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

GLOBAL CCS INSTITUTE

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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
## Day 1

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

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<td>Case Studies – Projects &amp; 45Q</td>
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<td>9:50 – 10:30</td>
<td>Challenges to Deployment and Strategies to Address Them</td>
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<td>10:30 – 10:35</td>
<td>Wrap-up and Break-out Instructions</td>
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<td>10:35 – 10:45</td>
<td>Break</td>
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### Breakout Sessions – 10:45 to 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

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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
THE STATUS OF CCS

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

JEFF ERIKSON, GENERAL MANAGER – CLIENT ENGAGEMENT
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)
USA REMAINS THE LEADER

Source: Global CCS Institute
CCS HUBS/CLUSTERS
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<th>Policies &amp; project characteristics</th>
<th>Carbon tax</th>
<th>Tax credit or emissions credit</th>
<th>Grant support</th>
<th>Provision by government or SOE</th>
<th>Regulatory requirement</th>
<th>Enhanced oil recovery</th>
<th>Low cost capture</th>
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Source: Global CCS Institute
# LOOKING AHEAD

<table>
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<td>Continued US leadership on CCUS</td>
<td>Revenue model?</td>
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Overview

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

US federal income tax credit for physically capturing CO₂ and storing it underground or in products

Tax credits are claimed on a per metric ton basis
  • The more CO₂ 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 CO₂ or CO ("carbon oxide")
  • Was only CO₂ 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 CO₂ at an EOR/EGR project
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 CO₂ - or to remove it from the atmosphere through DAC
- Includes all components of property used to capture or process the CO₂ until it is transported for storage
- Does not include pipelines or transport vessels to transport CO₂ 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
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)

Carbon Capture Equipment

* Carbon Capture Equipment must be placed in service at a Qualified Facility

Qualified Facility

- Qualified Facility must be one of the following:
  1. **Industrial Facility** is a facility that produces CO₂ from
     - a fuel combustion source or fuel cell, or
     - a fugitive CO₂ emission source, or
     - a manufacturing process (manufacture of any product other than CO₂ that is intended to be sold at a profit or used for a commercial purpose)
     - Excludes a CO₂ production well that produces from a natural CO₂-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 CO₂ directly from ambient air or atmosphere

- Must capture minimum amount of CO₂ 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
Where is it captured

45Q and Direct Air Capture (DAC) Plants

DAC Plant must use Carbon Capture Equipment to remove CO₂ directly from ambient air or atmosphere
- Must exclude facilities that capture CO₂ using natural photosynthesis or CO₂ that was deliberately released from the subsurface
- Must meet the requirements of a Qualified Facility
- Must capture at least 100,000 metric tons/year
- CO₂ must be measured at the source of capture
- CO₂ must be verified where it is Utilized, Injected, or Disposed

Source: Carbon Engineering

Direct Air Capture Facility
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
• 45Q credits are available if the minimum amount of captured CO₂ is stored through Utilization

• Utilization - Captured CO₂ must be utilized in one of the following ways:
  • Growing of algae or bacteria or other fixation through photosynthesis or chemosynthesis
  • Chemically converting CO₂ to a material or chemical compound where the CO₂ is securely stored
  • Use of the CO₂ for any other purpose for which a commercial market exists
• Amount of CO₂ utilized is determined based on a lifecycle GHG analysis (LCA) of CO₂ 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 CO₂
  • Whether utilization allows for 45Q credits when CO₂ 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 CO₂, and only serves to ensure the utilization process does not emit more GHGs than the amount of CO₂ 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 CO₂ 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 CO₂ to be placed in Secure Geologic Storage so that CO₂ does not escape into the atmosphere
  - Injection:
    - Use the captured CO₂ 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 CO₂ 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 CO₂ 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

Source: Houston Chronicle

CO₂ Injection Well
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 CO₂
  • 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
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).

