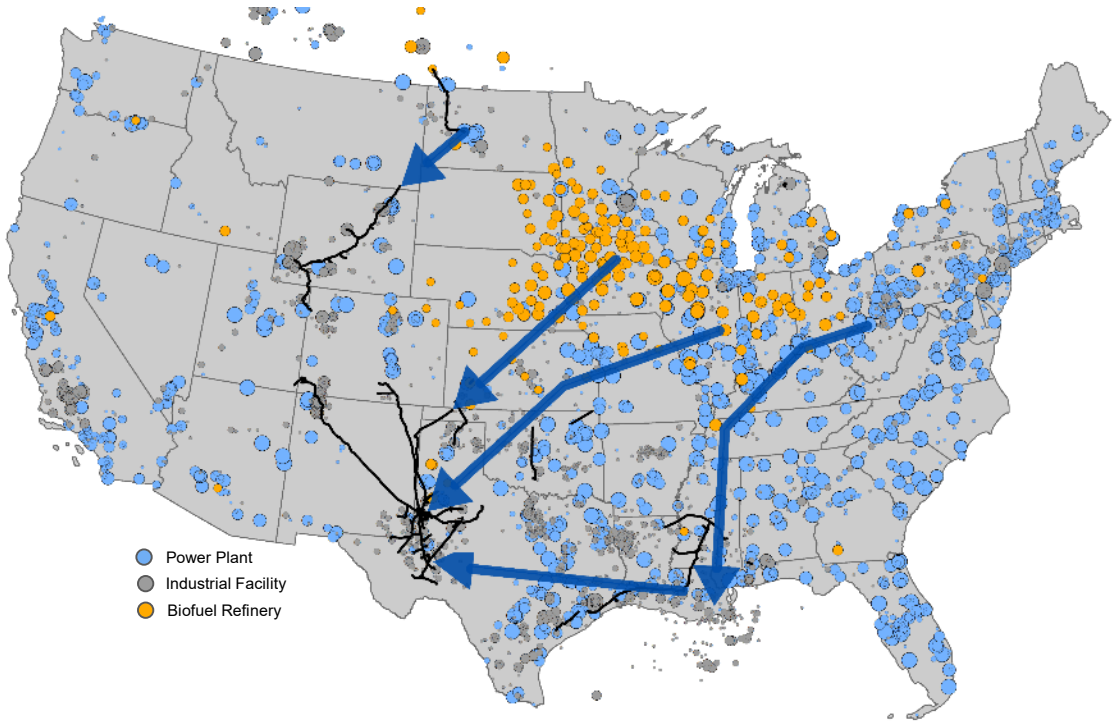
MONTANA STATE UNIVERSITY

B2E2 BROWN BROTHERS ENERGY & ENVIRONMENT

INDIANA UNIVERSITY

Stanford University

Initial CO_2 Corridor Scoping



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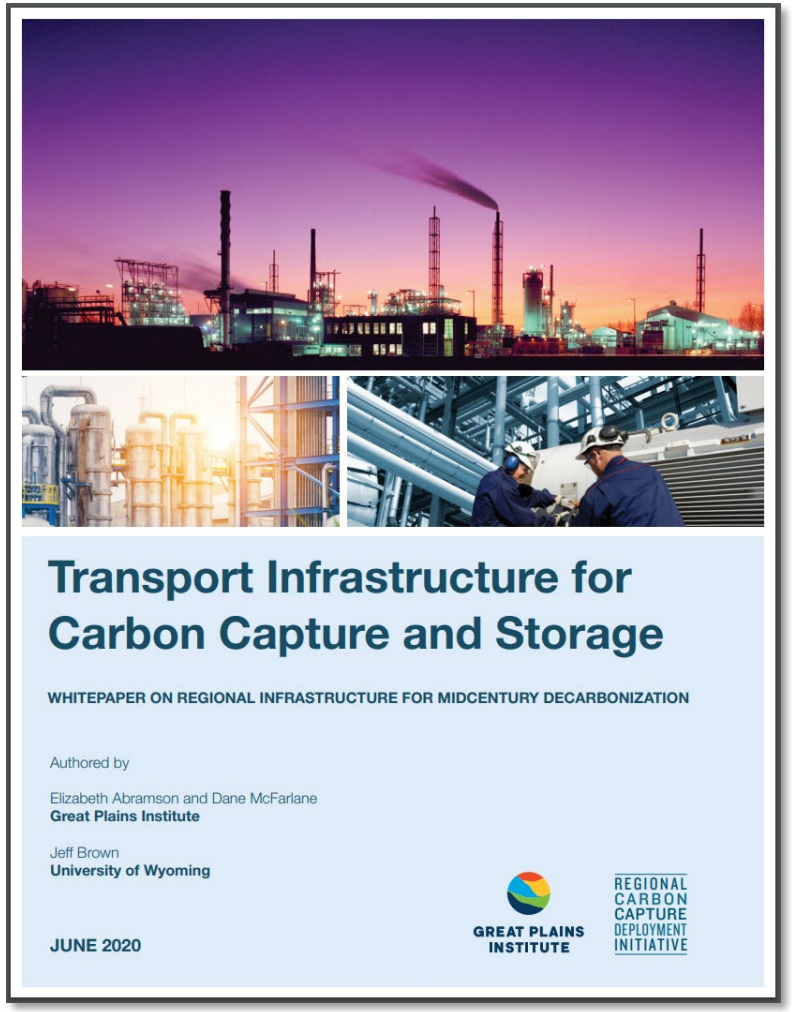
Analytical Report

Published June 30, 2020



Transport Infrastructure for Carbon Capture and Storage

WHITEPAPER ON REGIONAL INFRASTRUCTURE FOR MIDCENTURY DECARBONIZATION

Authored by

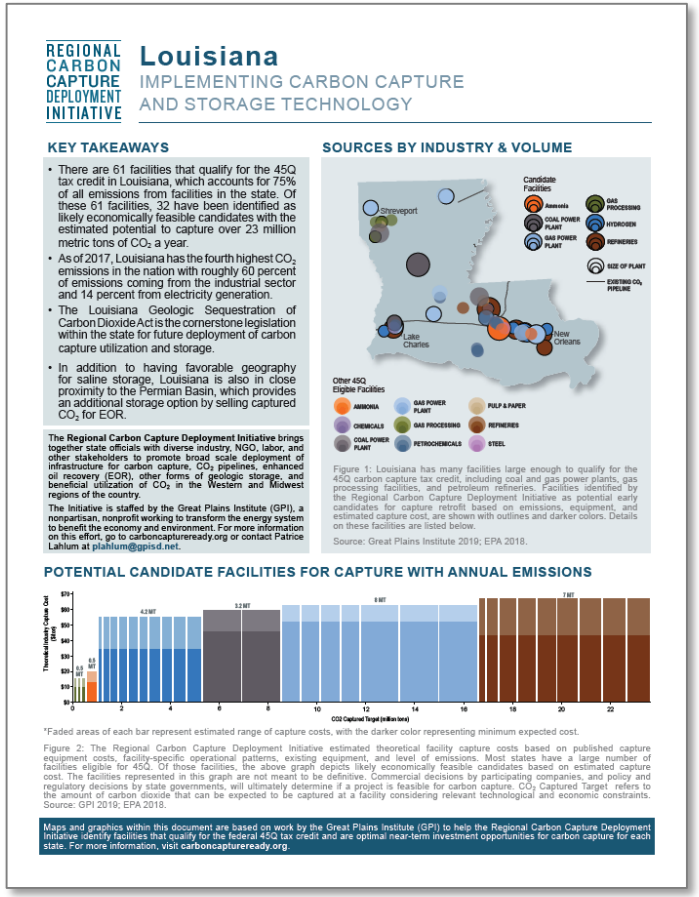
Elizabeth Abramson and Dane McFarlane
Great Plains Institute

Jeff Brown
University of Wyoming

JUNE 2020

GREAT PLAINS INSTITUTE

REGIONAL CARBON CAPTURE DEPLOYMENT INITIATIVE



REGIONAL CARBON CAPTURE DEPLOYMENT INITIATIVE

Louisiana

IMPLEMENTING CARBON CAPTURE AND STORAGE TECHNOLOGY

KEY TAKEAWAYS

- There are 61 facilities that qualify for the 45Q tax credit in Louisiana, which accounts for 75% of all emissions from facilities in the state. Of these 61 facilities, 32 have been identified as likely economically feasible candidates with the estimated potential to capture over 23 million metric tons of CO_2 a year.
- As of 2017, Louisiana has the fourth highest CO_2 emissions in the nation with roughly 60 percent of emissions coming from the industrial sector and 14 percent from electricity generation.
- The Louisiana Geologic Sequestration of Carbon Dioxide Act is the cornerstone legislation within the state for future deployment of carbon capture utilization and storage.
- In addition to having favorable geography for saline storage, Louisiana is also in close proximity to the Permian Basin, which provides an additional storage option by selling captured CO_2 for EOR.

The Regional Carbon Capture Deployment Initiative brings together state officials with diverse industry, NGO, labor, and other stakeholders to promote broad scale deployment of infrastructure for carbon capture, CO_2 pipelines, enhanced oil recovery (EOR), other forms of geologic storage, and beneficial utilization of CO_2 in the Western and Midwest regions of the country.

The Initiative is staffed by the Great Plains Institute (GPI), a nonpartisan, nonprofit working to transform the energy system to benefit the economy and environment. For more information on this effort, go to carboncaptureready.org or contact Patrice Lahlum at plahlum@gpisd.net.

SOURCES BY INDUSTRY & VOLUME

Figure 1: Louisiana has many facilities large enough to qualify for the 45Q carbon capture tax credit, including coal and gas power plants, gas processing facilities, and petroleum refineries. Facilities identified by the Regional Carbon Capture Deployment Initiative as potential early candidates for capture retrofit based on emissions, equipment, and estimated capture cost, are shown with outlines and darker colors. Details on these facilities are listed below.

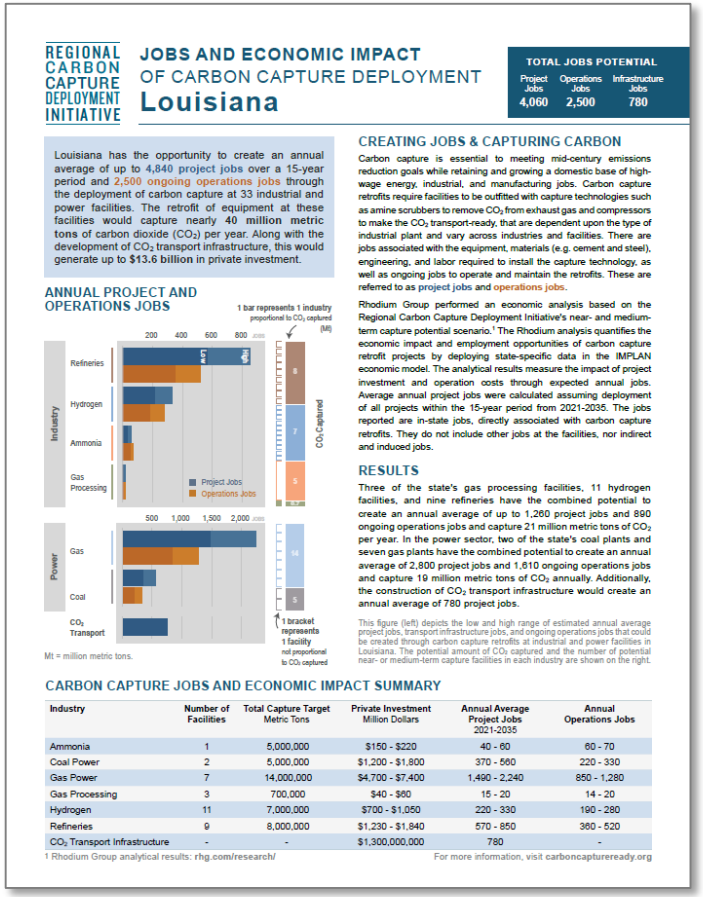
Source: Great Plains Institute 2019; EPA 2018.

POTENTIAL CANDIDATE FACILITIES FOR CAPTURE WITH ANNUAL EMISSIONS

*Faded areas of each bar represent estimated range of capture costs, with the darker color representing minimum expected cost.

Figure 2: The Regional Carbon Capture Deployment Initiative estimated theoretical facility capture costs based on published capture equipment costs, facility-specific operational patterns, existing equipment, and level of emissions. Most states have a large number of facilities eligible for 45Q. Of those facilities, the above graph depicts likely economically feasible candidates based on estimated capture cost. The facilities represented in this graph are not meant to be definitive. Commercial decisions by participating companies, and policy and regulatory decisions by state governments, will ultimately determine if a project is feasible for carbon capture. CO_2 Captured Target refers to the amount of carbon dioxide that can be expected to be captured at a facility considering relevant technological and economic constraints. Source: GPI 2019; EPA 2018.

Maps and graphics within this document are based on work by the Great Plains Institute (GPI) to help the Regional Carbon Capture Deployment Initiative identify facilities that qualify for the federal 45Q tax credit and are optimal near-term investment opportunities for carbon capture for each state. For more information, visit carboncaptureready.org.



REGIONAL CARBON CAPTURE DEPLOYMENT INITIATIVE

JOBS AND ECONOMIC IMPACT OF CARBON CAPTURE DEPLOYMENT Louisiana

TOTAL JOBS POTENTIAL

Project Jobs	Operations Jobs	Infrastructure Jobs
4,060	2,500	780

Louisiana has the opportunity to create an annual average of up to 4,840 project jobs over a 15-year period and 2,500 ongoing operations jobs through the deployment of carbon capture at 33 industrial and power facilities. The retrofit of equipment at these facilities would capture nearly 40 million metric tons of carbon dioxide (CO_2) per year. Along with the development of CO_2 transport infrastructure, this would generate up to $13.6 billion in private investment.

ANNUAL PROJECT AND OPERATIONS JOBS

Mt = million metric tons.

CREATING JOBS & CAPTURING CARBON

Carbon capture is essential to meeting mid-century emissions reduction goals while retaining and growing a domestic base of high-wage energy, industrial, and manufacturing jobs. Carbon capture retrofits require facilities to be outfitted with capture technologies such as amine scrubbers to remove CO_2 from exhaust gas and compressors to make the CO_2 transport-ready, that are dependent upon the type of industrial plant and vary across industries and facilities. There are jobs associated with the equipment, materials (e.g. cement and steel), engineering, and labor required to install the capture technology, as well as ongoing jobs to operate and maintain the retrofits. These are referred to as project jobs and operations jobs.

Rhodium Group performed an economic analysis based on the Regional Carbon Capture Deployment Initiative's near- and medium-term capture potential scenario.[1] The Rhodium analysis quantifies the economic impact and employment opportunities of carbon capture retrofit projects by deploying state-specific data in the IMPLAN economic model. The analytical results measure the impact of project investment and operation costs through expected annual jobs. Average annual project jobs were calculated assuming deployment of all projects within the 15-year period from 2021-2035. The jobs reported are in-state jobs, directly associated with carbon capture retrofits. They do not include other jobs at the facilities, nor indirect and induced jobs.

RESULTS

Three of the state's gas processing facilities, 11 hydrogen facilities, and nine refineries have the combined potential to create an annual average of up to 1,260 project jobs and 890 ongoing operations jobs and capture 21 million metric tons of CO_2 per year. In the power sector, two of the state's coal plants and seven gas plants have the combined potential to create an annual average of 2,800 project jobs and 1,610 ongoing operations jobs and capture 19 million metric tons of CO_2 annually. Additionally, the construction of CO_2 transport infrastructure would create an annual average of 780 project jobs.

This figure (left) depicts the low and high range of estimated annual average project jobs, transport infrastructure jobs, and ongoing operations jobs that could be created through carbon capture retrofits at industrial and power facilities in Louisiana. The potential amount of CO_2 captured and the number of potential near- or medium-term capture facilities in each industry are shown on the right.

CARBON CAPTURE JOBS AND ECONOMIC IMPACT SUMMARY

Industry	Number of Facilities	Total Capture Target Metric Tons	Private Investment Million Dollars	Annual Average Project Jobs 2021-2035	Annual Operations Jobs
Ammonia	1	5,000,000	$150 - $220	40 - 60	60 - 70
Coal Power	2	5,000,000	$1,200 - $1,800	370 - 560	220 - 330
Gas Power	7	14,000,000	$4,700 - $7,400	1,490 - 2,240	850 - 1,280
Gas Processing	3	700,000	$40 - $60	15 - 20	14 - 20
Hydrogen	11	7,000,000	$700 - $1,050	220 - 330	190 - 280
Refineries	9	8,000,000	$1,230 - $1,840	570 - 850	360 - 520
CO_2 Transport Infrastructure	-	-	$1,300,000,000	780	-

1 Rhodium Group analytical results: rhg.com/research/

For more information, visit carboncaptureready.org

Download the paper at:

carboncaptureready.org/analysis

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CO_2 Capture Opportunities: Industrial and Power Facilities

Section 45Q
Tax Credit for CO_2 Storage

Geologic Saline:	$50 / ton
EOR Storage:	$35 / ton

Minimum Capture Thresholds

Industrial Facility:	100 thousand tons CO_2
Power Plants:	500 thousand tons CO_2

Near- and Medium-Term Screening Criteria:

- 45Q Eligibility
- Operational patterns
- Expected life
- Right-size capture equipment to specific units within each facility

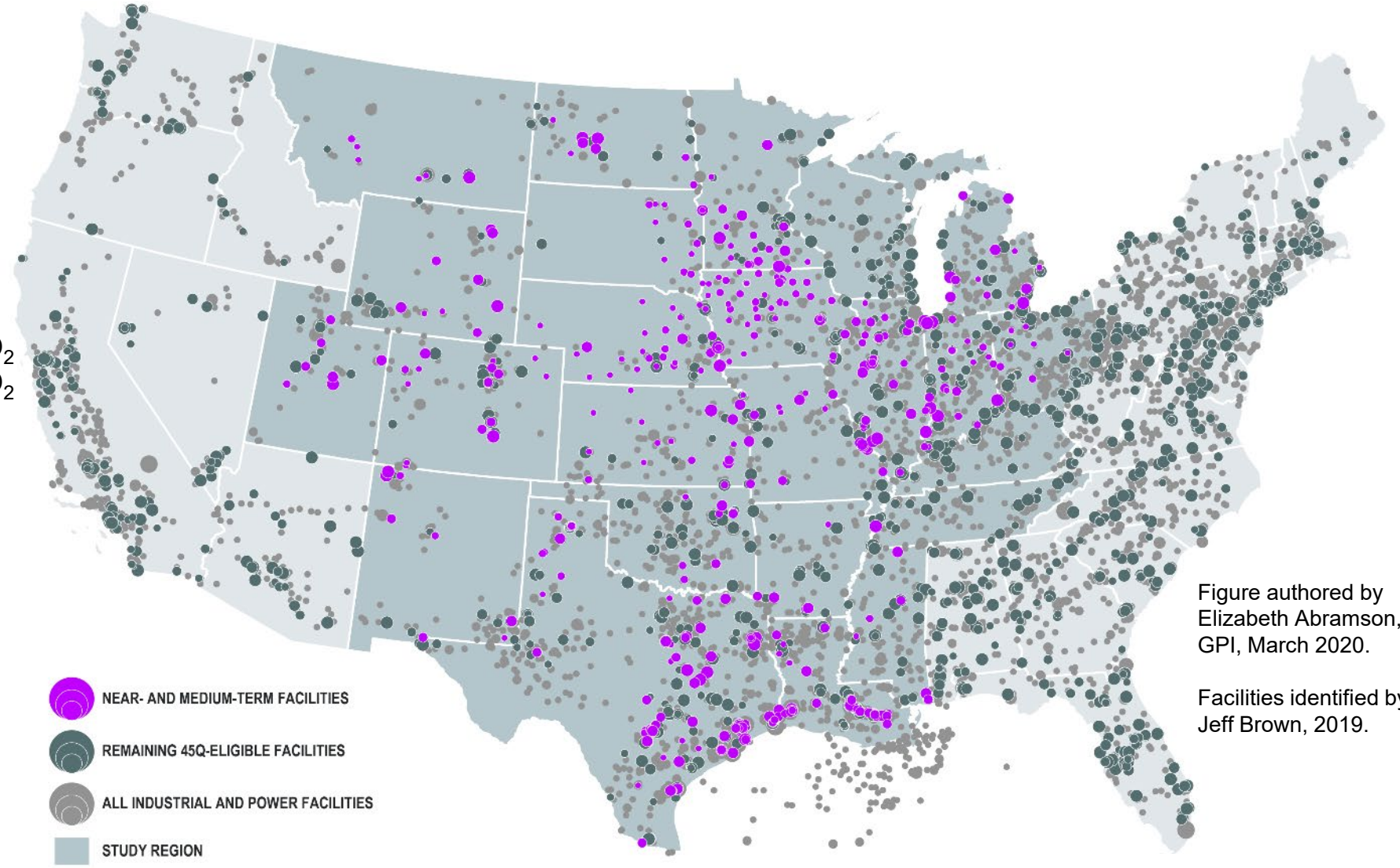

Figure authored by Elizabeth Abramson, GPI, March 2020.

