

APRIL 14, 2023

Hydrogen Asset Inventory

 **H₂theFUTURE**
ENERGY TRANSFORMATION IN SOUTH LOUISIANA

PREPARED BY:
EMERGENT METHOD

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Overview

South Louisiana's hydrogen value chain is well-developed and includes key components from energy and feedstocks to end users. The region's access to abundant and diverse energy resources, well-developed infrastructure, and established end users position south Louisiana as a key player in the global energy transition. South Louisiana's Regional Economic Development Organizations—Baton Rouge Area Chamber, Greater New Orleans, Inc., South Louisiana Economic Council, Southwest Louisiana Economic Development Alliance, and One Acadiana—have significant opportunities to leverage their collective assets to attract new jobs and capital investments across south Louisiana.

ENERGY AND FEEDSTOCKS

South Louisiana has access to abundant and diverse energy resources, including natural gas, coal, and biomass. These resources can be used as feedstocks for hydrogen production through various methods such as steam methane reforming, gasification, and electrolysis. Additionally, the region has access to renewable energy sources such as solar and wind, which can be used for hydrogen production through renewable electrolysis.

PRODUCTION

Several companies in south Louisiana are involved in hydrogen production, including Air Products, Air Liquide, and Praxair. These companies use a variety of methods to produce hydrogen, including steam methane reforming, gasification, and electrolysis. Additionally, south Louisiana is home to large-scale ammonia production facilities. Ammonia can be broken down into its component gases, hydrogen, and nitrogen. The resulting hydrogen can then be used as a fuel or as a feedstock for various industrial processes.

INFRASTRUCTURE

South Louisiana has well-developed infrastructure

for hydrogen production and transportation. The region has numerous hydrogen production facilities, which primarily rely on natural gas and other fossil fuels as feedstock, resulting in grey, brown, or pink hydrogen. As Carbon Capture and Sequestration (CCS) technology continues to progress, companies in south Louisiana are well-positioned to produce blue hydrogen. In addition, south Louisiana has various pipelines and storage facilities for hydrogen transportation. Upcoming federal funding opportunities and anticipated private investments will facilitate cleaner production technologies and bolster the blue and green hydrogen industries in the region moving forward.

Air Products' hydrogen pipeline provides a consistent and reliable supply of hydrogen to companies integrating hydrogen into their operations. The pipeline can support the growth of the hydrogen economy by providing access to green and blue hydrogen, which is particularly important as demand for low-carbon hydrogen continues to grow and companies seek reliable and efficient ways to transport hydrogen.

STORAGE

Hydrogen can be stored in several forms, including compressed gas, liquid, and solid-state storage. South Louisiana has several hydrogen storage facilities that