### Table: Income/Loss and 45Q Credits

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<td>Cash</td>
<td>Income/Loss, and 45Q Credits</td>
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<td>Period 1</td>
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<tr>
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<td>Period 3</td>
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- 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.
What to avoid

Recapture

- “Recapture” is where Qualified CO₂ is Captured, Injected or Disposed and 45Q credits are claimed as a result, but then the Qualified CO₂ later leaks or ceases to be Captured, Injected or Disposed
- “Leaked Amount of Qualified CO₂” is the amount of CO₂ 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 CO₂ in a tax year during the Recapture Period
  - “Recapture Qualified CO₂” is the amount by which the Leaked Amount of Qualified CO₂ that year exceeds the Qualified CO₂ 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 CO₂ in a tax year exceeds the amount of Qualified CO₂ 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 CO₂ 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 CO₂ 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
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 CO₂ exceeds the CO₂ 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 CO₂ have been taken into account
- Current projection: phase out at end of 2021
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 CO₂ 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 CO₂ 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 CO₂, 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.
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
• CO₂ Transporter
• CO₂ 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
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 CO₂ were stored
  - Effective for CO₂ captured after October 3, 2008

- Amended on February 17, 2009:
  - CO₂ injected for EOR must go into “secure geologic storage”
  - Effective for CO₂ 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 CO2 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

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

ktracy@elysian.cc

Developing and operating carbon capture projects that decarbonize power and industrial facilities
BREAK
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
Regional Carbon Capture and Transport Opportunities for Storage in Louisiana

November 17, 2020

Elizabeth Abramson
Research Analyst
Great Plains Institute
Regional CO₂ Transport Infrastructure Study

Study Components
1. Identify near-term opportunities for CO₂ capture retrofit
2. Locate areas of CO₂ storage and use
3. Model optimized CO₂ transport infrastructure to maximize capture and storage

Primary Partners:
Analytical Report
Published June 30, 2020

Download the paper at:
carboncaptureready.org/analysis
Section 45Q
Tax Credit for CO₂ Storage

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

Minimum Capture Thresholds
Industrial Facility: 100 thousand tons CO₂
Power Plants: 500 thousand tons CO₂

Near- and Medium-Term Screening Criteria:
• 45Q Eligibility
• Operational patterns
• Expected life
• Right-size capture equipment to specific units within each facility
CO₂ Storage in Saline Formations & Petroleum Basins

US Saline Storage Potential
8.3 to 21.6 trillion metric tons CO₂

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

<table>
<thead>
<tr>
<th>Industry</th>
<th># of Facilities</th>
<th>Optimized Capture (mmt/year)</th>
<th>Average Estimated Cost $/ton</th>
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<tr>
<td>Ethanol</td>
<td>150</td>
<td>50.6</td>
<td>$17</td>
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<tr>
<td>Cement</td>
<td>45</td>
<td>32.7</td>
<td>$56</td>
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<tr>
<td>Refineries</td>
<td>38</td>
<td>26.5</td>
<td>$56</td>
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<td>Steel</td>
<td>6</td>
<td>14.6</td>
<td>$59</td>
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<tr>
<td>Hydrogen</td>
<td>34</td>
<td>14.4</td>
<td>$44</td>
</tr>
<tr>
<td>Gas Processing</td>
<td>20</td>
<td>4.5</td>
<td>$14</td>
</tr>
<tr>
<td>Petrochemicals</td>
<td>2</td>
<td>1.7</td>
<td>$59</td>
</tr>
<tr>
<td>Ammonia</td>
<td>3</td>
<td>0.9</td>
<td>$17</td>
</tr>
<tr>
<td>Chemicals</td>
<td>2</td>
<td>0.7</td>
<td>$30</td>
</tr>
<tr>
<td>Coal Power Plant</td>
<td>58</td>
<td>143.4</td>
<td>$56</td>
</tr>
<tr>
<td>Gas Power Plant</td>
<td>60</td>
<td>67.9</td>
<td>$57</td>
</tr>
<tr>
<td><strong>Grand Total</strong></td>
<td><strong>418</strong></td>
<td><strong>357.8</strong></td>
<td><strong>$39</strong></td>
</tr>
</tbody>
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Source: Jeff Brown, 2019
Midcentury: Long-term Economy-Wide Deployment
Expanded storage in saline formations and petroleum basins

Capture and storage: ~ 670 million metric tons per year
Midcentury: Long-term Economy-Wide Deployment
Expanded storage in saline formations and petroleum basins

Capture and storage: ~ 670 million metric tons per year
Shared CO₂ Transport Infrastructure: Beneficial Economies of Scale

Higher capacity achieves lower costs per ton

**Infrastructure investment by capacity**

$ per inch-mile

**Transport tariff by capacity**

$ per ton

Calculated with:

CO₂ Transport Cost Model
Small feeder lines have a higher per-ton cost because they deliver less CO₂.