Facilities identified by Jeff Brown, 2019.

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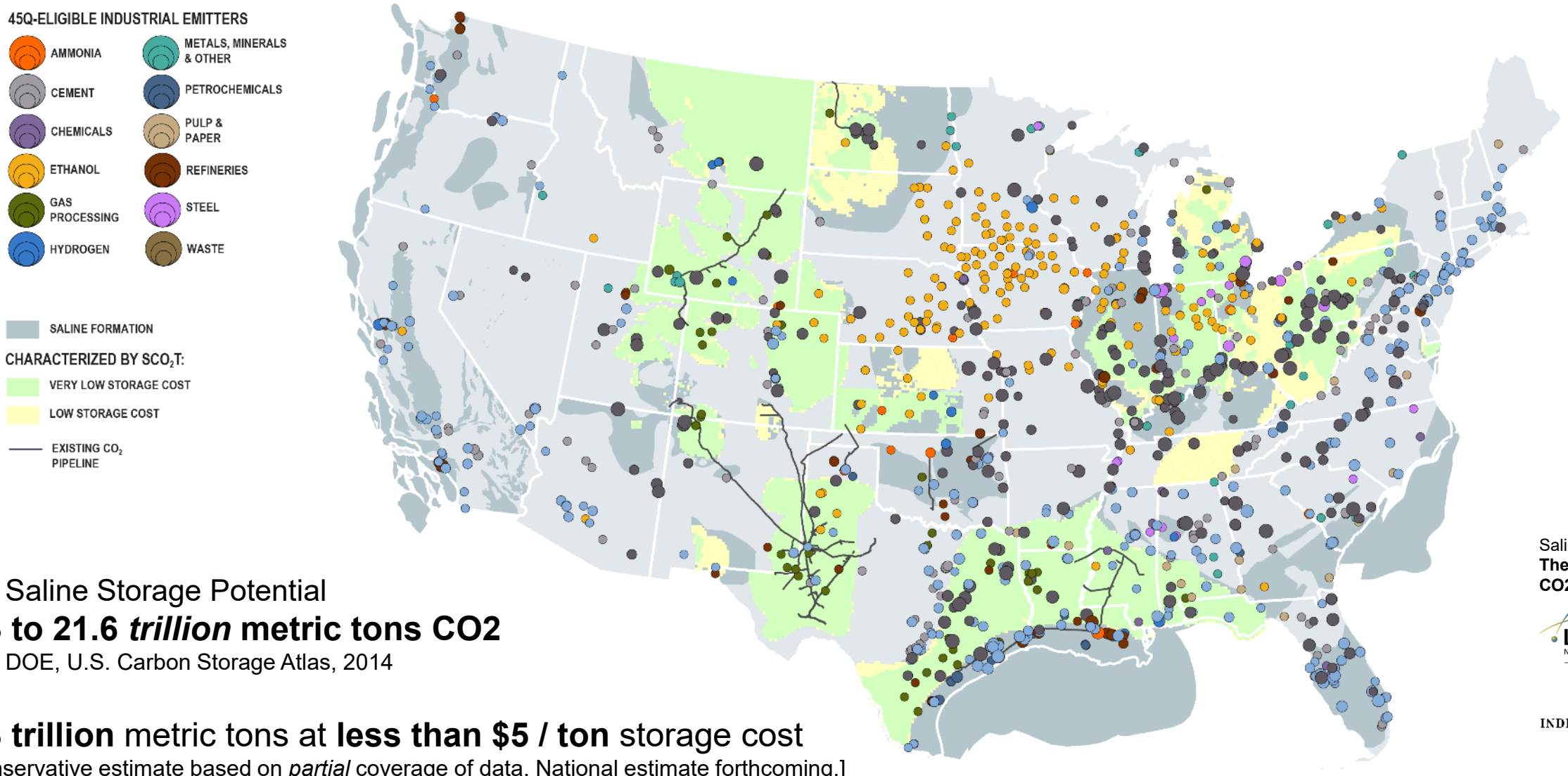
CO_2 Storage in Saline Formations & Petroleum Basins



US Saline Storage Potential

8.3 to 21.6 *trillion* metric tons CO2

U.S. DOE, U.S. Carbon Storage Atlas, 2014

1.8 trillion metric tons at **less than $5 / ton** storage cost

[Conservative estimate based on *partial* coverage of data. National estimate forthcoming.]

Los Alamos National Lab and Indiana Geological Survey, SCO2T Model, 2020

Saline data via **The Sequestration of CO2 Tool (SCO2T)**

Los Alamos NATIONAL LABORATORY EST. 1943

INDIANA UNIVERSITY

Figure authored by Elizabeth Abramson, GPI, March 2020

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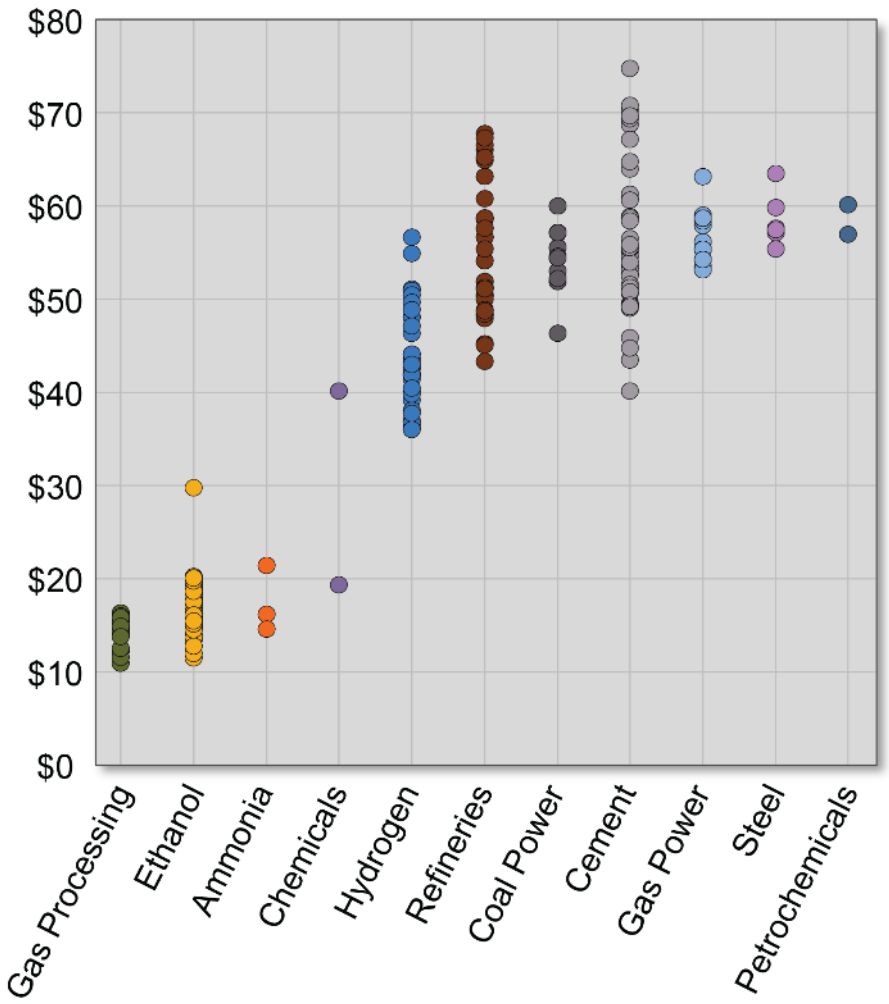
Estimated Cost of Capture per Industry for Near-Term Facilities in Study Area



Industry	# of Facilities	Optimized Capture (mmt/year)	Average Estimated Cost $/ton
Ethanol	150	50.6	$17
Cement	45	32.7	$56
Refineries	38	26.5	$56
Steel	6	14.6	$59
Hydrogen	34	14.4	$44
Gas Processing	20	4.5	$14
Petrochemicals	2	1.7	$59
Ammonia	3	0.9	$17
Chemicals	2	0.7	$30
Coal Power Plant	58	143.4	$56
Gas Power Plant	60	67.9	$57
Grand Total	**418**	**357.8**	**$39**

Source: Jeff Brown, 2019

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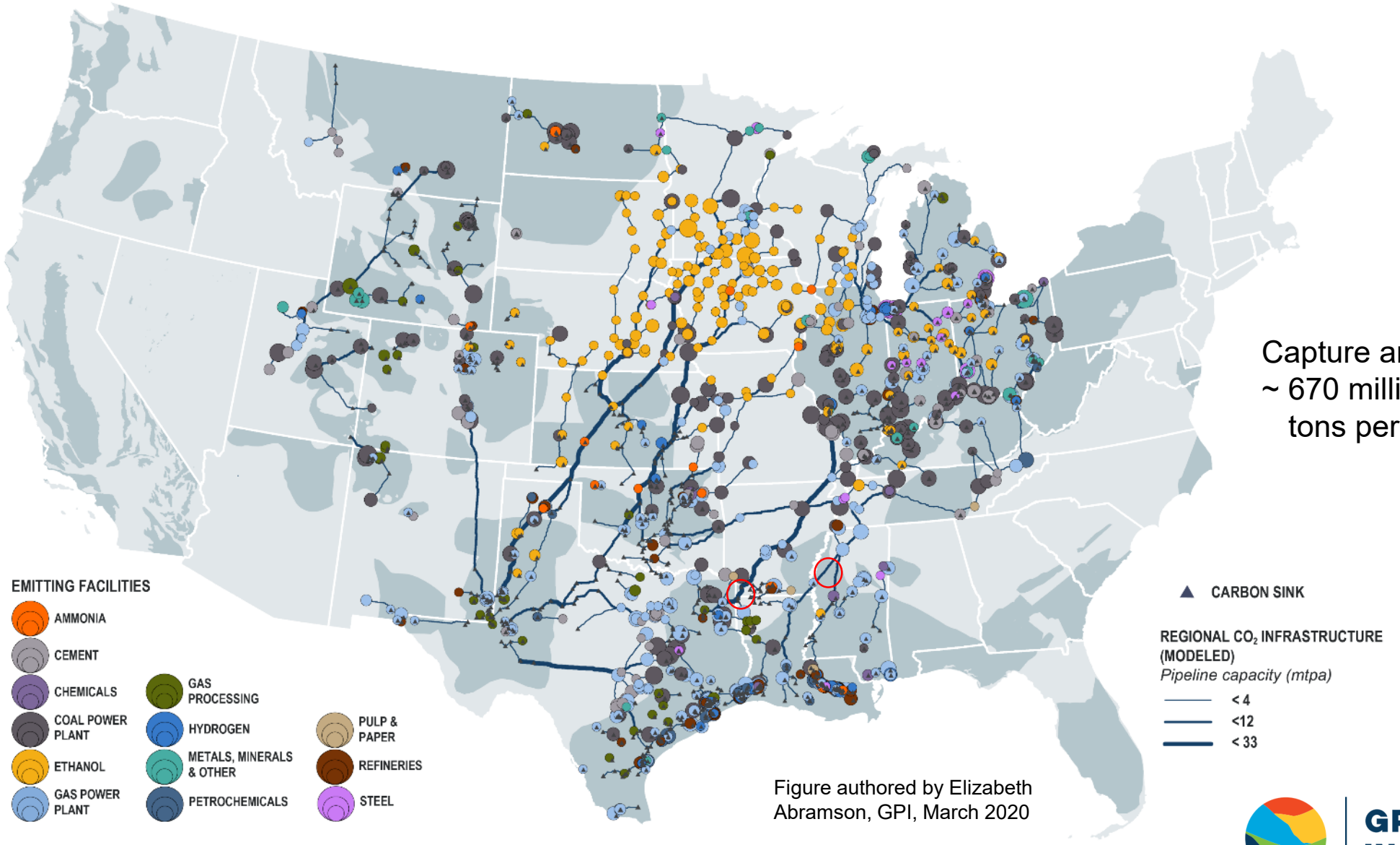
Midcentury: Long-term Economy-Wide Deployment
Expanded storage in saline formations and petroleum basins



Capture and storage:
~ 670 million metric tons per year

Figure authored by Elizabeth Abramson, GPI, March 2020

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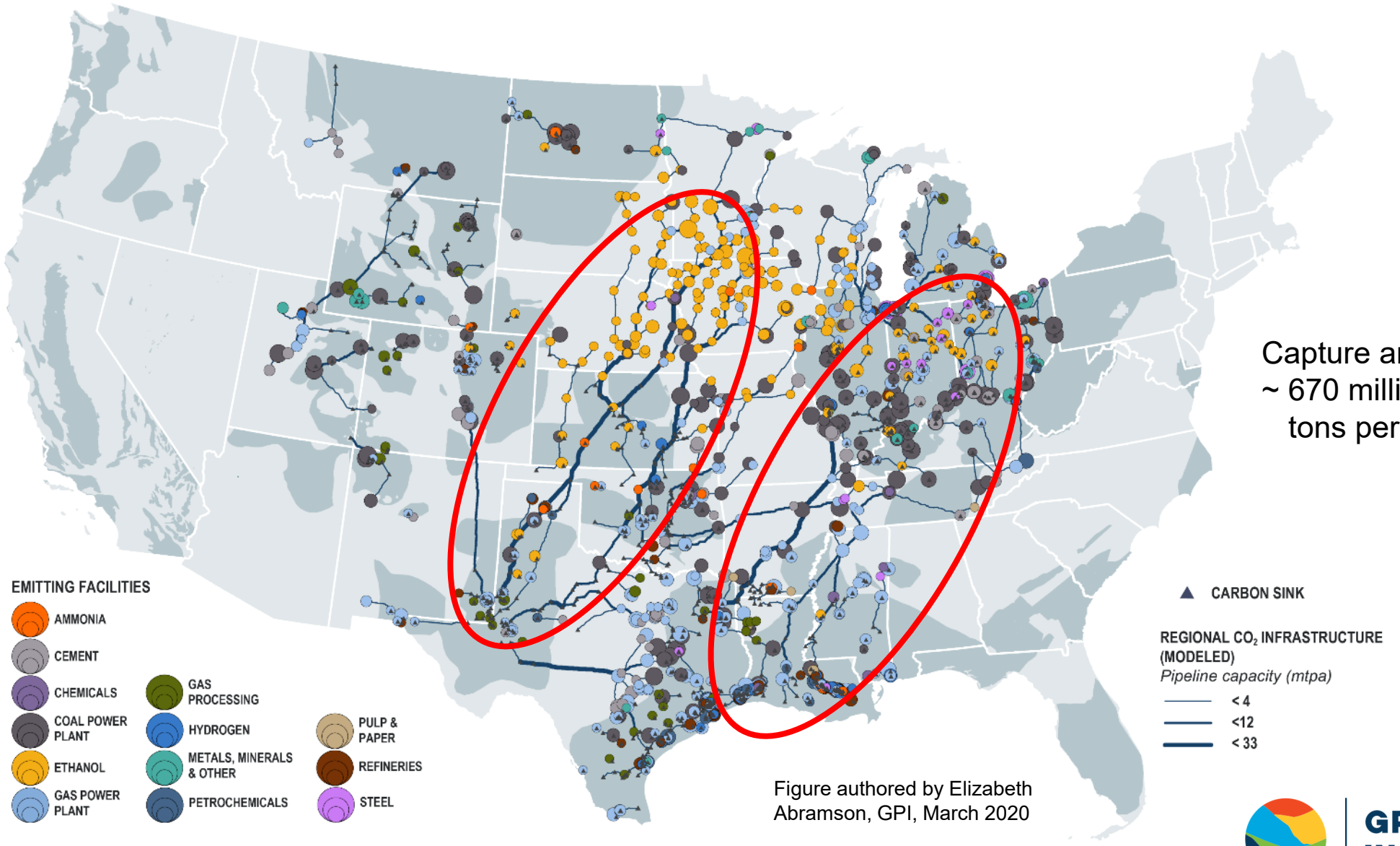
Expanded storage in saline formations and petroleum basins



Capture and storage:
~ 670 million metric tons per year

Figure authored by Elizabeth Abramson, GPI, March 2020

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Shared CO_2 Transport Infrastructure: Beneficial Economies of Scale

Higher capacity achieves lower costs per ton

Infrastructure investment by capacity
$ per inch-mile

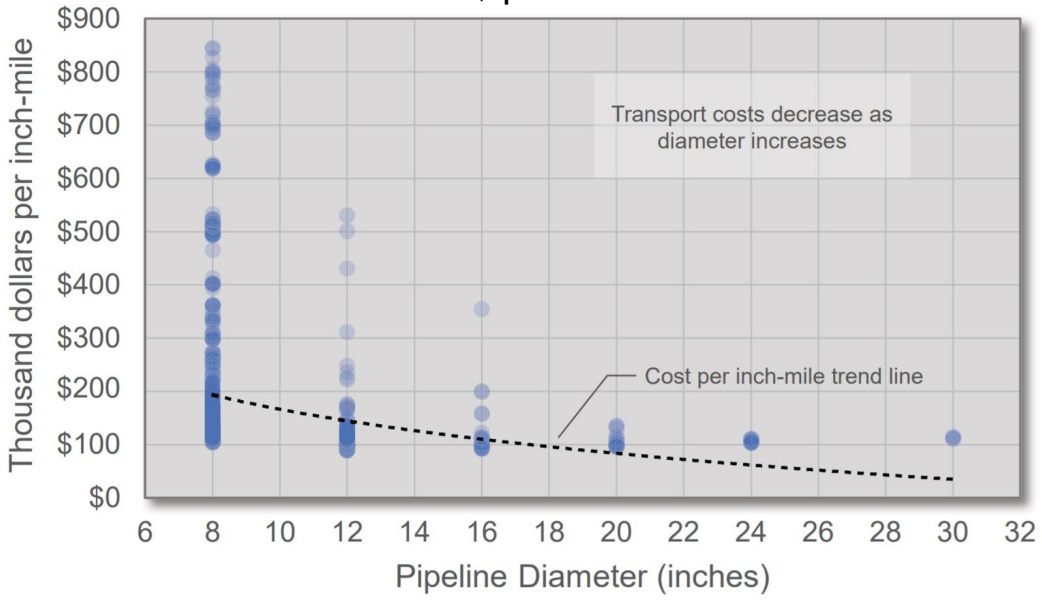

Figure authored by GPI based on calculations performed using the NETL CO_2 Transport Cost Model.

Transport tariff by capacity
$ per ton

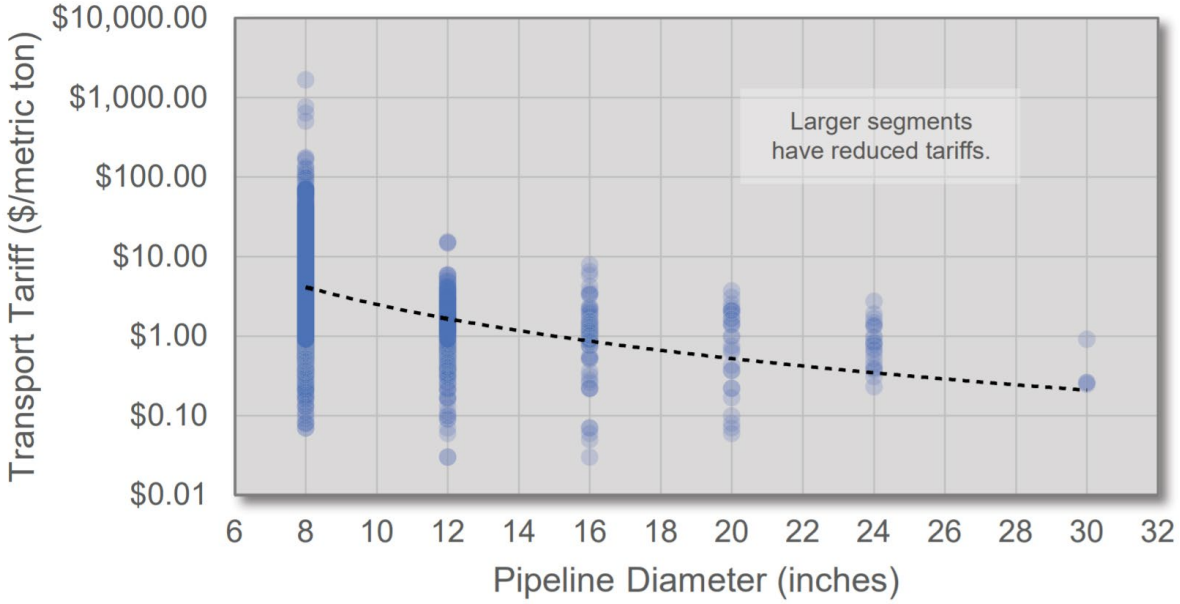

Figure authored by GPI based on calculations performed using the NETL CO_2 Transport Cost Model, as modified by McFarlane, Dubois, and Edwards, 2018.