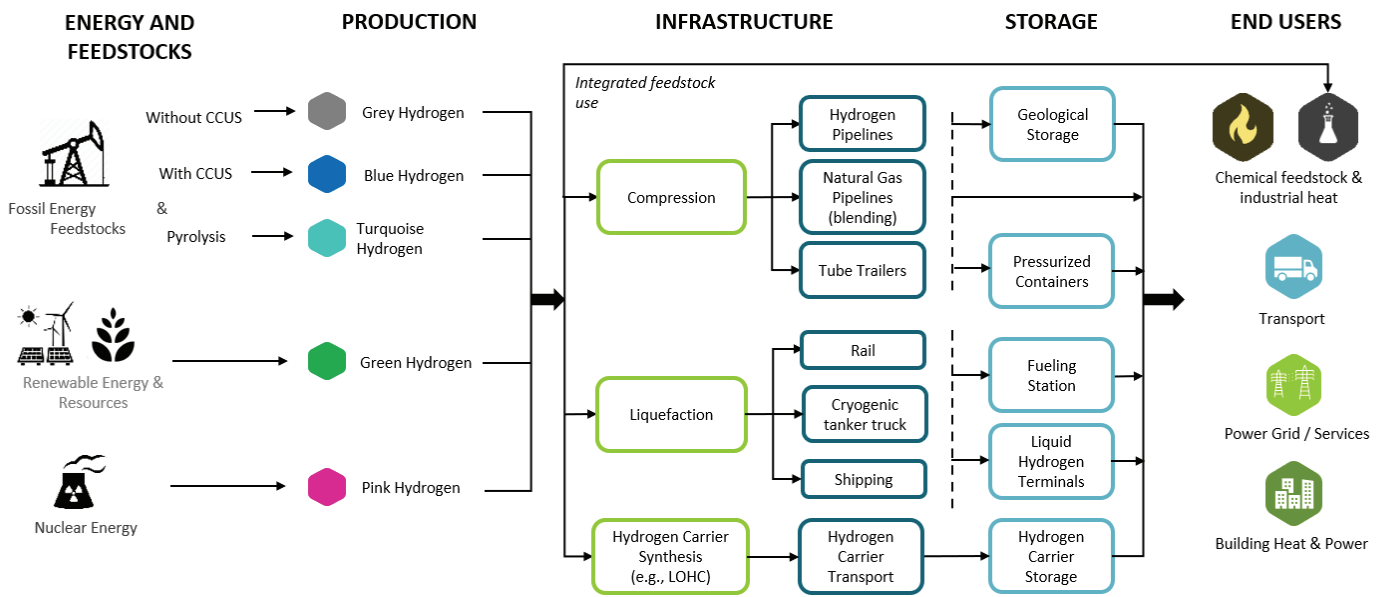
use these methods to store hydrogen for transportation and end-use applications.

END USERS

South Louisiana has a wide range of hydrogen end users, primarily in the chemical and refining industries. These industries use hydrogen as a feedstock and for process applications, such as hydrocracking and hydrotreating. Additionally, there is a growing demand for the use of hydrogen as a fuel for transportation, including fuel cell electric vehicles and hydrogen-powered buses, which signals continued growth for industry across south Louisiana.