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

Customers generally pay a transport tariff ($/ton) based on the route their CO₂ product takes through the transport network.
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.

<table>
<thead>
<tr>
<th>Cost Range</th>
<th>Length (miles)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Very Low</td>
<td>17,488</td>
</tr>
<tr>
<td>Low to Moderate</td>
<td>8,284</td>
</tr>
<tr>
<td>Moderate to High</td>
<td>4,027</td>
</tr>
</tbody>
</table>

Figure authored by Elizabeth Abramson, GPI, March 2020
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.

**Midcentury Scenario:**

Relative transport cost of network segments

*Capacity: 13.9 million tons CO2 per year*

*Capacity: 19.1 million tons CO2 per year*

Additional aggregation from sources within Louisiana
### Economies of Scale
- Benefit higher capacity for CO₂ delivery

### Regional Infrastructure
- Can store more CO₂ at a lower cost

### Long-term Planning
- Results in more CO₂ stored, smaller land use, and lower marginal cost

<table>
<thead>
<tr>
<th>Scenario</th>
<th>CO₂ Stored</th>
<th>Land Use</th>
<th>Capital Investment</th>
<th>Project Labor Investment</th>
<th>Annual O&amp;M Spending</th>
</tr>
</thead>
<tbody>
<tr>
<td>Near- and Medium-Term</td>
<td>281 million metric tons</td>
<td>29,710 miles</td>
<td>$16.6 billion</td>
<td>$14.3 billion</td>
<td>$252 million</td>
</tr>
<tr>
<td>Midcentury</td>
<td>669 million metric tons</td>
<td>29,922 miles</td>
<td>$19.3 billion</td>
<td>$15.3 billion</td>
<td>$254 million</td>
</tr>
</tbody>
</table>

Midcentury scenario increase over Near- and Medium-Term scenario:
- x 2.38 more CO₂ stored
- +0.7% Land Use
- 16.3% Capital Investment
- 7.0% Project Labor Investment
- 0.8% Annual O&M Spending

---

**GREAT PLAINS INSTITUTE**
Louisiana
Identified near- and medium-term capture opportunities

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: EPA GHGRP 2018; GPI 2019

<table>
<thead>
<tr>
<th>Industry</th>
<th>CO2 Captured Target (million metric tons CO2)</th>
<th>Total Louisiana Facility CO2 Emissions (million metric tons CO2)</th>
<th>Share of Industry Emissions Captured</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ammonia</td>
<td>0.5</td>
<td>8.9</td>
<td>5.5%</td>
</tr>
<tr>
<td>Chemicals</td>
<td>-</td>
<td>3.8</td>
<td>-</td>
</tr>
<tr>
<td>Coal Power Plant</td>
<td>3.2</td>
<td>18.5</td>
<td>17.3%</td>
</tr>
<tr>
<td>Gas Power Plant</td>
<td>8.0</td>
<td>26.0</td>
<td>30.8%</td>
</tr>
<tr>
<td>Gas Processing</td>
<td>0.5</td>
<td>11.9</td>
<td>4.0%</td>
</tr>
<tr>
<td>Hydrogen</td>
<td>4.2</td>
<td>7.6</td>
<td>55.1%</td>
</tr>
<tr>
<td>Metals, Minerals &amp; Other</td>
<td>-</td>
<td>2.4</td>
<td>-</td>
</tr>
<tr>
<td>Other Power Plant</td>
<td>-</td>
<td>2.1</td>
<td>-</td>
</tr>
<tr>
<td>Petrochemicals</td>
<td>-</td>
<td>14.2</td>
<td>-</td>
</tr>
<tr>
<td>Pulp &amp; Paper</td>
<td>0.0</td>
<td>2.8</td>
<td>-</td>
</tr>
<tr>
<td>Refineries</td>
<td>7.0</td>
<td>32.1</td>
<td>21.7%</td>
</tr>
<tr>
<td>Steel</td>
<td>-</td>
<td>0.1</td>
<td>-</td>
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<tr>
<td>Waste</td>
<td>-</td>
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<td>-</td>
</tr>
<tr>
<td><strong>Grand Total</strong></td>
<td><strong>23.3 MMT</strong></td>
<td><strong>130.5 MMT</strong></td>
<td><strong>18%</strong></td>
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</table>
### 45Q-Qualifying Power and Industrial Sources of CO2 in Louisiana