Investment by owner/operator → **Cost to user/customer**

Calculated with:

NATIONAL ENERGY TECHNOLOGY LABORATORY CO_2 Transport Cost Model

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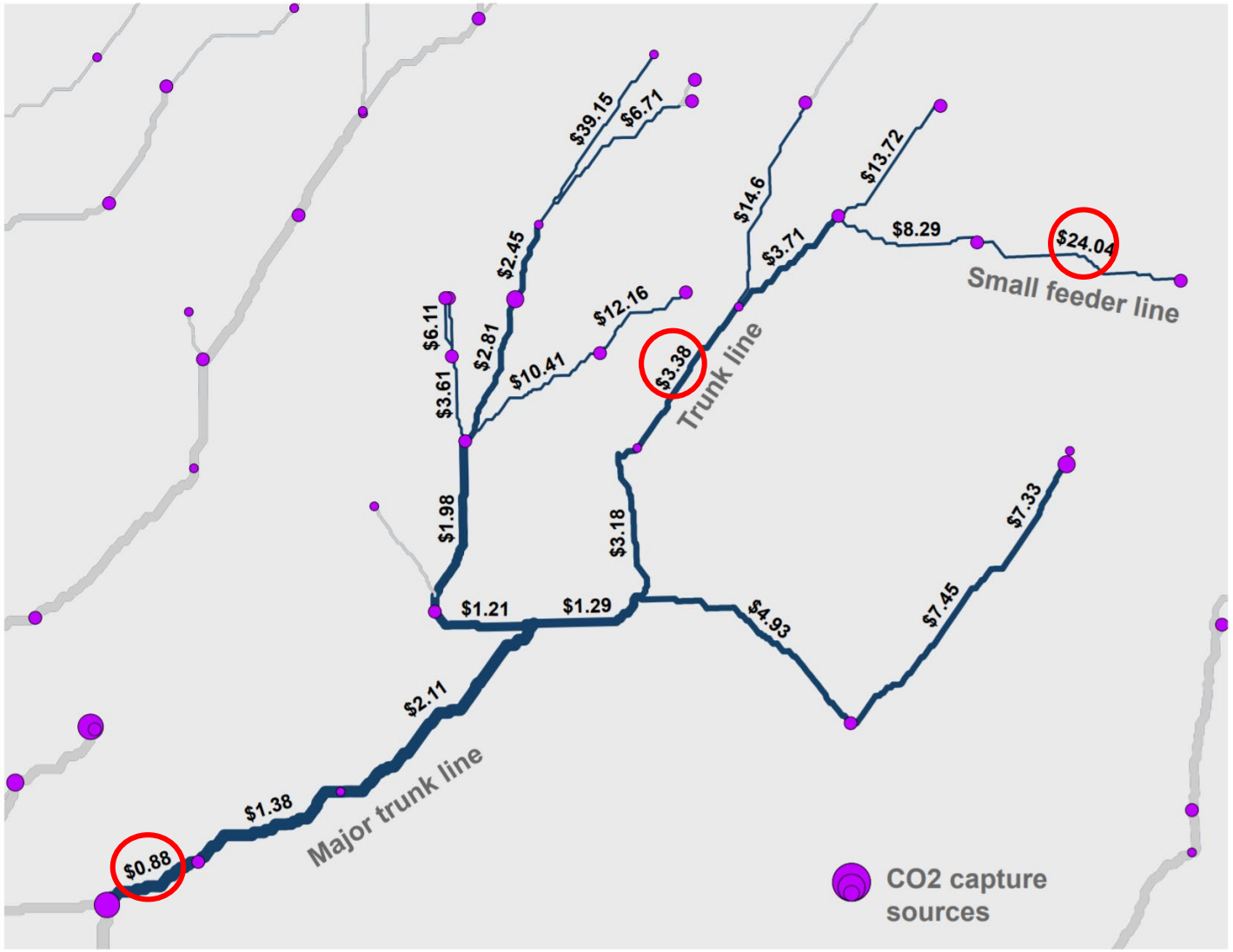
Shared CO_2 Transport Infrastructure: Beneficial Economies of Scale



Example network section from the Near- and Medium-Term Scenario. Figure authored by GPI based on results from the SimCCS model, with cost estimates calculated by the NETL CO_2 Transport Cost model.

Small feeder lines have a higher per-ton cost because they deliver less CO_2.

Shared high-capacity transport segments achieve beneficial economies of scale.

Customers generally pay a transport tariff ($/ton) based on the route their CO_2 product takes through the transport network.

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Midcentury Scenario:
Relative transport cost of network segments

Large trunk lines achieve best economies of scale and lowest per-ton transport cost.

Small-feeder lines to individual facilities require less capital but have higher per-ton cost.

Cost Range	Length (miles)
Very Low	17,488
Low to Moderate	8,284
Moderate to High	4,027

Figure authored by Elizabeth Abramson, GPI, March 2020

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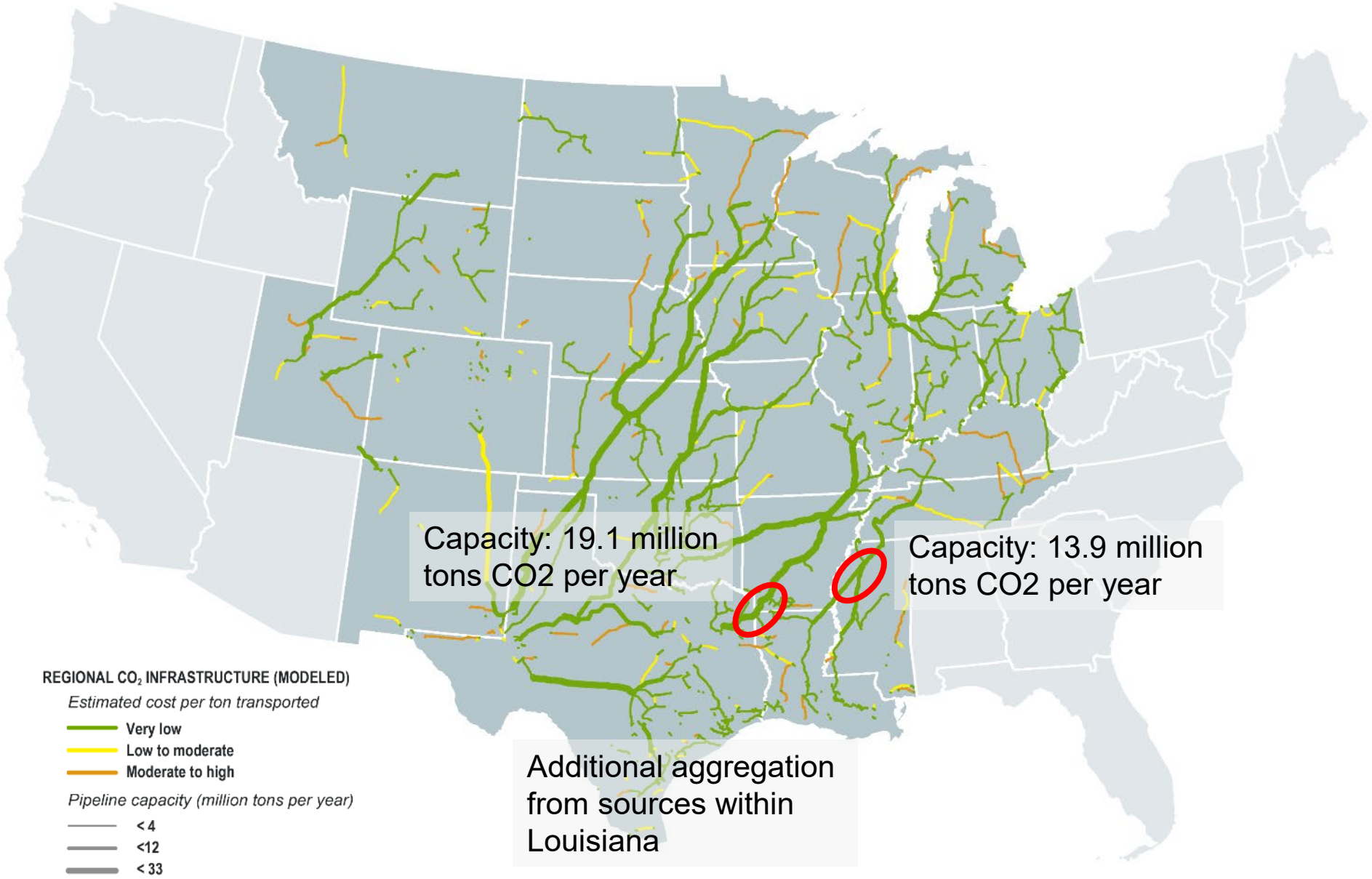
Midcentury Scenario:
Relative transport cost of network segments



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Cost Range	Length (miles)
Very Low	17,488
Low to Moderate	8,284
Moderate to High	4,027

Figure authored by Elizabeth Abramson, GPI, March 2020

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Planning for Near-Term versus Long-term Economy-Wide Deployment

Economies of scale benefit higher capacity for CO_2 delivery

Regional infrastructure can store more CO_2 at a lower cost

Long term planning results in more CO_2 stored, smaller land use, and lower marginal cost

Scenario	CO_2 Stored	Land Use	Capital Investment	Project Labor Investment	Annual O&M Spending
Near- and Medium-Term	**281** million metric tons	**29,710** miles	**$16.6** billion	**$14.3** billion	**$252** million
Midcentury	**669** million metric tons	**29,922** miles	**$19.3** billion	**$15.3** billion	**$254** million
Midcentury scenario **increase over Near- and Medium-Term** scenario	**x 2.38** more CO_2 stored	**+0.7%**	**16.3%**	**7.0%**	**0.8%**

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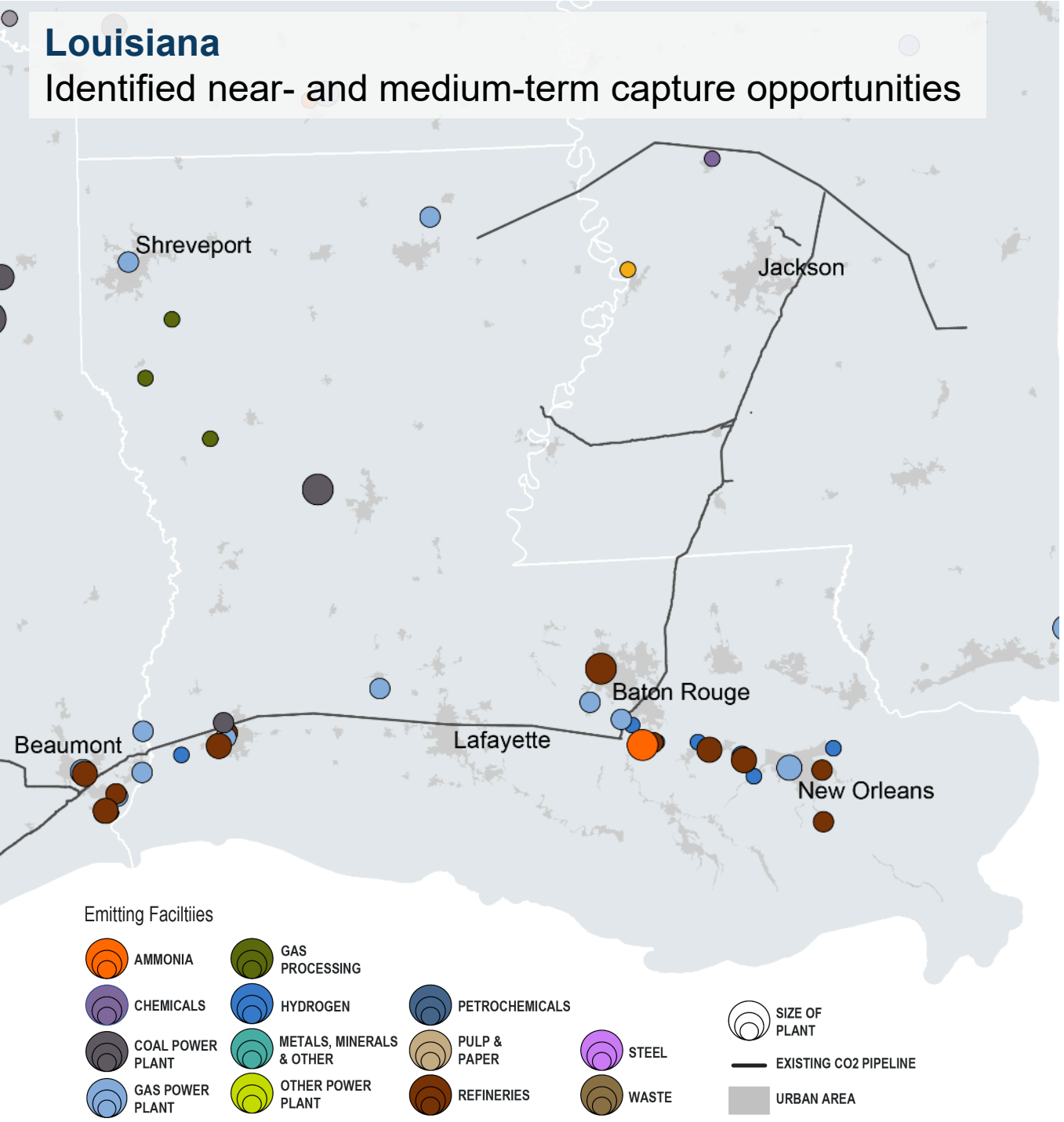
Louisiana

Identified near- and medium-term capture opportunities



Industry	CO2 Captured Target (million metric tons CO2)	Total Louisiana Facility CO2 Emissions (million metric tons CO2)	Share of Industry Emissions Captured
Ammonia	0.5	8.9	5.5%
Chemicals	-	3.8	-
Coal Power Plant	3.2	18.5	17.3%
Gas Power Plant	8.0	26.0	30.8%
Gas Processing	0.5	11.9	4.0%
Hydrogen	4.2	7.6	55.1%
Metals, Minerals & Other	-	2.4	-
Other Power Plant	-	2.1	-
Petrochemicals	-	14.2	-
Pulp & Paper	0.0	2.8	-
Refineries	7.0	32.1	21.7%
Steel	-	0.1	-
Waste	-	0.0	-
Grand Total	**23.3 MMT**	**130.5 MMT**	**18%**

Source: EPA GHGRP 2018; GPI 2019

Near- and Medium-Term Opportunities

Economically feasible with today's technology, 45Q tax credit, and assumed $10-$15 / ton pipeline transport tariff, for sale to EOR at $20 / ton.

Source: Regional Carbon Capture Deployment Initiative, GPI, and Jeff Brown. 2019.

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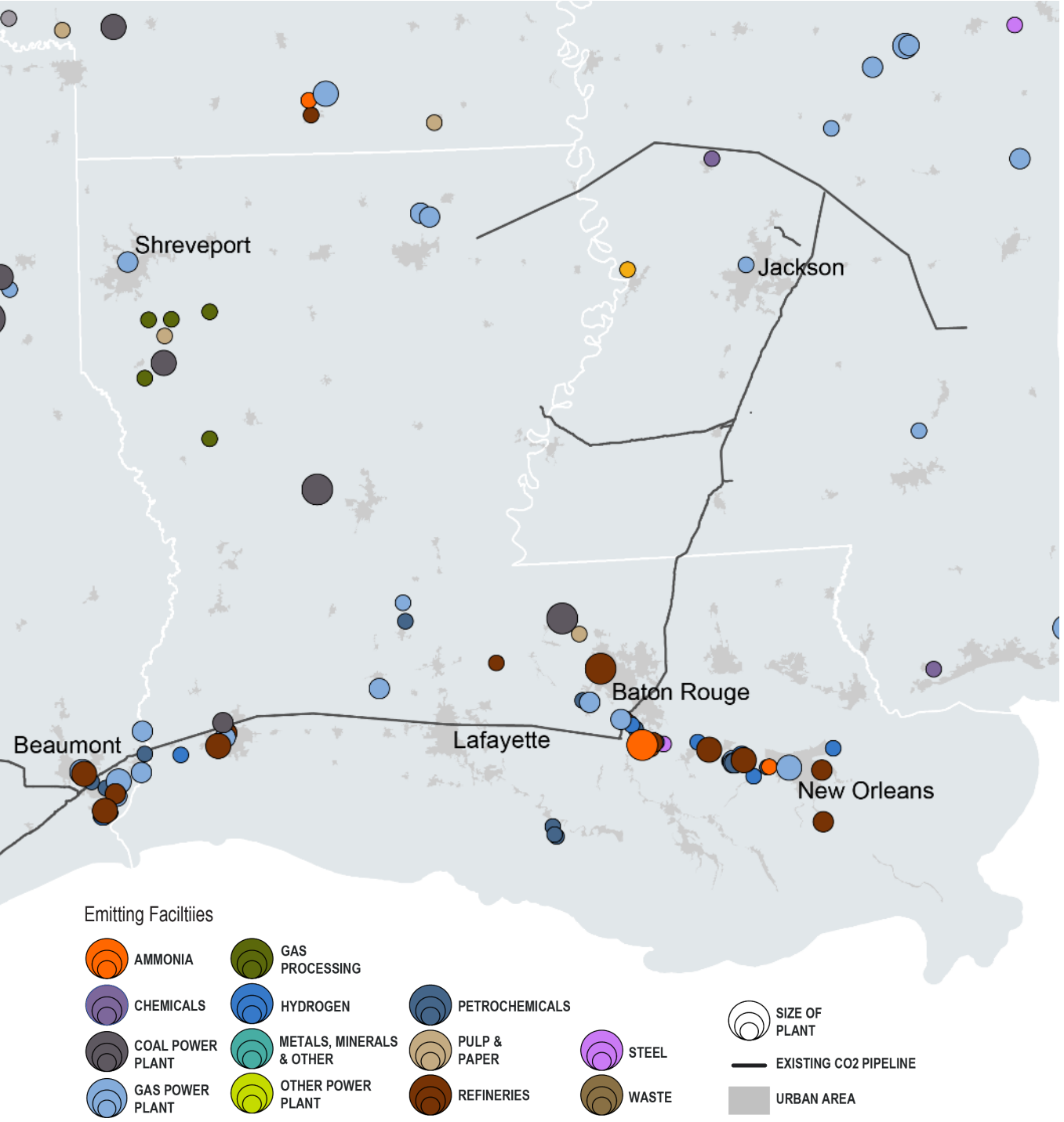
45Q-Qualifying Power and Industrial Sources of CO2 in Louisiana



Industry	# of 45Q Qualifying Facilities	45Q Qualifying Emissions (million metric tons CO2)	Total # of Facilities in Louisiana	Total Facility Emissions in Louisiana (million metric tons CO2)
Ammonia	4	8.9	4	8.9
Chemicals	1	0.3	31	3.8
Coal Power Plant	4	18.5	4	18.5
Gas Power Plant	12	23.2	26	26.0
Gas Processing	4	0.8	227	11.9
Hydrogen	10	7.4	13	7.6
Metals, Minerals & Other	-	-	25	2.4
Other Power Plant	-	-	1	2.1
Petrochemicals	12	10.2	20	14.2
Pulp & Paper	2	1.4	9	2.8
Refineries	11	30.7	15	32.1
Steel	1	0.1	1	0.1
Waste	-	-	25	-
Grand Total	**61**	**101.4 MMT**	**401**	**130.5 MMT**

MMT: million metric tons CO2

Source: EPA GHGRP 2018

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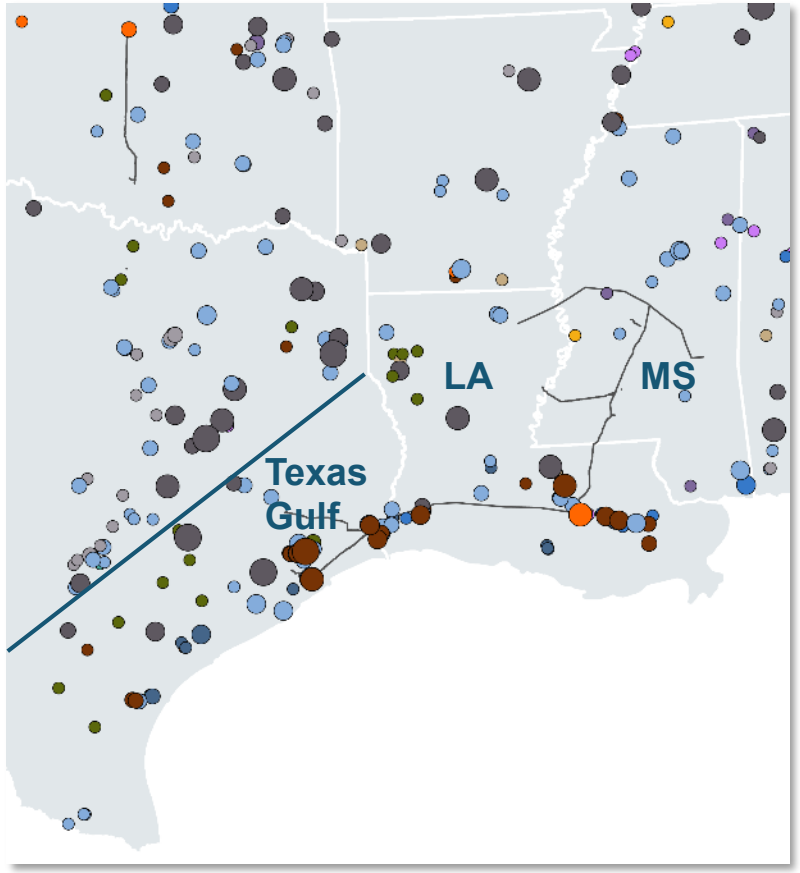
Louisiana & Gulf Coast

Identified 45Q-qualifying industrial & power facilities

		Near- to Medium-Term Candidates		45Q-Qualifying Facilities	
Region	**Industry**	**Number of Candidates**	**CO2 Emissions** (million metric tons)	**Number of Candidates**	**CO2 Emissions** (million metric tons)
Louisiana	Ammonia	1	6.3	4	8.9
	Chemicals	-	-	1	0.3
	Coal Power Plant	2	9.2	4	18.5
	Gas Power Plant	7	16.2	12	23.2
	Gas Processing	3	0.4	5	0.9
	Hydrogen	10	7.4	10	7.4
	Petrochemicals	-	-	12	10.2
	Pulp & Paper	-	-	2	1.4
	Refineries	9	29.5	11	30.7
	Steel	-	-	1	0.1
	Total	**32**	**69**	**62**	**101.5**
Mississippi	Chemicals	1	1.0	3	2.3
	Ethanol	1	0.2	1	0.2
	Gas Power Plant	3	8.9	13	24.5
	Hydrogen	1	3.7	1	3.7
	Steel	-	-	1	0.6
	Total	**6**	**13.8**	**19**	**31.2**
Texas Gulf	Coal Power Plant	3	27.3	5	32.2
	Gas Power Plant	16	43.1	28	57.5
	Gas Processing	5	2.3	8	3.0
	Hydrogen	11	8.9	15	12.0
	Metals & Minerals	-	-	1	0.2
	Petrochemicals	2	2.7	11	12.5
	Refineries	17	52.5	19	53.4
	Total	**54**	**136.9**	**87**	**170.9**
Grand Total		**92**	**219.7**	**168**	**303.5**



Source: EPA GHGRP 2018

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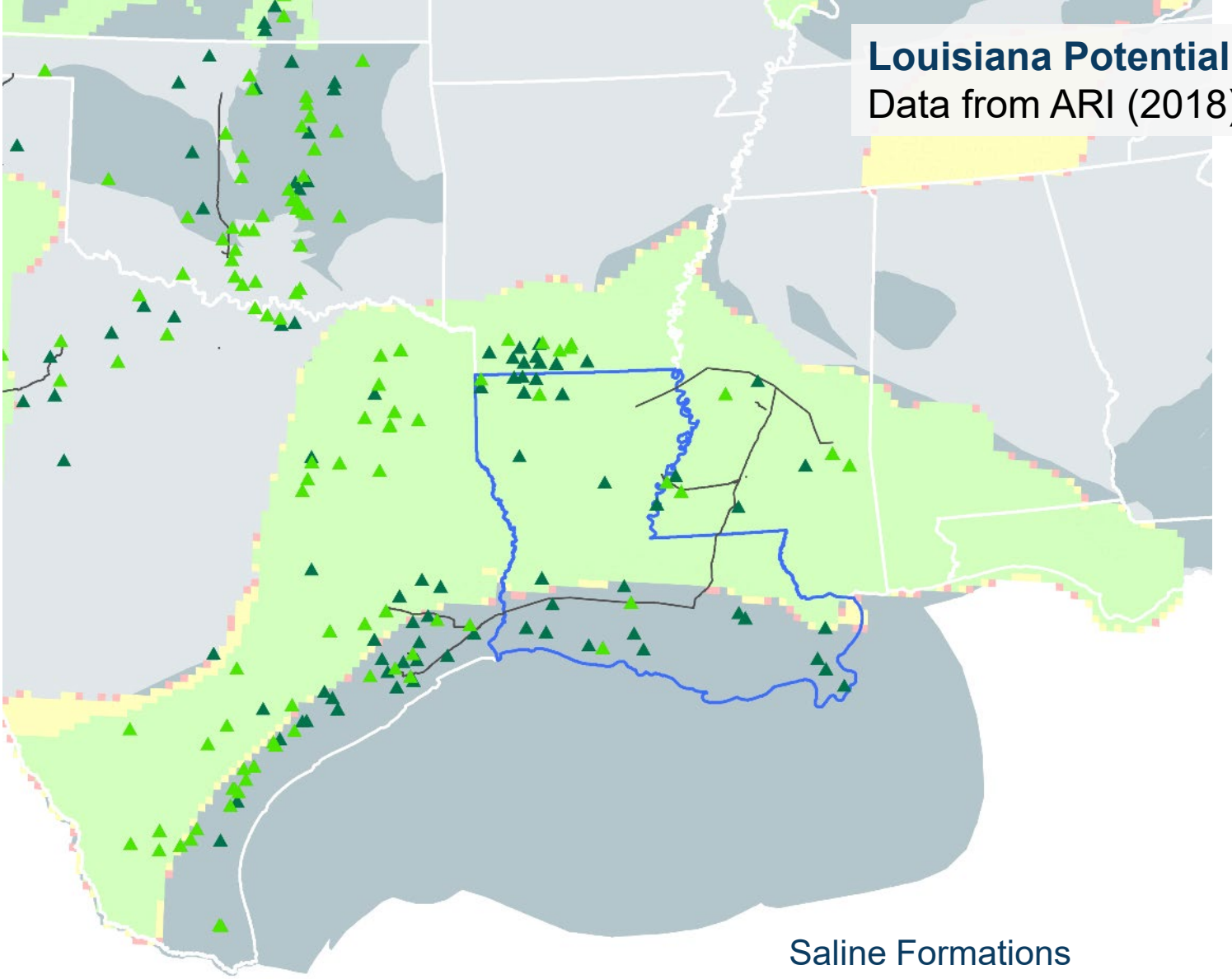
Louisiana Potential CO2 Demand for Enhanced Oil Recovery

Data from ARI (2018)



- Demand for CO2 grows with oil price
- Assume willingness to pay $20 / ton CO2

LA Potential CO2 Demand by Oil Price

$40 / bbl: 2.5 million metric tons per year

$60 / bbl: 15.5 million metric tons per year

Gulf & Midcontinent at $40/bbl

Area	Million Tons CO2 per Year
N. Louisiana	**1.6**
Louisiana Gulf	**0.9**
Oklahoma	50.9
Greater Texas	44.5
Permian	27.5
Corpus Christi	11.4
Houston	10.6
Kansas	9.6
Arkansas	1.4
Mississippi	1.2
Total	159.6

Source: ARI 2019.
Figures authored by GPI 2019.

Oil Fields

- Could purchase CO2 when oil is $40 / bbl
- Could purchase CO2 when oil is $60 / bbl

Saline Formations

- Very Low Cost Storage
- Low Cost Storage
- Moderate to High Cost Storage
- Not Yet Characterized

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Annual Supply and Demand of CO2 in Louisiana

Potential Import of CO2 into Louisiana

Supply Region	To Target Region	Economically Feasible Capture
Midwest	Gulf	**48 million tons**
Midwest	Midcontinent & TX	**98 million tons**
Louisiana	Louisiana	**23 million tons**

Annual CO2 Storage Potential in Louisiana

Storage Type	Storage Opportunity	
EOR	2.5 - 15 million tons	Potential Demand
Total Saline	2.4 billion tons	Technical Potential
Saline under $5	2 billion tons	Technical Potential

Annually. All tons are in metric tons.

Nationwide near- and medium-term capture potential outstrips in-state EOR demand for CO2. However, 45Q creates an additional market for CO2 in saline storage, with vast potential in LA.

Louisiana could focus on capture opportunities within the state to maximize economic impact of both supply and demand.

Thank You

Elizabeth Abramson
Research Analyst
Great Plains Institute
eabramson@gpisd.net

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Why is Louisiana Unique?

Brian Snyder

Assistant Professor

Department of Environmental Sciences

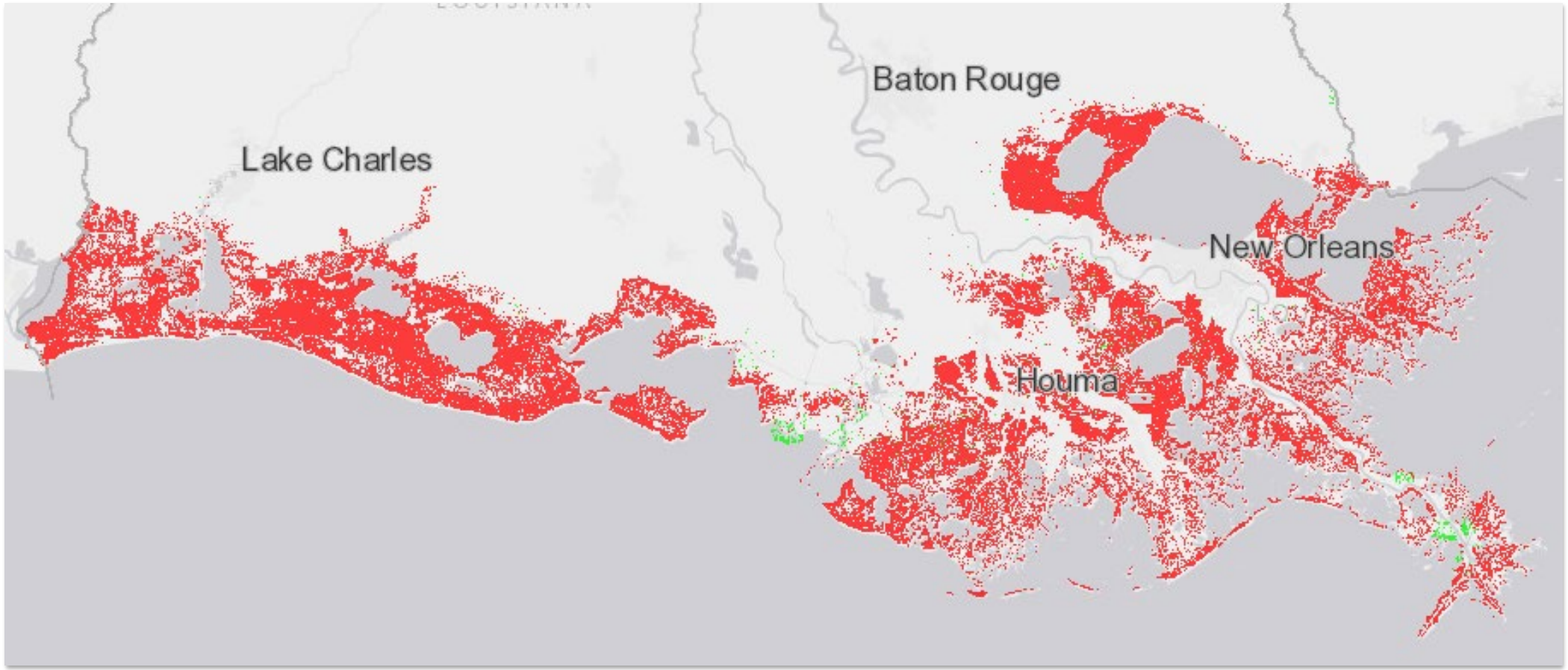
Louisiana State University

What Makes Louisiana Different?

Wetlands

Architecture

Coach O



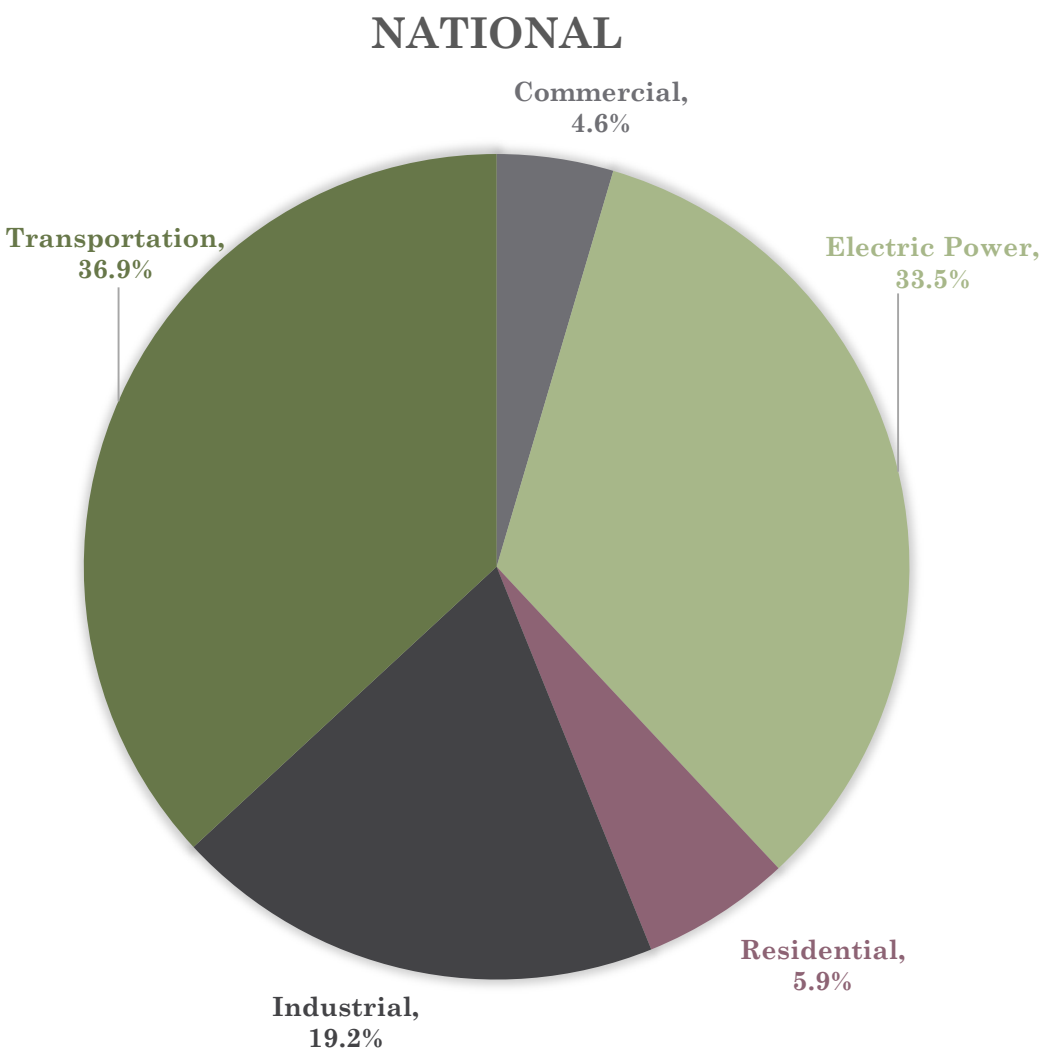
What Makes Louisiana Different?