<table>
<thead>
<tr>
<th>Industry</th>
<th># of 45Q Qualifying Facilities</th>
<th>45Q Qualifying Emissions (MMT)</th>
<th>Total # of Facilities in Louisiana</th>
<th>Total Facility Emissions in Louisiana (MMT)</th>
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</thead>
<tbody>
<tr>
<td>Ammonia</td>
<td>4</td>
<td>8.9</td>
<td>4</td>
<td>8.9</td>
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<tr>
<td>Chemicals</td>
<td>1</td>
<td>0.3</td>
<td>31</td>
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</tr>
<tr>
<td>Coal Power Plant</td>
<td>4</td>
<td>18.5</td>
<td>31</td>
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<tr>
<td>Gas Power Plant</td>
<td>12</td>
<td>23.2</td>
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<td>Gas Processing</td>
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<td>227</td>
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<td>Hydrogen</td>
<td>10</td>
<td>7.4</td>
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<td>7.6</td>
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<td>Metals, Minerals &amp; Other</td>
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<td>1</td>
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<tr>
<td>Waste</td>
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<tr>
<td><strong>Grand Total</strong></td>
<td><strong>61</strong></td>
<td><strong>101.4 MMT</strong></td>
<td><strong>401</strong></td>
<td><strong>130.5 MMT</strong></td>
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**MMT**: million metric tons CO2

Source: EPA GHGRP 2018
Louisiana & Gulf Coast
Identified 45Q-qualifying industrial & power facilities

<table>
<thead>
<tr>
<th>Region</th>
<th>Industry</th>
<th>Number of Candidates</th>
<th>CO2 Emissions (million metric tons)</th>
<th>Number of Candidates</th>
<th>CO2 Emissions (million metric tons)</th>
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<td>13</td>
<td>24.5</td>
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<td>43.1</td>
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<td>57.5</td>
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<td>Gas Processing</td>
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<td>8</td>
<td>3.0</td>
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<td>54</td>
<td>136.9</td>
<td>87</td>
<td>170.9</td>
</tr>
<tr>
<td>Grand Total</td>
<td></td>
<td>92</td>
<td>219.7</td>
<td>168</td>
<td>303.5</td>
</tr>
</tbody>
</table>

Source: EPA GHGRP 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**

<table>
<thead>
<tr>
<th>Area</th>
<th>Million Tons CO2 per Year</th>
</tr>
</thead>
<tbody>
<tr>
<td>N. Louisiana</td>
<td>1.6</td>
</tr>
<tr>
<td>Louisiana Gulf</td>
<td>0.9</td>
</tr>
<tr>
<td>Oklahoma</td>
<td>50.9</td>
</tr>
<tr>
<td>Greater Texas</td>
<td>44.5</td>
</tr>
<tr>
<td>Permian</td>
<td>27.5</td>
</tr>
<tr>
<td>Corpus Christi</td>
<td>11.4</td>
</tr>
<tr>
<td>Houston</td>
<td>10.6</td>
</tr>
<tr>
<td>Kansas</td>
<td>9.6</td>
</tr>
<tr>
<td>Arkansas</td>
<td>1.4</td>
</tr>
<tr>
<td>Mississippi</td>
<td>1.2</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>159.6</strong></td>
</tr>
</tbody>
</table>

Potential Import of CO2 into Louisiana

<table>
<thead>
<tr>
<th>Supply Region</th>
<th>To Target Region</th>
<th>Economically Feasible Capture</th>
</tr>
</thead>
<tbody>
<tr>
<td>Midwest</td>
<td>Gulf</td>
<td>48 million tons</td>
</tr>
<tr>
<td>Midwest</td>
<td>Midcontinent &amp; TX</td>
<td>98 million tons</td>
</tr>
<tr>
<td>Louisiana</td>
<td>Louisiana</td>
<td>23 million tons</td>
</tr>
</tbody>
</table>

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
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

**NATIONAL**

- Transportation, 36.9%
- Electric Power, 33.5%
- Residential, 5.9%
- Industrial, 19.2%
- Commercial, 4.6%

**LOUISIANA**

- Transportation, 23.2%
- Electric Power, 14.7%
- Residential, 0.7%
- Industrial, 60.4%
- Commercial, 1.0%
High Concentration CO$_2$ Sources in Louisiana over 100,000 tonnes
Is CCUS Financially Feasible?