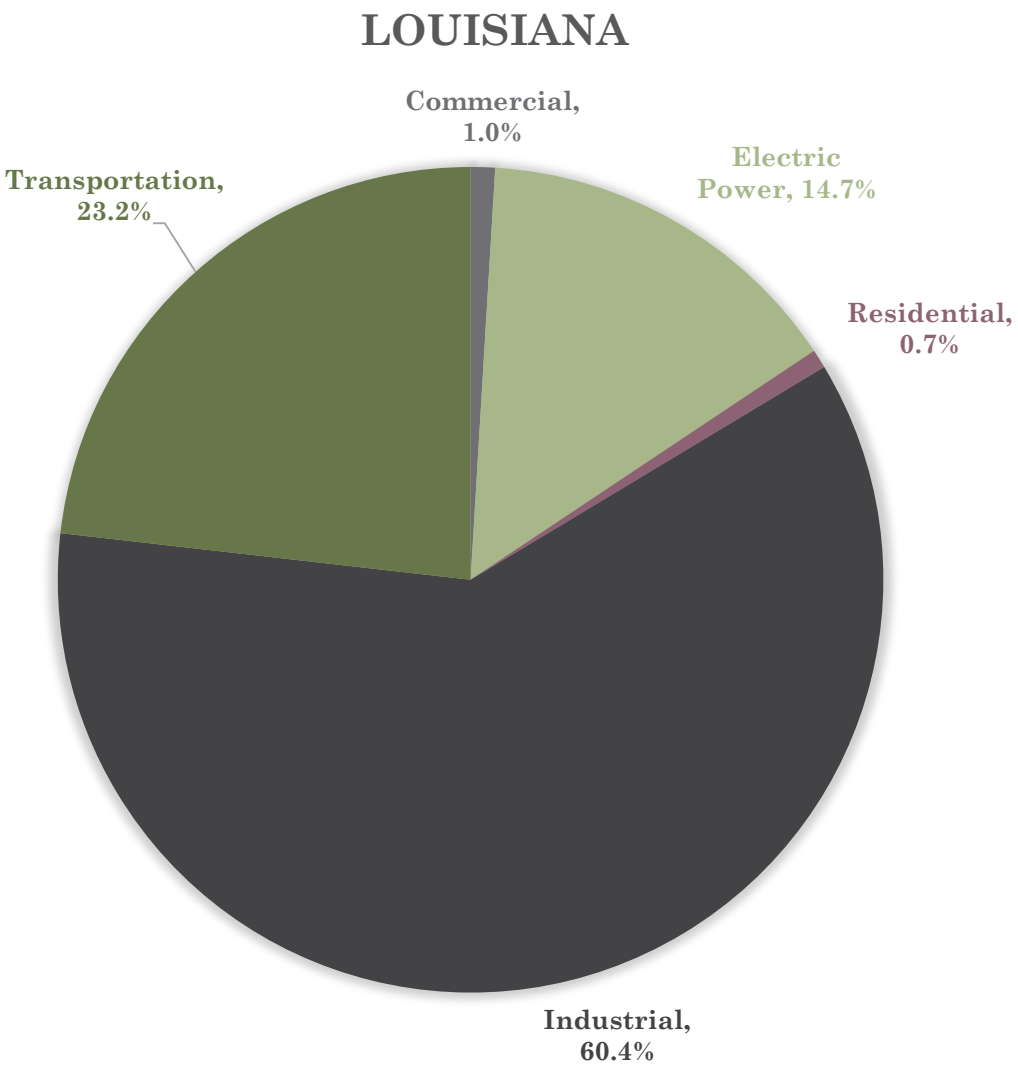
High Scenario without intervention

Edwards Announces Climate Task Force – August 2020

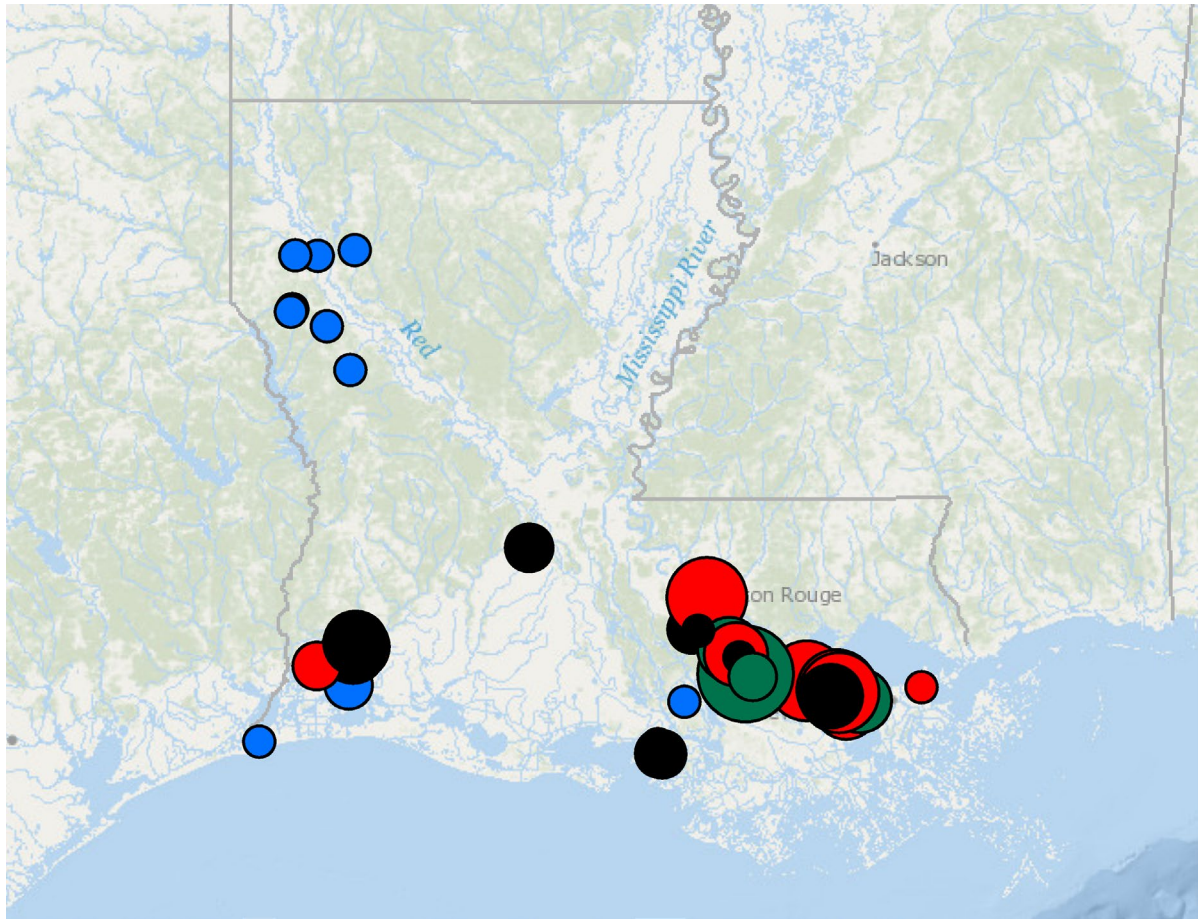
- Task force asked to identify cuts to emissions by 26-28% by 2025, 40-50% by 2030, and 100% by 2050
- On November 5, **CF Industries** announces intention to reduce emissions by 25% by 2030, and 100% by 2050

One More Reason Louisiana is Unique



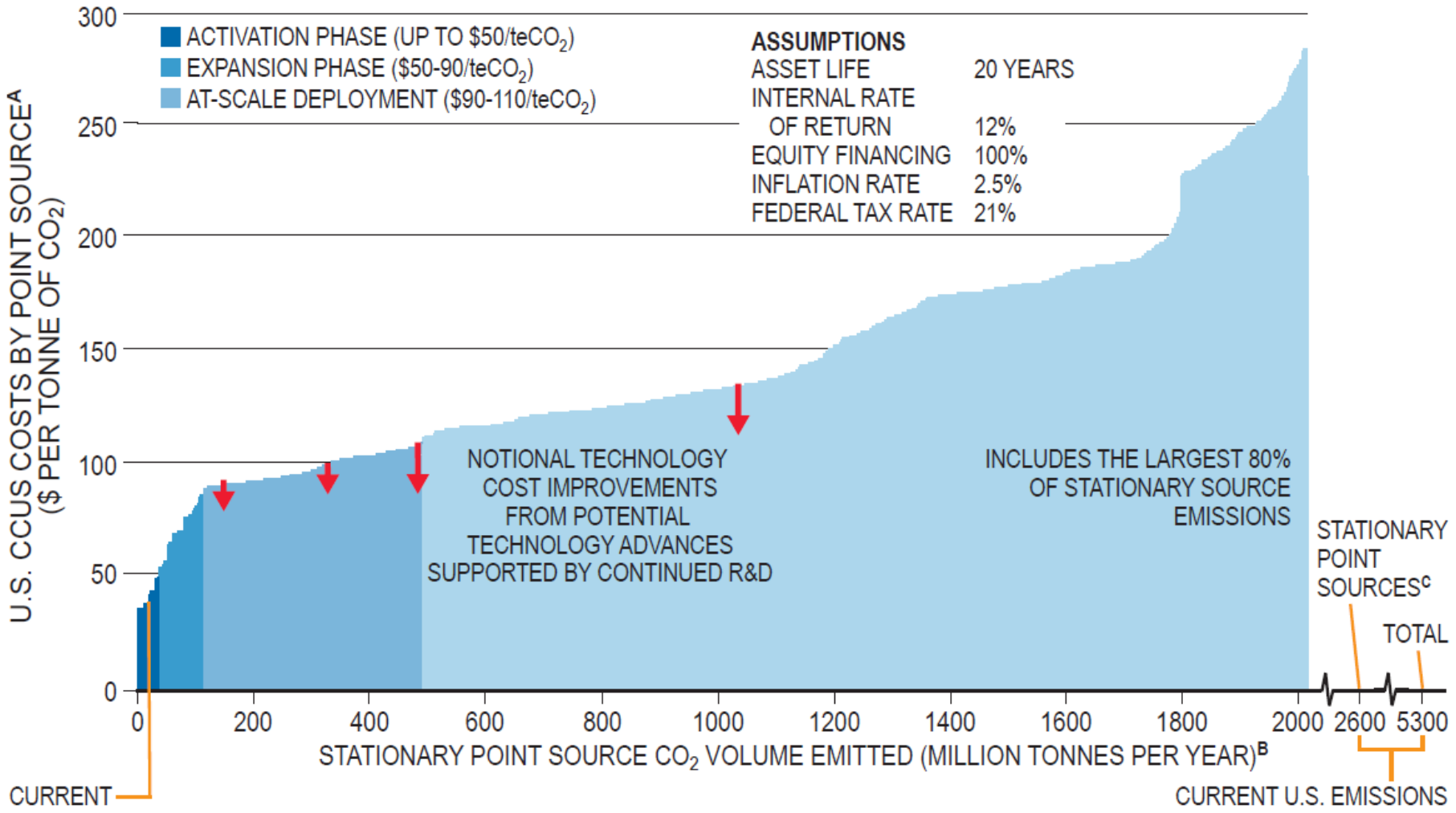


High Concentration CO_2 Sources in Louisiana over 100,000 tonnes



Nat Gas Processing
Ammonia
Hydrogen
Other Petrochem

100 – 200 k tonnes
1.8 – 5 M tonnes



Is CCUS Financially Feasible?

Source: NPC 2020

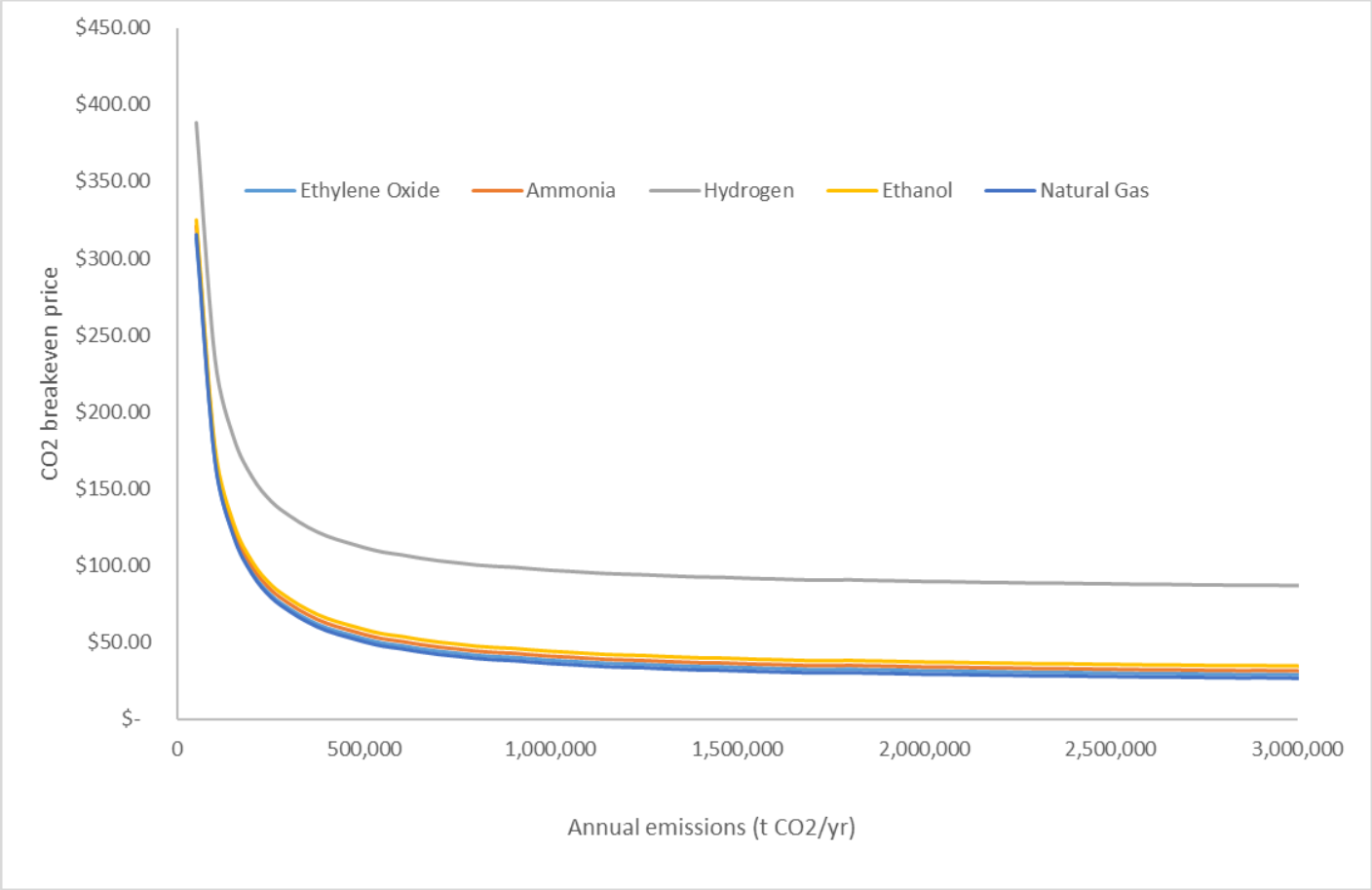
Is EOR Financially Feasible in LA?

Oil Price ($/bbl)	Nat Gas Processing	Ammonia	Ethylene oxide	Hydrogen
30	316	254	299	-413
50	571	509	553	-158
70	826	764	808	97

			NPV (million $)	
Field	OOIP (million bbls)	Depth (ft)	50 miles	100 miles
Paradis	206	11,000	509	484
Avery Island	155	9,000	358	333
Bayou Sale	290	14,000	763	717
Delhi	334	3,135	915	880
Hackberry West	166	7,360	394	369
Lake Pelto	32	13,200	10	-8
Clovelly	17	11,900	-26	-44
Erath	28	8,695	10	-8

Source: Snyder et al. 2020

What About Saline Storage?



Tarufelli et al. In review

Is CCUS Viable in Louisiana?

- It can be. Some form of CCUS (EOR or saline) is likely to be cost effective for emitters with large, concentrated emissions
- Costs will likely fall with learning
- Removing 45Q's 12-year sunset would help
- Analysis suggest that **scale will be important** and that **an "industry-oriented" project** as opposed to a **"company-specific" project** will be more cost-effective
- Louisiana's Industrial Tax Exemption Program (ITEP) improves project economics

Public Acceptance

- Louisiana has a governor who is publicly supportive of CCUS
- Louisiana may be more vulnerable to climate change than any other state
- There is occasionally public opposition to some projects/plants (e.g. Formosa plastics; Denka), but the overall record of public acceptance of similar projects is good
- Overall, the climate for CCUS in Louisiana is positive

Thanks!

Denbury

Developing CCUS Projects in LA

November 17, 2020

CO_2 Storage in Saline Formations & Petroleum Basins

Denbury's Green Pipeline

- 321 miles, 24" CO_2 Pipeline
- In-service Capital >$1B
- Capacity >800 MMSCFD

Eminent Domain in Louisiana

- Pipeline companies that transport natural gas, liquid petroleum products and carbon dioxide in Louisiana have the power to expropriate private property if
  1) Authorized by statute
  2) The property will be used for a public purpose
  3) It is necessary for the property to be expropriated
- Landowners are entitled to “just” compensation
- Procedures must be followed to ascertain value, make an offer and provide information to the landowner to evaluate the offer
- Recognized in both statute (Title 19 LRS) and the Louisiana Constitution (Article I)
- Expropriation or Eminent Domain is considered commercially a “last resort” when efforts to acquire necessary right of way become impossible

Louisiana Storage Statute

- SB 353 – 2020 – Senator Sharon Hewitt
- Legislation designed to improve the regulatory framework necessary for the development of the emerging CO_2 storage industry on the Gulf Coast and Louisiana
- Amends the 11-year-old and unused Geologic Sequestration of Carbon Dioxide Act
- Aligned the definition of "interested party" with existing procedures before the Commissioner of Conservation
- Removed CO_2 pipelines that transport CO_2 from the definition of "Storage Facility"
- Clarified existing CO_2 pipeline expropriation authority as under Title 19 rather than Title 30

Louisiana Storage Statute – Remaining Issues

- With the 2018 Federal 45Q Carbon Capture Tax Credit expansion driving commercial project discussion, several areas of the Louisiana Geologic Sequestration of Carbon Dioxide Act need improvement, including:
  - Clarification that the CO_2 owner retains ownership option of injected CO_2;
  - Clarification of shorter time frame for issuance of a Certificate of Completion consistent with "substantial evidence" post injection provision of federal Class VI requirements;
  - Clarification that either project transfer or Certificate of Completion for a project in good- standing results in release of all liability, not just liability to the State, while ensuring Trust Fund performance for the State;
  - Elimination of open-ended "spring back" provision on operator after Certificate of Completion issued if at an indeterminate future date the Trust Fund is exhausted;
  - Clarification of the requirement of cost and funding schedule redetermination for the site- specific trust fund upon project transfer.

Final Thoughts

- Louisiana has a far reaching and thoughtful, however untried, Carbon Sequestration program. CO_2 storage site project capital funding decisions will consider:
  - Statutory and regulatory alignment with commercial principles and practices;
  - Clarity and certainty regarding project legal liability exposure and Trust Fund remediation funding requirements; and
  - Post injection monitoring and site closure time, expense and post-Certificate of Completion requirements
- CO_2 Storage Site Development will drive CO_2 Capture and CO_2 Pipeline Development...not the other way around
- LA's Legacy Lawsuit experience is viewed as a risk to CCUS development

PUTTING A PROJECT TOGETHER: THE MAIN ELEMENTS AND PROJECT PARTICIPANTS

JOHN KRUSE, ***VICE PRESIDENT, KIEWIT***
ANTHONY COTTONE, ***SENIOR DIRECTOR, STRATEGIC DEVELOPMENT, OXY LOW CARBON VENTURES***
BRIAN HILL, ***VICE PRESIDENT, CRESCENT RESOURCE INNOVATION***

U.S. DEPARTMENT OF ENERGY
Office of Fossil Energy
USEA
United States Energy Association
GLOBAL CCS INSTITUTE

END OF DAY 1

U.S. DEPARTMENT OF ENERGY
Office of Fossil Energy
USEA
United States Energy Association
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DEVELOPING CCUS PROJECTS IN LOUISIANA AND THE GULF COAST
NOVEMBER 17-18, 2020

U.S. DEPARTMENT OF ENERGY
Office of Fossil Energy

USEA
United States Energy Association

GLOBAL CCS INSTITUTE

AGENDA

Day 1

1:00 – 1:10 pm CST	Welcome
1:10 – 1:30	Louisiana's Net Zero Emissions Commitment and the Role of CCUS
1:30 – 1:45	The Status of CCUS in the US and Around the World
1:45 – 2:35	How to Utilize 5Q on your CCUS Project
2:35 – 2:45	Break
2:45 – 3:30	The Louisiana Gulf Coast Environment: Industry and CO2 Sources, Geology, and Pipelines
3:30 – 4:15	Putting a Project Together: Capture, Transportation, and Storage
4:15 – 4:20	Day 1 Wrap-up and Day 2 Preview

Day 2

9:00 – 9:05 am CST	Welcome
9:05 – 9:50	Case Studies – Projects & 45Q
9:50 – 10:30	Challenges to Deployment and Strategies to Address Them
10:30 – 10:35	Wrap-up and Break-out Instructions
10:35 – 10:45	Break
Breakout Sessions – 10:45 t0 11:30 am	
Breakout Session 1	Q&A and Broader Discussion on 45Q with Keith Tracy
Breakout Session 2	Putting together CCUS Projects with Brian Hill
Breakout Session 3	Understanding the LA context regarding liability, permitting, etc. with Jason Lanclos

Patricia Loria, Senior Client Engagement Lead, GCCSI

CASE STUDIES – PROJECTS & 45Q

LAKE CHARLES METHANOL, *HUNTER JOHNSTON, PARTNER AT STEPTOE & JOHNSON LLP*

OGCI KICKSTARTER (SHELL), *LEE STOCKWELL, GENERAL MANAGER – US CARBON CAPTURE & STORAGE*

VELOCYS CCS PROJECT, *JEFF MCDANIEL, VP, NEW PROJECTS*

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Lake Charles Methanol
Worlds Largest Single-Project Carbon Reduction Opportunity

Hunter Johnston

Lake Charles Methanol

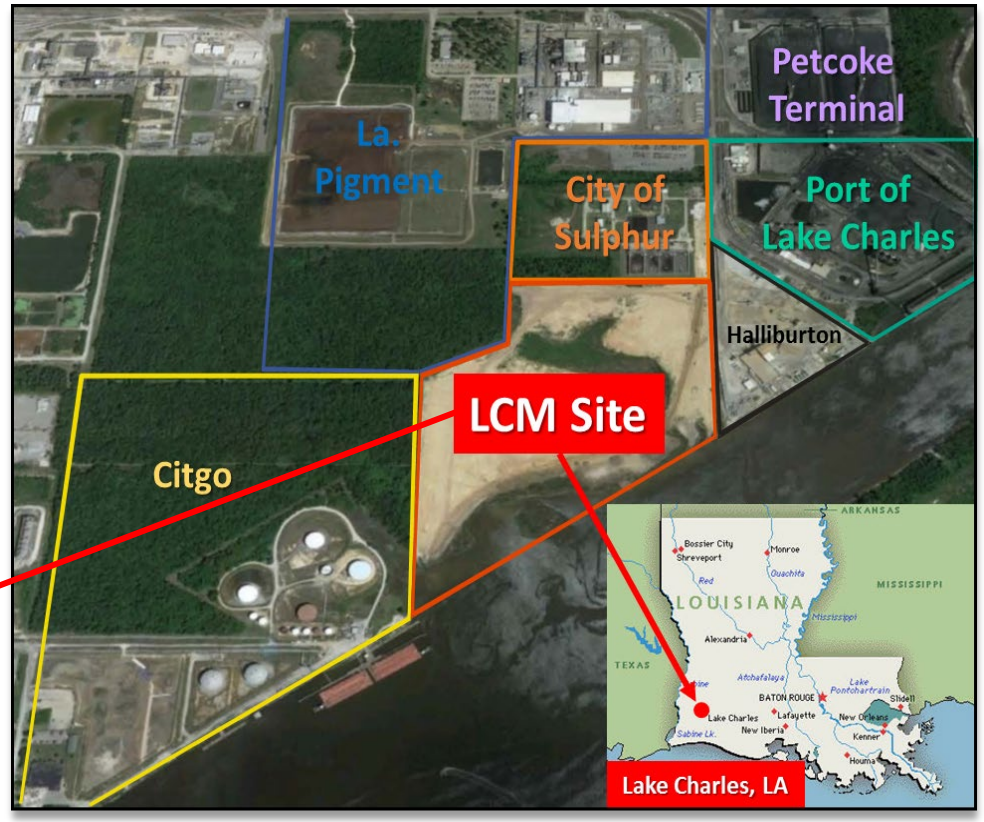
November 2020

Lake Charles Methanol

World Class Methanol and Carbon Capture Project

Lake Charles Methanol and Carbon Capture is a fully contracted, greenfield, state-of-the-art facility that will produce methanol and capture and sequester over 4 million metric tons of CO_2 per year.

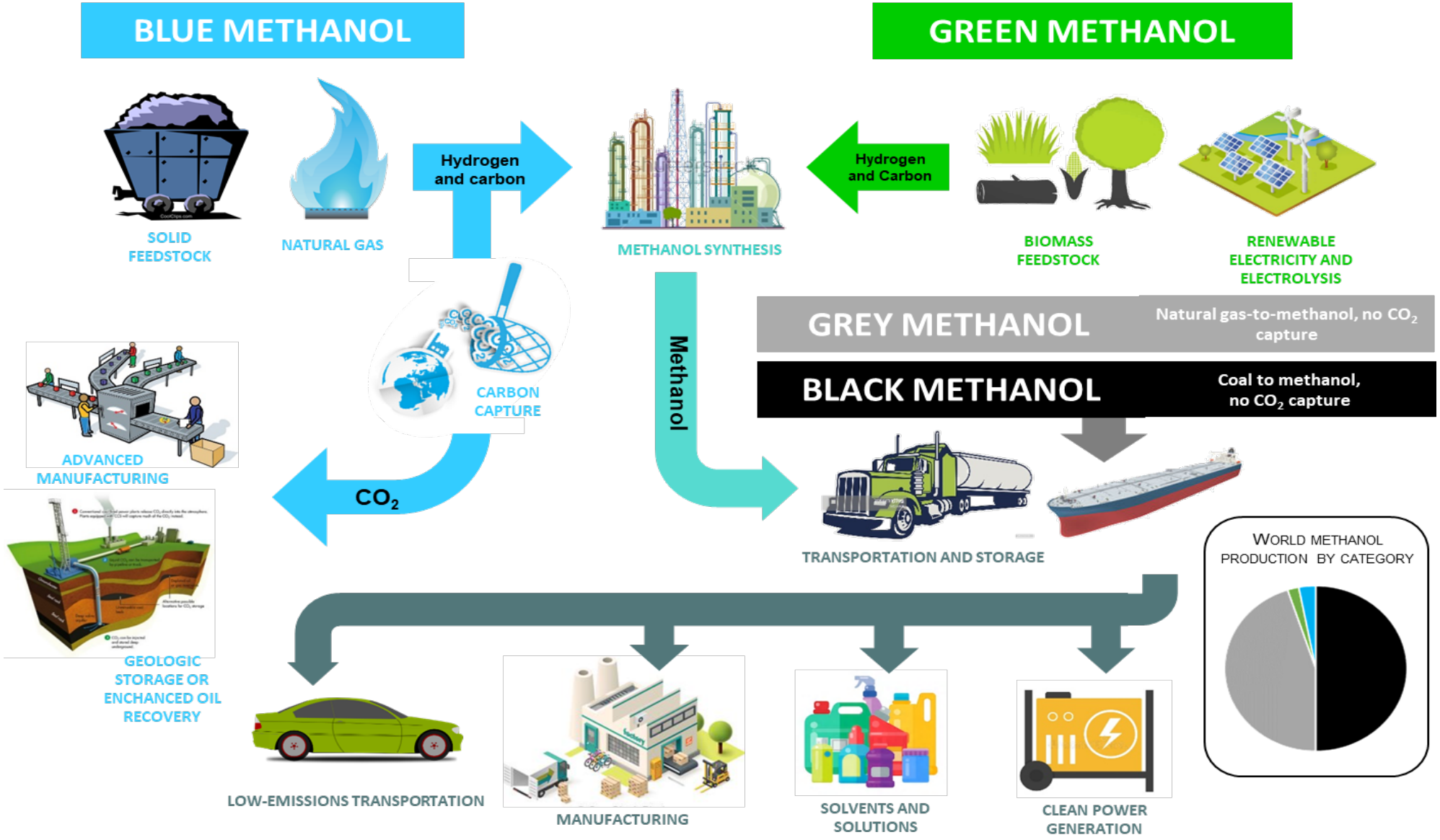
Construction ready greenfield site at Port of Lake Charles



Low-cost, clean methanol from petcoke

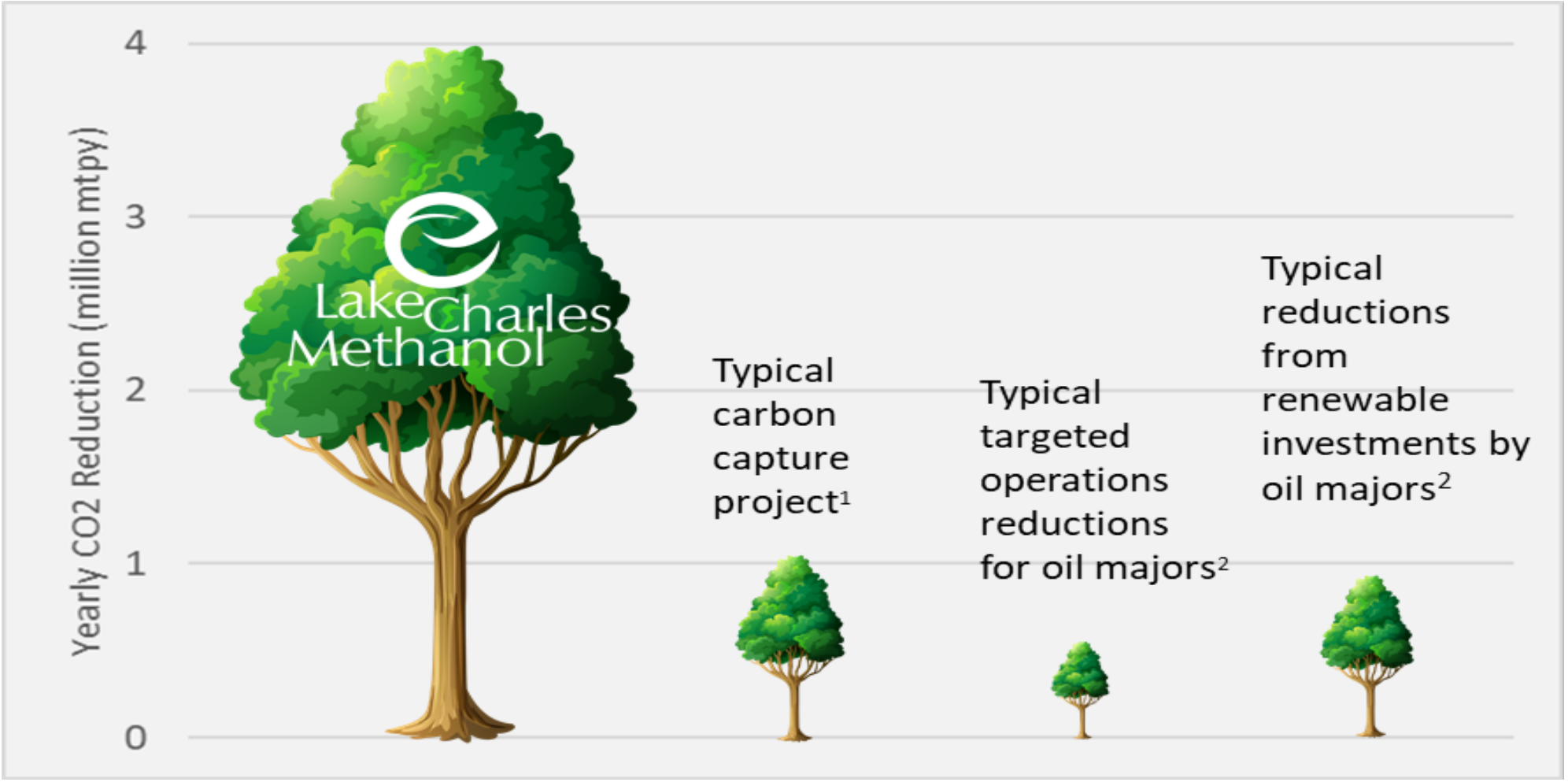
Lake Charles Methanol

LCM's CO_2 Capture and Sequestration will Produce Blue Methanol



Lake Charles Methanol

Largest Single Project CO_2 Reduction Opportunity



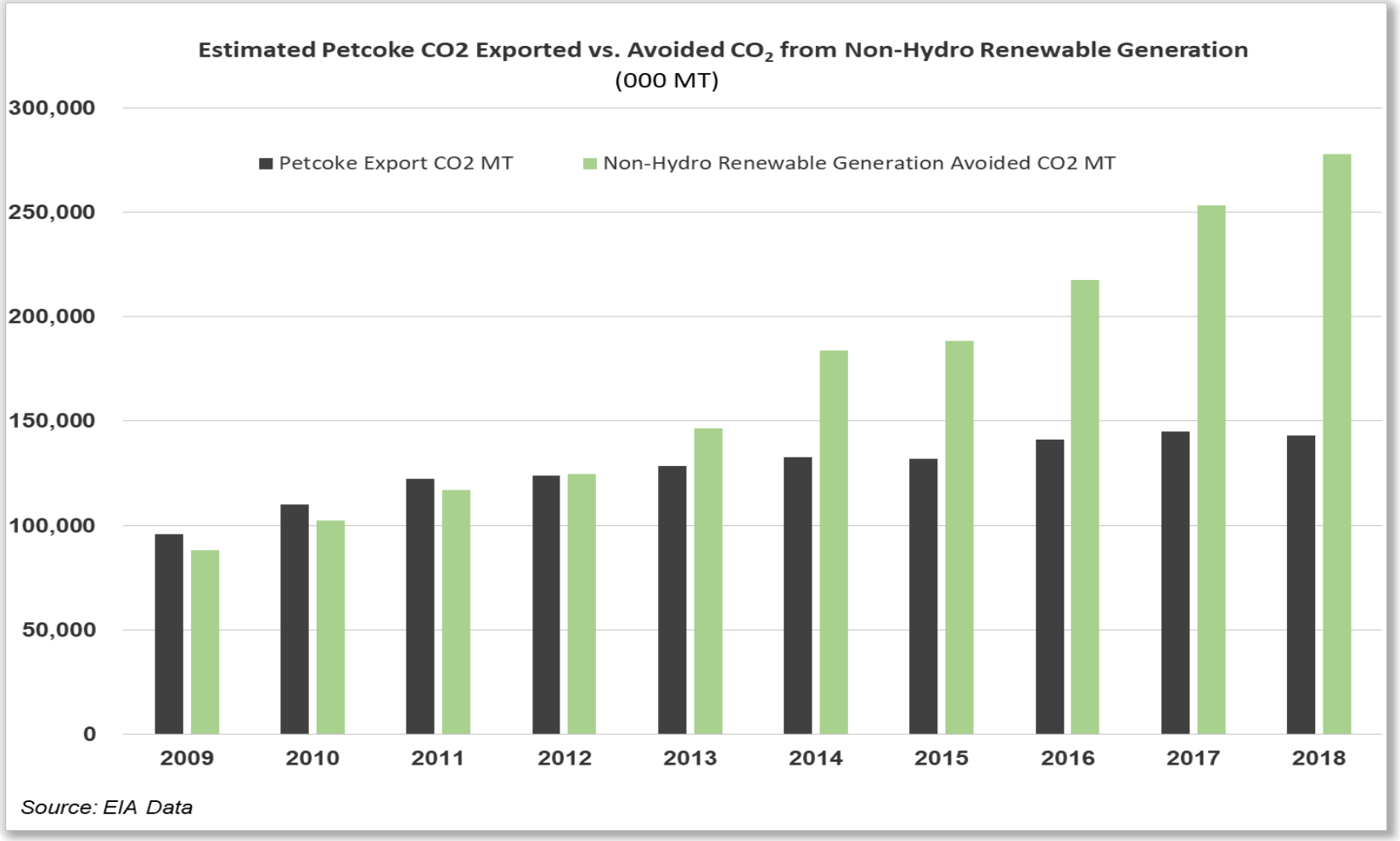
[1] Based on ~1 mm mtpa CO2: Boundary Dam, Saskatchewan, Petra Nova Texas, Coffeyville Kansas, Quest Alberta, Port Arthur Texas

[2] BP Sustainability Report 2018, ExxonMobil Sustainability Report 2017, Chevron Sustainability Report 2018, Shell Sustainability Report 2018

One-of-a-kind opportunity for oil industry decarbonization

Lake Charles Methanol

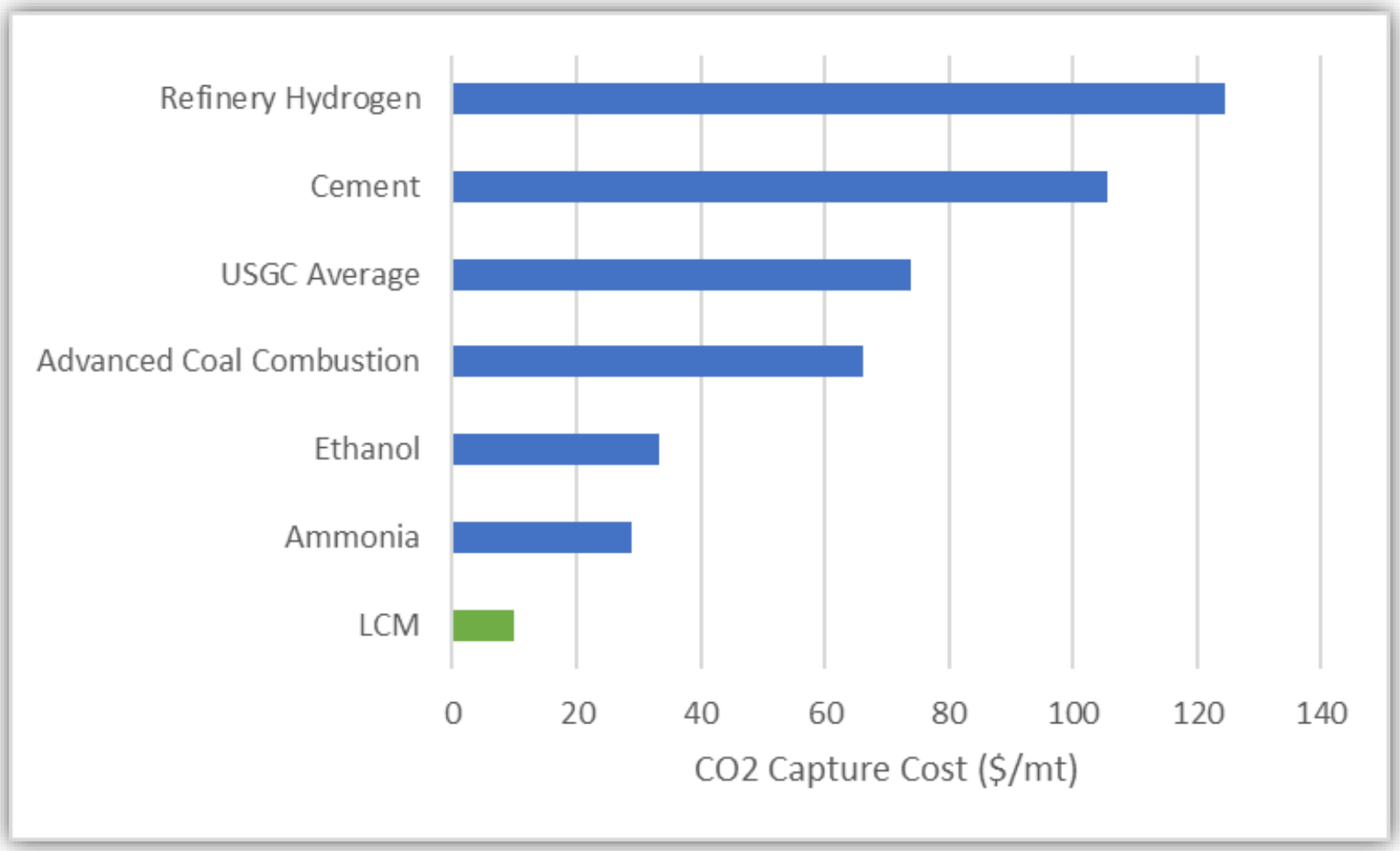
Petcoke CCS will Support U.S. Decarbonization Progress



Petcoke gasification with CCS could have equaled up to 75% of non-hydro renewable energy CO_2 benefit over last 10 years

Lake Charles Methanol

Industry-Leading CO_2 Capture Cost



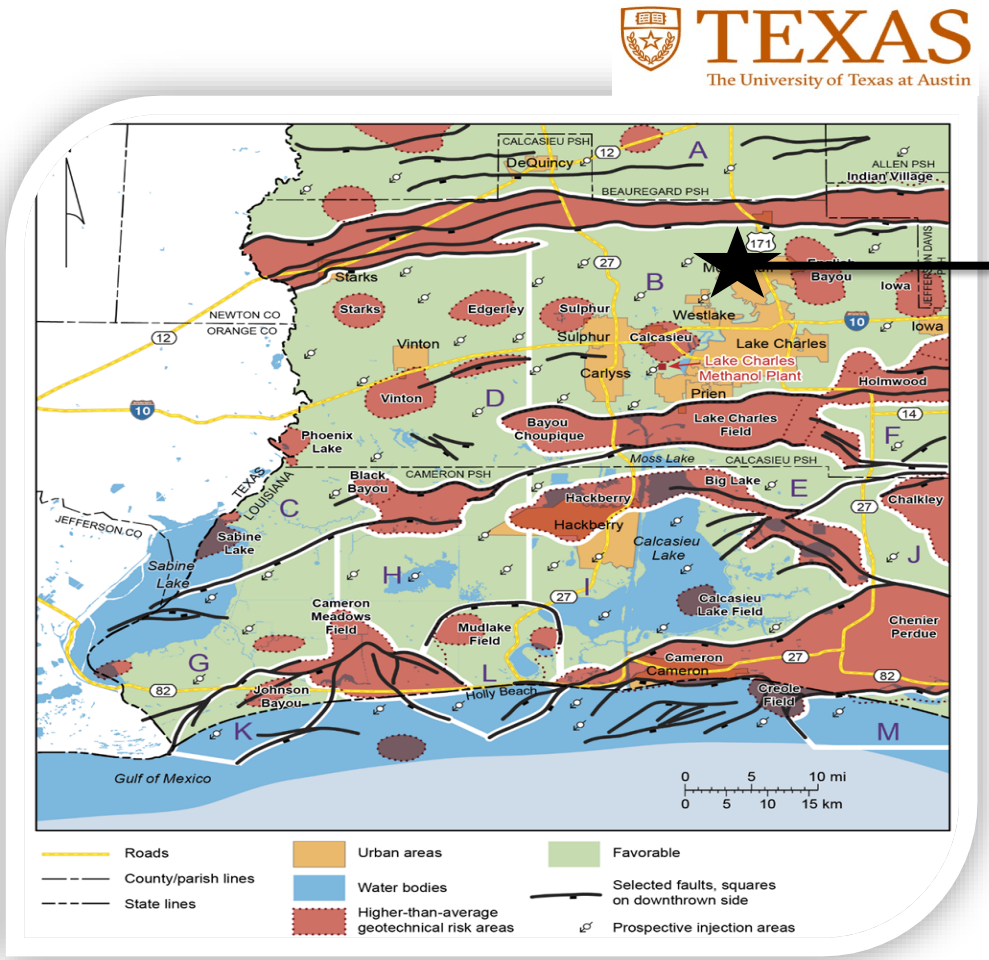
Sources: BP Sustainability Report 2018, ExxonMobil Sustainability Report 2017, Chevron Sustainability Report 2018, Shell Sustainability Report 2018; Cost of Capturing CO2 from Industrial Sources, Summers NETL 2013