Source: NPC 2020
## Is EOR Financially Feasible in LA?

<table>
<thead>
<tr>
<th>Oil Price ($/bbl)</th>
<th>Nat Gas Processing</th>
<th>Ammonia</th>
<th>Ethylene oxide</th>
<th>Hydrogen</th>
</tr>
</thead>
<tbody>
<tr>
<td>30</td>
<td>316</td>
<td>254</td>
<td>299</td>
<td>-413</td>
</tr>
<tr>
<td>50</td>
<td>571</td>
<td>509</td>
<td>553</td>
<td>-158</td>
</tr>
<tr>
<td>70</td>
<td>826</td>
<td>764</td>
<td>808</td>
<td>97</td>
</tr>
</tbody>
</table>

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

Source: Snyder et al. 2020
What About Saline Storage?
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!
Developing CCUS Projects in LA

November 17, 2020
CO₂ Storage in Saline Formations & Petroleum Basins

Denbury’s Green Pipeline

- 321 miles, 24” CO₂ Pipeline
- In-service Capital >$1B
- Capacity >800 MMSCFD
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 CO₂ 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 CO₂ pipelines that transport CO₂ from the definition of “Storage Facility”
- Clarified existing CO₂ pipeline expropriation authority as under Title 19 rather than Title 30
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 CO₂ owner retains ownership option of injected CO₂;
- 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.
Louisiana has a far reaching and thoughtful, however untried, Carbon Sequestration program. CO\textsubscript{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\textsubscript{2} Storage Site Development will drive CO\textsubscript{2} Capture and CO\textsubscript{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
DEVELOPING CCUS PROJECTS IN LOUISIANA AND THE GULF COAST
NOVEMBER 17-18, 2020
## AGENDA

### Day 1

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

### Day 2

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

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
Lake Charles Methanol
Worlds Largest Single-Project Carbon Reduction Opportunity

Hunter Johnston
Lake Charles Methanol

November 2020
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 CO₂ per year.

Low-cost, clean methanol from petcoke
LCM’s CO₂ Capture and Sequestration will Produce Blue Methanol
Largest Single Project CO₂ Reduction Opportunity

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

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

Petcoke CCS will Support U.S. Decarbonization Progress

Petcoke gasification with CCS could have equaled up to 75% of non-hydro renewable energy CO₂ benefit over last 10 years
Industry-Leading CO₂ Capture Cost

Opportunity to implement substantial, low-cost CCS

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 CO₂ 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 CO₂ 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 CO₂ “is a valuable commodity”
Regional Hub for CO₂ 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 CO₂ 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
N. Hunter Johnston
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

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

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)
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

- **Gasifier**: Thermally and chemically break the material into its component parts to produce syngas.
- **Syngas clean-up**: Physically and chemically remove impurities from the syngas.
- **Fischer Tropsch Synthesis**: Chemically react the syngas to form long chain hydrocarbons.
- **Hydrocracker**: Chemically cut the long hydrocarbons to sustainable fuels (SPK and naphtha).

**Tree residue or Waste** → **Syngas** → **Clean syngas, High purity CO₂** → **FT product** → **Fuels**

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

Reference project: Bayou Fuels, Mississippi, US
Carbon Capture and Sequestration

• Partnership with industry leader

• Agreement with Oxy Low Carbon Ventures to capture and sequester the CO₂ from the Bayou Fuels plant

• Syngas clean-up systems produce concentrated, clean CO₂ stream which can be compressed for pipeline

• CO₂ 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

Carbon Intensity (CI) Scores of transportation fuel options

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
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
Developing CCUS Projects in Louisiana and the Gulf Coast

Lee Stockwell  
November 18th, 2020
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

Louisiana Total CO2 emissions:
200 mtCO₂/year of which 35mtCO₂/year is pure streams

Potential emitters:
Power plants, refineries, chemical plants, fertilizers, hydrogen producers, 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
Gulf Coast – Potential Carbon Capture Model

How this model could work:
- CO₂ capture from a selection of facilities along the Gulf Coast, pipeline transport to CO₂ 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 CO₂ storage
- Operating CCUS projects and CO₂ 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
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