Opportunity to implement substantial, low-cost CCS

Lake Charles Methanol

Strong Sequestration Feasibility

- LCM commissioned a report by the University of Texas at Austin to evaluate sequestration feasibility around its site
- The study identified 38 candidate well locations within the study range
- Each well location could access six vertically-stacked target zones at depths of 3,000-10,000 feet



Total CO_2 storage capacity for the U.S. Gulf Coast is over 200 gigatons*
(enough for 1,000 projects of LCM's size)

* Integrated Carbon Capture and Storage in the Louisiana Chemical Corridor, Dismukes et al. DOE 2019

Favorable Legal and Regulatory Environment

Federal Financial Incentives

- DOE $2 billion loan guarantee
- 45Q tax credits for secure geologic storage worth approximately $200 mm annually for a period of 12 years ($2.3 billion total)

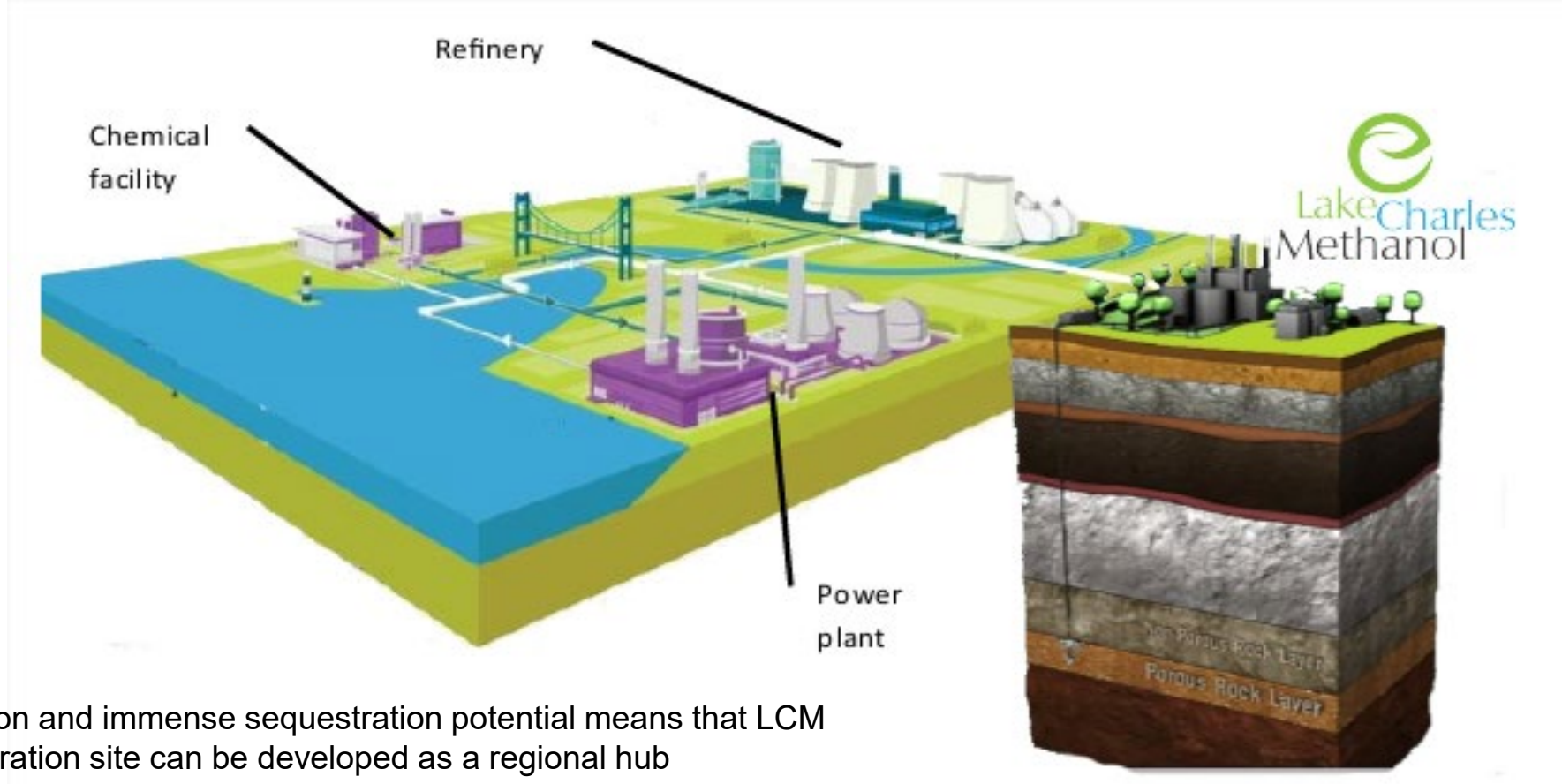
Louisiana Regulatory Support

- Louisiana Geologic Sequestration of Carbon Dioxide Act passed in 2009
- Empowers Commissioner of Conservation with jurisdiction
- Eminent domain available to CO_2 storage operators
- Liability limits and transfer of long-term liability to the state
- Louisiana is seeking regulatory primacy over permitting
- Clear ownership of pore space (tied to surface owner, not mineral rights)

Louisiana Geologic Sequestration Act declares that the geologic storage of carbon dioxide is "in the public interest" and that captured CO_2 "is a valuable commodity"

Lake Charles Methanol

Regional Hub for CO_2 Sequestration



- Gulf Coast location and immense sequestration potential means that LCM geologic sequestration site can be developed as a regional hub
- Will be able to provide storage services to other CO_2 sources in the area, including refineries, power plants, chemical facilities, gas processers, and other industrials

Game-changer for U.S. CCS and decarbonization progress

Second Quarter 2021 Closing

- Project challenge has been mitigating investors' methanol price risk exposure
- Passage of 45Q and creative new investment structure developed by Morgan Stanley insulate outside investors from methanol prices and resolve that challenge
- Morgan Stanley is working with investors to move the project rapidly to closing

Engineered, contracted, permitted…and structured to close

Lake Charles Methanol

N. Hunter Johnston

N. Hunter Johnston
hjohnston@steptoe.com
202-429-6404

Lake Charles Methanol

VELOCYS

Enabling growth of Sustainable Aviation Fuel

November 2020

Overview

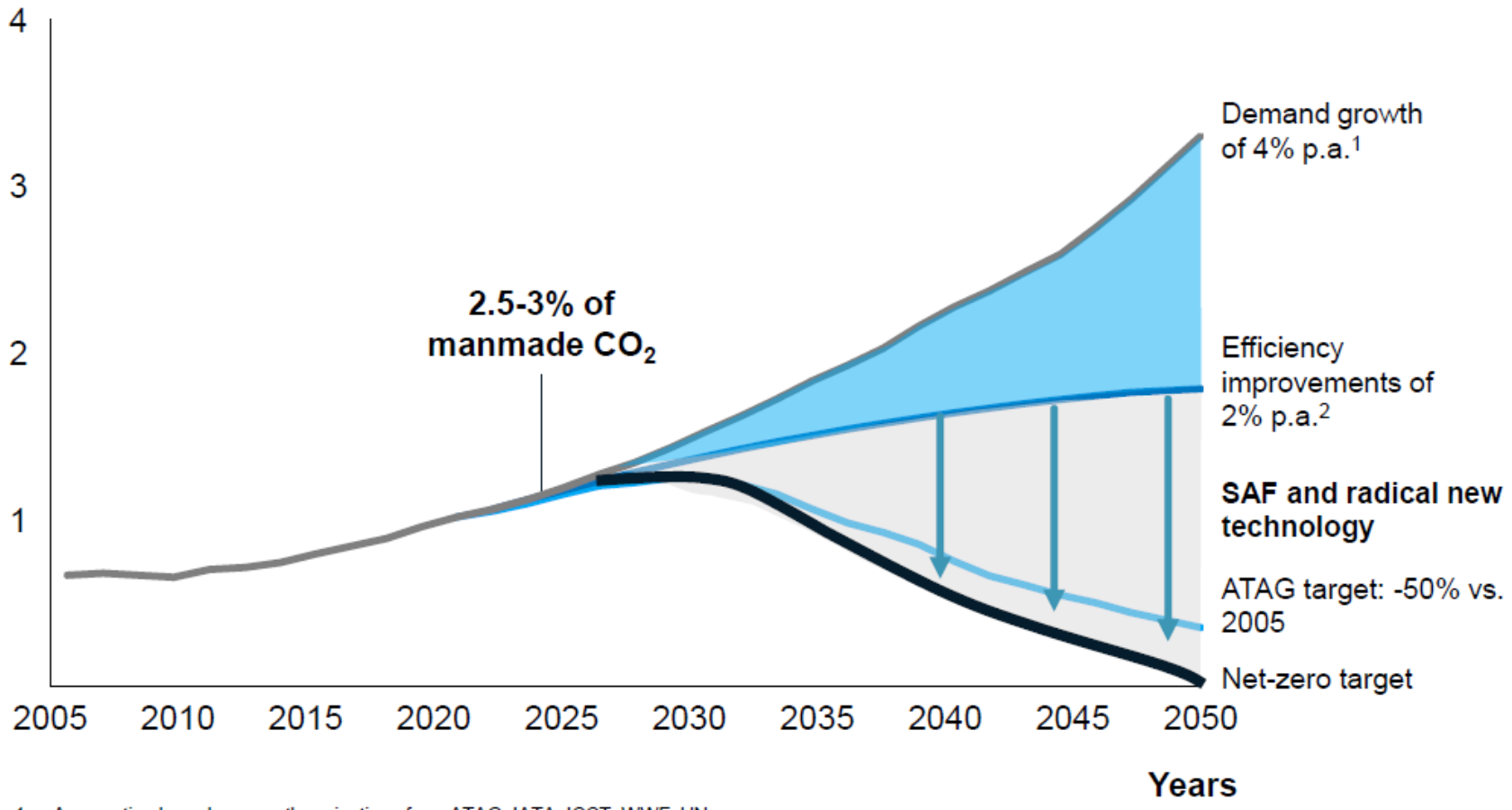
- Velocys is a sustainable fuels technology company.
- Velocys is enabling an expanded supply base for Sustainable Aviation Fuel (SAF).
- Key co-investors are IAG (British Airways) and Shell.
- Our patented technology is a robust solution which meets all regulatory standards and performance requirements.
- Utilization of difficult to process solid waste feedstocks to produce advanced, sustainable biofuels.
- Carbon Capture Usage and Storage (CCUS) of CO2 at our plants will enable **net negative emissions transportation fuels**

The airline industry commits to 50% CO2 reduction by 2050

Sustainable Aviation Fuel (SAF) is a key enabler for industry decarbonization

Does Not Include Compensation Schemes

Gt CO_2 emissions from aviation



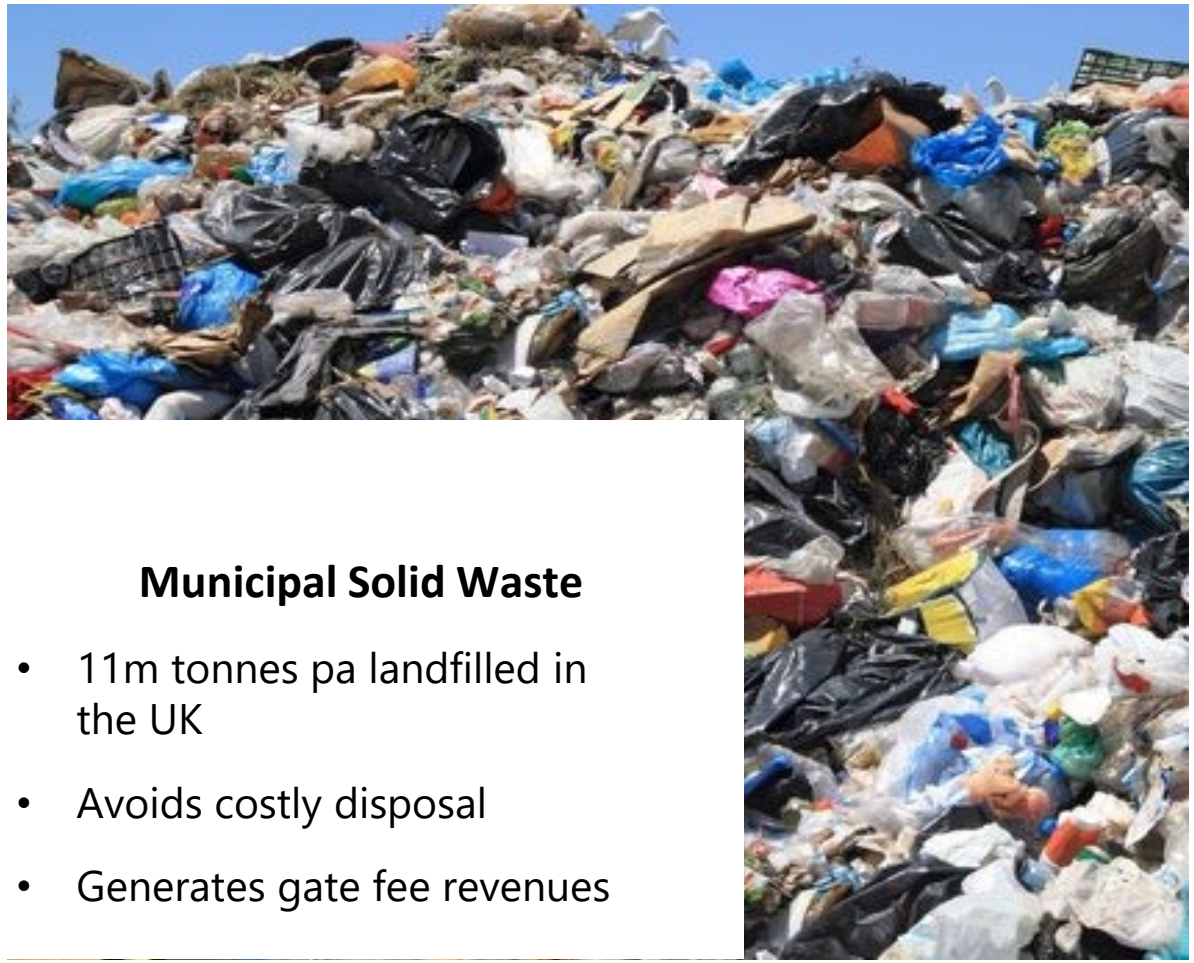
1. Assumption based on growth projections from ATAG, IATA, ICCT, WWF, UN
2. ICAO ambition incl. efficiency improvements in aircraft technology, operations and infrastructure – however highly ambitious compared to other sources (EASA)

Source: ATAG, IATA, ICCT, WWF, UN, ICAO

Why is it hard to decarbonize aviation?

- **High energy density required** to carry payload over long distances
- **Cross-border industry** with airlines competing globally
- **Infrastructure build around fuels** - any new energy source disrupts the supply chain
- **Long-lived airline assets** - new aircraft could remain in business for 25+ years
- **Safety-focused industry** - innovation requires certification

Two abundant feedstocks



Municipal Solid Waste

- 11m tonnes pa landfilled in the UK
- Avoids costly disposal
- Generates gate fee revenues

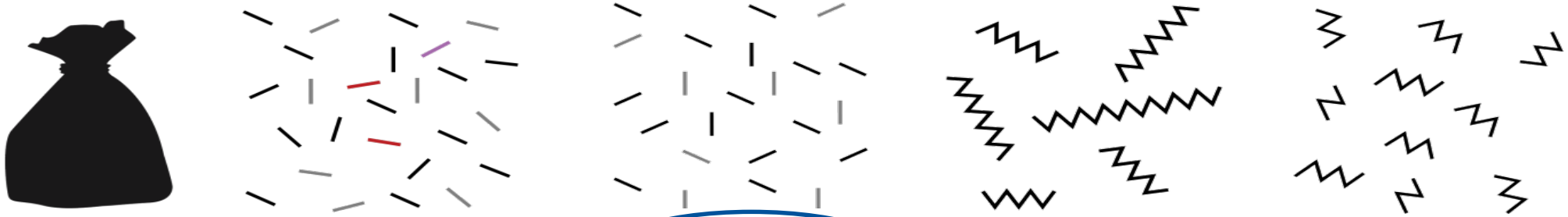
Wood Chips

- Vast volumes available globally
- High carbon content
- Byproduct of forest management
- Homogeneous quality

Process overview

Worley
Engineering and co-ordination

	Gasifier	Syngas clean-up	Fischer Tropsch Synthesis	Hydrocracker
	TRI, Linde, ARVOS GROUP	Air Liquide	VELOCYS	HALDOR TOPSØE
Physical preparation of the feedstock, removal of remaining recyclables	Thermally and chemically break the material into its component parts to produce syngas	Physically and chemically remove impurities from the syngas	Chemically react the syngas to form long chain hydrocarbons	Chemically cut the long hydrocarbons to sustainable fuels (SPK and naphtha)



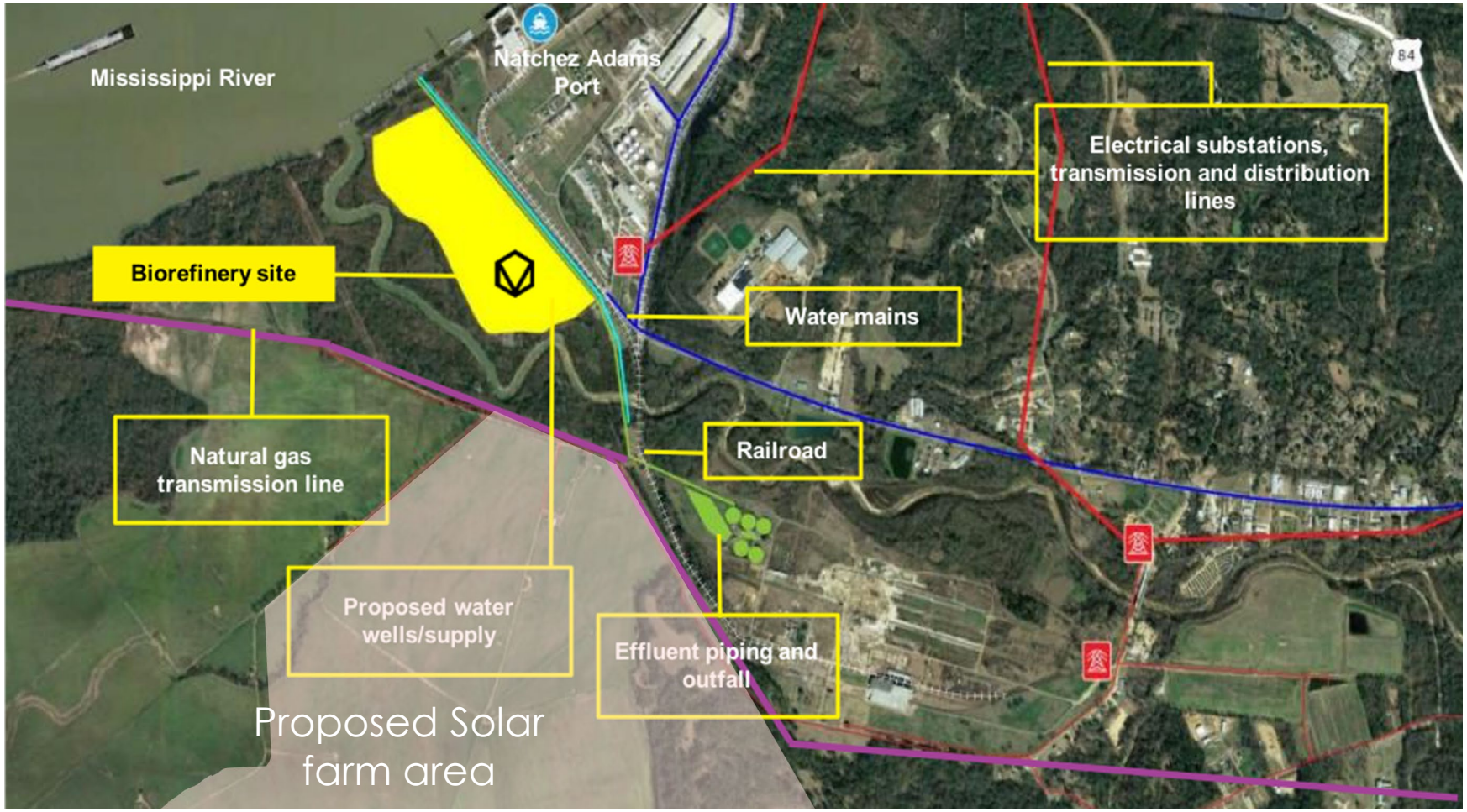
Tree residue or Waste → **Syngas** → **Clean syngas, High purity CO_2** → **FT product** → **Fuels**

Micro-channel, patented Fischer Tropsch reactor

- Demonstrated technology: reactor and catalyst for Fischer Tropsch (FT) hydrocarbon synthesis.
- Velocys' patented FT process made commercially viable using micro-channel reactors.
- Compatible with other proven technologies for end-to-end process producing drop-in fuels.
- Expert team with in-depth experience designing, commissioning and operating fuel facilities in UK & US.
- Velocys operates a capital light, licensing model for plant owners/operators.

Reference project: Bayou Fuels, Mississippi, US

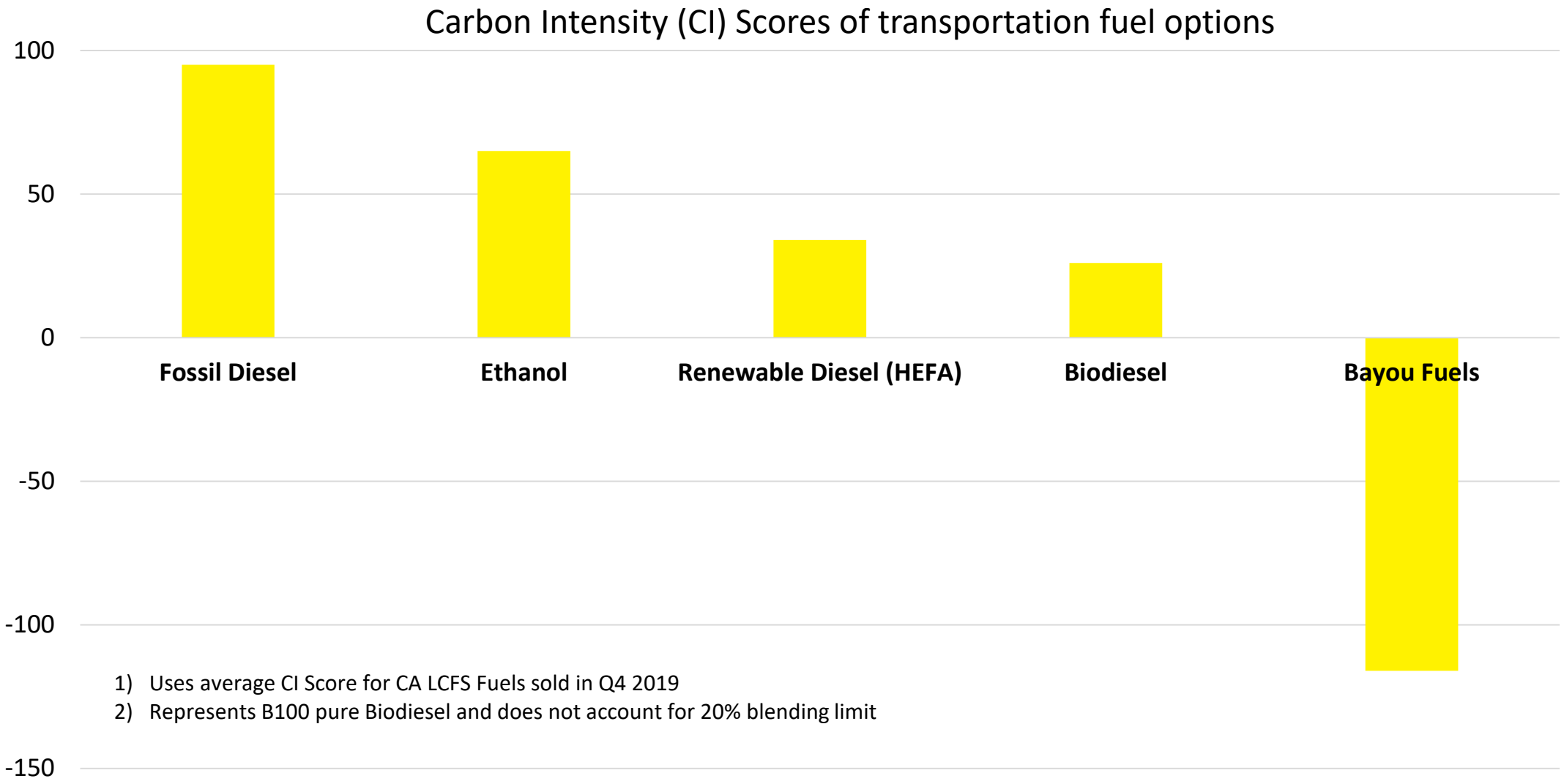
- Feedstock: woody biomass
- Nameplate capacity: 50+ million gallons / year
- Status: Pre-FEED and permitting completed
- Partners: Occidental for CCS and others in negotiation



Carbon Capture and Sequestration

- Partnership with industry leader
- Agreement with Oxy Low Carbon Ventures to capture and sequester the CO_2 from the Bayou Fuels plant
- Syngas clean-up systems produce concentrated, clean CO_2 stream which can be compressed for pipeline
- CO_2 will be piped 15 miles to the Denbury pipeline and then to Occidental's sequestration hub
- CCS lowers Carbon Intensity and generates 45Q tax credits

Bayou Fuels project has deeply negative Carbon Intensity



1) Uses average CI Score for CA LCFS Fuels sold in Q4 2019
2) Represents B100 pure Biodiesel and does not account for 20% blending limit

Summary

- Velocys is enabling the next generation of renewable fuels.
- Commercially demonstrated solution for decarbonizing air travel and heavy transport.
- Significant opportunity of Carbon Capture Usage and Storage at our plants.
  - First facility in Natchez, MS
  - Future sites throughout Southeast US

Presenter

Jeff McDaniel

VP – New Projects

- Founding member of Velocys with 25 years' experience in engineering, commercial and business development roles in the energy industry.
- Responsible for commercial transactions, off-take management, governmental and regulatory affairs, overall industry liaison.
- jeff.mcdaniel@Velocys.com
- Mobile: 614-348-5029

OIL AND GAS CLIMATE INITIATIVE

U.S. DEPARTMENT OF ENERGY
Office of Fossil Energy

USEA
United States Energy Association

GLOBAL CCS INSTITUTE

Developing CCUS Projects in Louisiana and the Gulf Coast

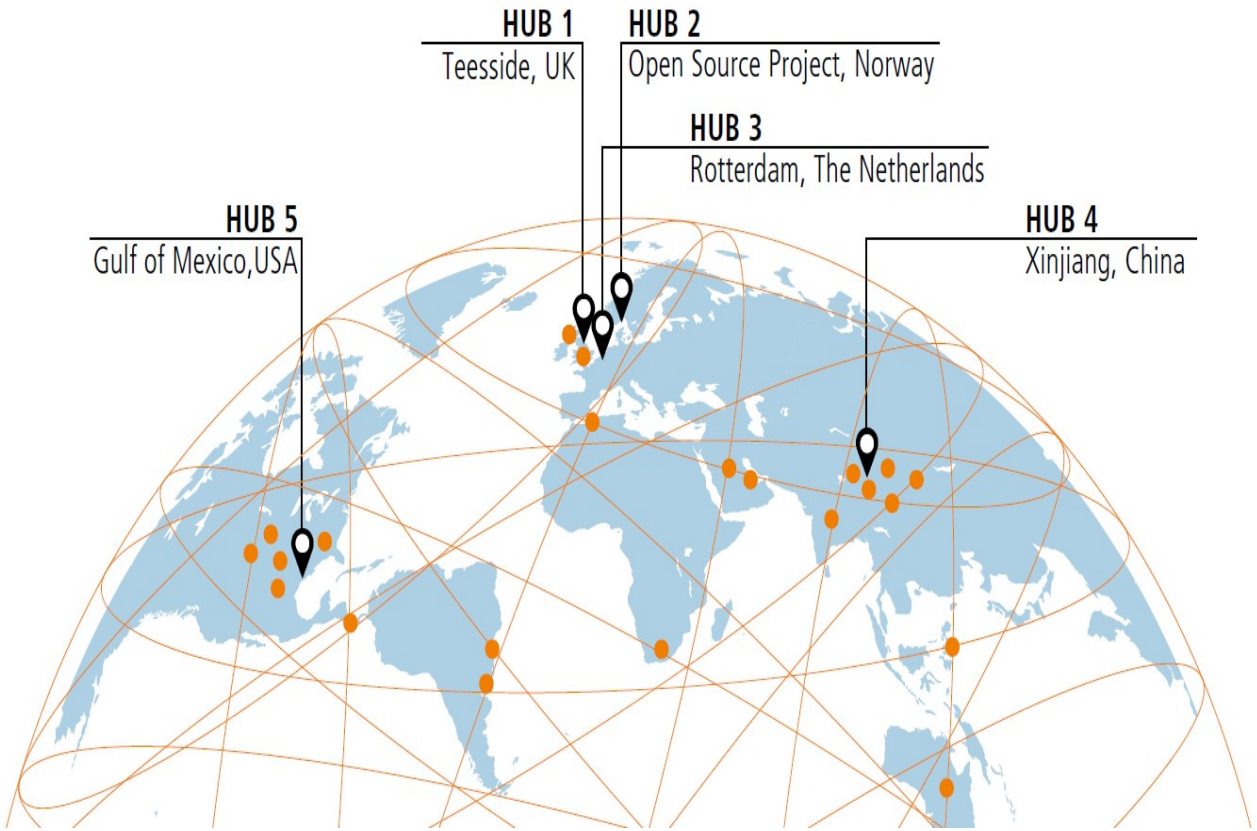
Lee Stockwell

November 18th, 2020

OUR MEMBER COMPANIES

bp Chevron CNPC eni equinor ExxonMobil OXY PEMEX PETROBRAS REPSOL أرامكو السعودية saudi aramco TOTAL

CCUS Kickstarter



Objective

- Play our part in the emergence of a commercially viable, safe and environmentally responsible CCUS industry
- Help facilitate large scale commercial investment in CCUS
- Bring stakeholders together to enable multiple low carbon industrial hubs

OGCI's role:

- Convene and engage with stakeholders
- Identify commercialization pathways
- Identify investments
- Work on policies and regulations
- Share knowledge with other hubs

Hub 5 – CCUS Hubs in the Gulf of Mexico, USA

OIL AND GAS CLIMATE INITIATIVE

Louisiana Total CO2 emissions:

200 $mtCO_2$/year of which 35$mtCO_2$/year is pure streams

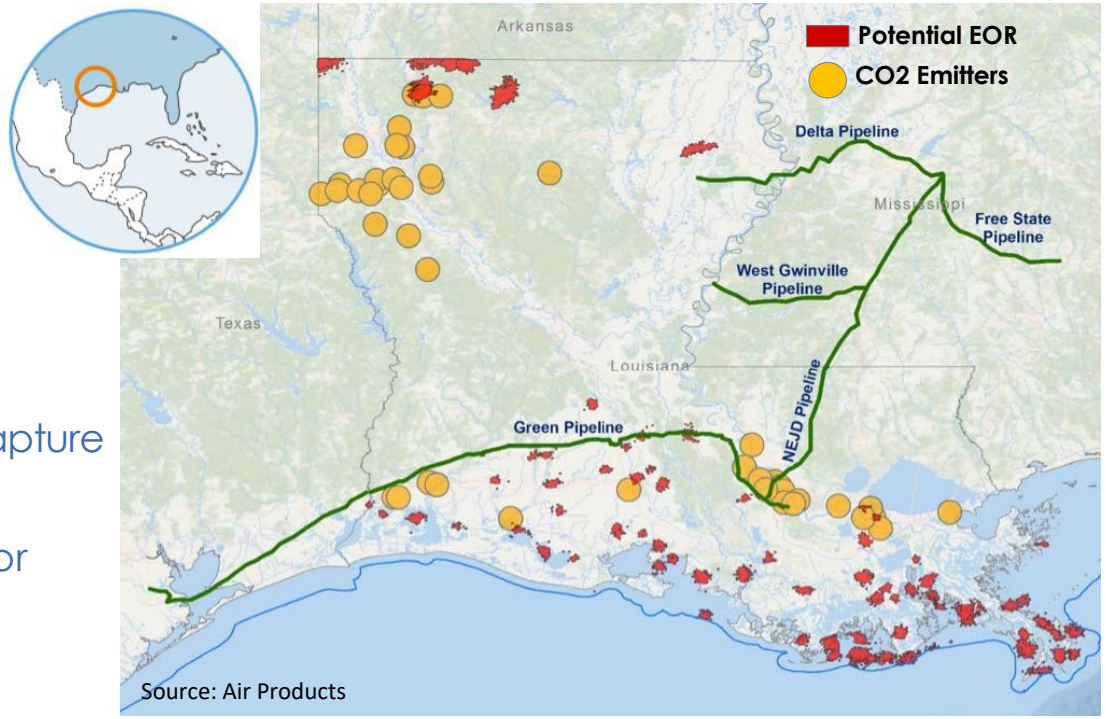
Potential emitters:

Power plants, refineries, chemical plants, fertilizers, hydrogen produ

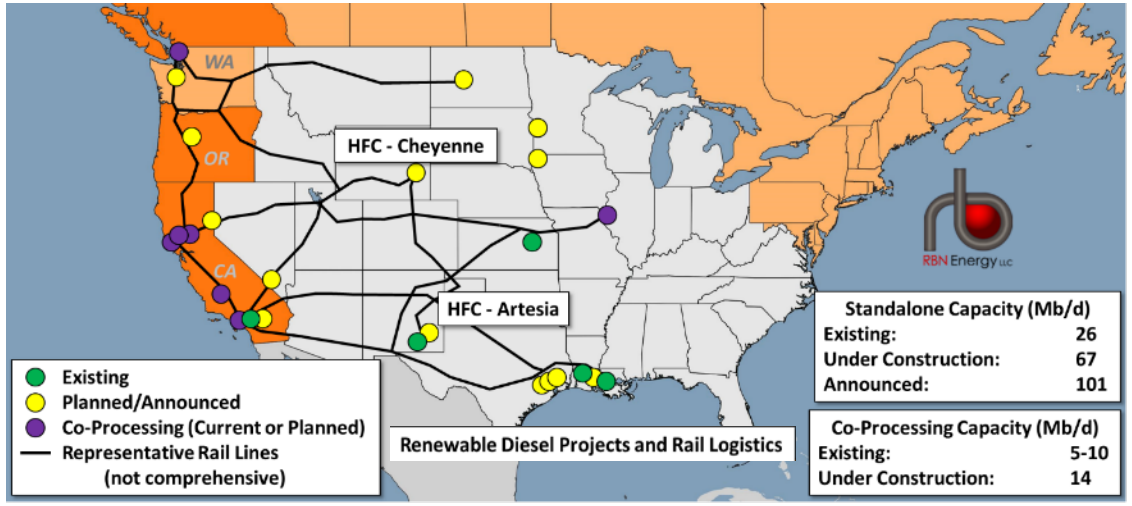
renewable fuels

Challenges:

- Policy and incentivization – liability & post combustion cost of capture
- Infrastructure availability
- 45Q and LCFS credit qualification; Commercial structures for emitters
- Change in landowner mentality

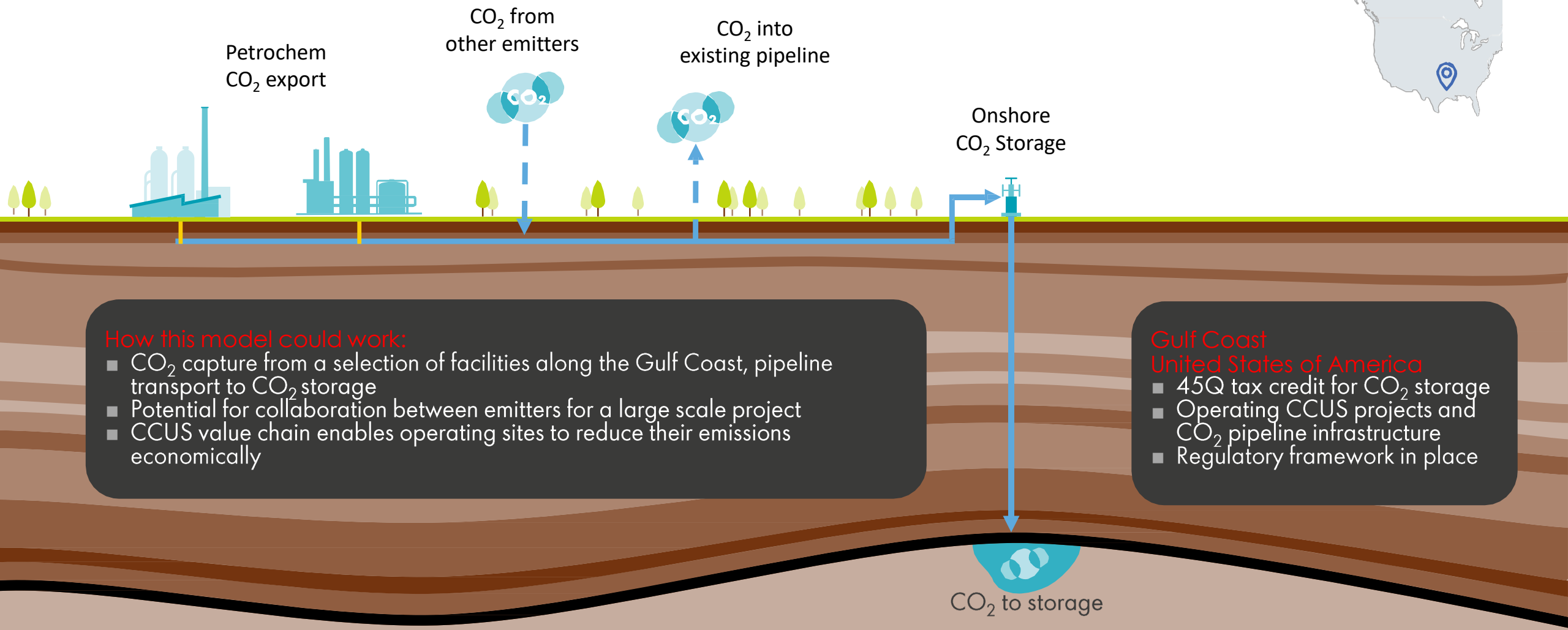


Source: Air Products



Source: Air Products

Gulf Coast – Potential Carbon Capture Model



How this model could work:

- CO_2 capture from a selection of facilities along the Gulf Coast, pipeline transport to CO_2 storage
- Potential for collaboration between emitters for a large scale project
- CCUS value chain enables operating sites to reduce their emissions economically

Gulf Coast
United States of America

- 45Q tax credit for CO_2 storage
- Operating CCUS projects and CO_2 pipeline infrastructure
- Regulatory framework in place

CHALLENGES TO DEPLOYMENT AND STRATEGIES TO ADDRESSING THEM

BENJAMIN HEARD, ***PROJECT LEAD & PRINCIPAL, GULF COAST SEQUESTRATION***
ADAM PELTZ, ***SENIOR ATTORNEY, ENVIRONMENTAL DEFENSE FUND***
JASON LANCLOS, ***DIRECTOR, STATE ENERGY OFFICE, LA***

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BREAKOUT SESSIONS

BREAKOUT 1: Q&A AND BROADER DISCUSSION ON 45Q WITH KEITH TRACY

BREAKOUT 2: PUTTING TOGETHER CCUS PROJECTS WITH BRIAN HILL

BREAKOUT 3: UNDERSTANDING THE LA CONTEXT REGARDING LIABILITY, PERMITTING, ETC. WITH JASON LANCLOS

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