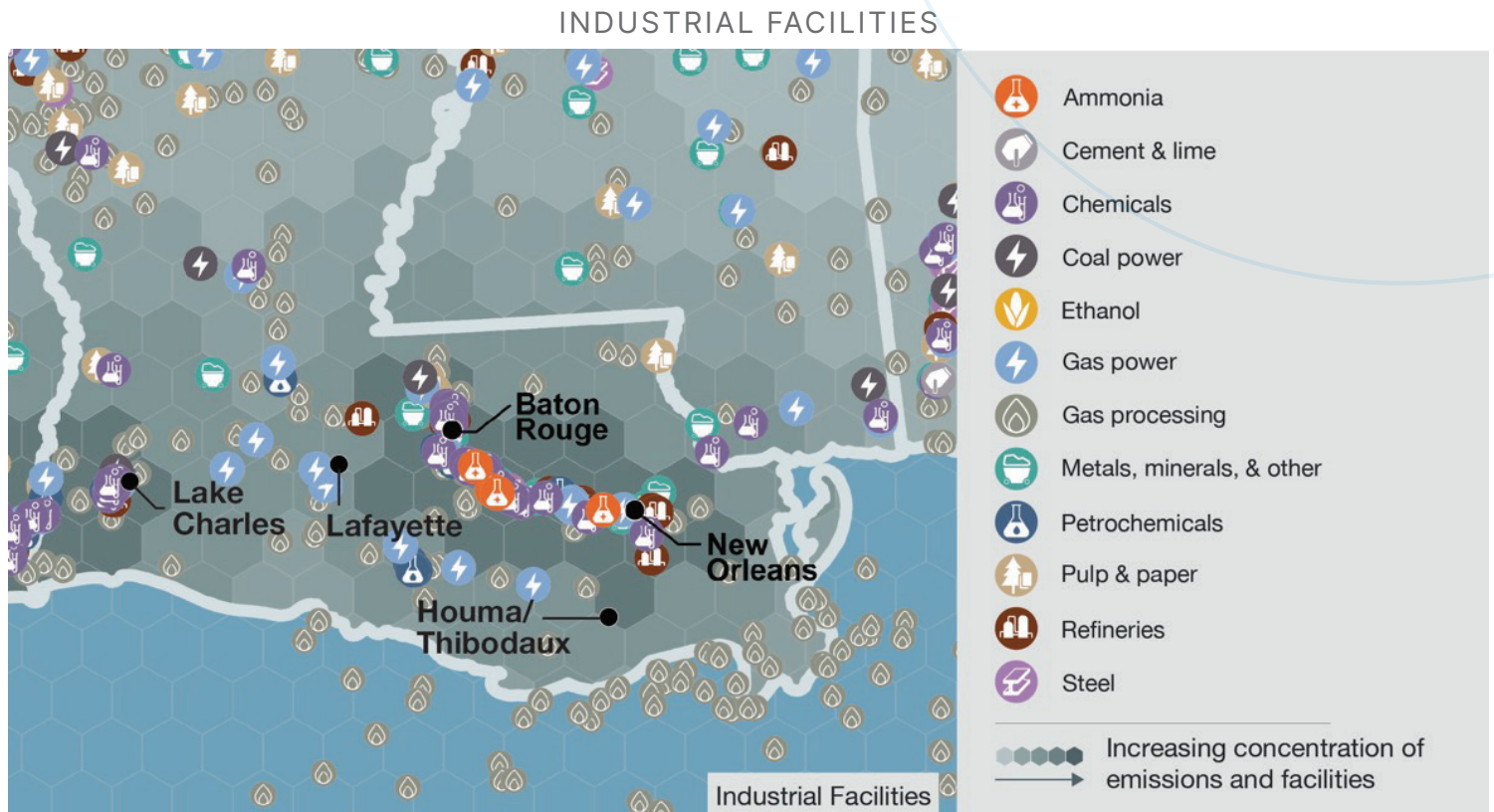
HYDROGEN VALUE CHAIN



South Louisiana's Hydrogen Advantages

INDUSTRIAL OPERATIONS POISED FOR DECARBONIZATION

Louisiana's abundant energy resources, access to CCS technology, skilled energy workforce, competitive state policies, and established industrial infrastructure position the state's industrial facilities to reduce carbon emissions, develop more efficient technologies, and transition to cleaner energy sources. By leveraging these advantages and investing in clean energy solutions, Louisiana can create clean energy jobs, reduce its carbon footprint, and contribute to a more sustainable future.



A DENSE NETWORK OF NATURAL GAS AND OIL PIPELINES

South Louisiana's existing oil and natural gas pipelines provide important benefits for the state's hydrogen economy. By strategically placing hydrogen pipelines alongside preexisting natural gas and oil pipelines, where established rights-of-ways already exist, the state can increase efficiency and minimize surface disturbances. Pipeline transportation of hydrogen can be cost-effective and efficient, especially over long distances. It can also be a safer

option than other modes of transportation, as it reduces the risk of accidents and spills. Existing pipelines can be integrated into the hydrogen supply chain, connecting hydrogen production facilities to other transportation modes and distribution channels. This can help support the development of a comprehensive hydrogen infrastructure in south Louisiana. The state's pipelines connect to major cities and industries in the region, providing access to a wide range of potential customers and markets for hydrogen. This accessibility can help support the growth of the hydrogen industry in south Louisiana and the wider Gulf Coast region.

The U.S. Department of Energy's (DOE) \$8 billion Regional Clean Hydrogen Hub funding opportunity, which Louisiana is pursuing with Arkansas and Oklahoma, allows for companies to retrofit existing pipeline infrastructure for hydrogen transport. This will complement ongoing private investments to repurpose existing pipeline networks to transport hydrogen from production facilities to various end-users, including refineries, chemical plants, and other industrial facilities.

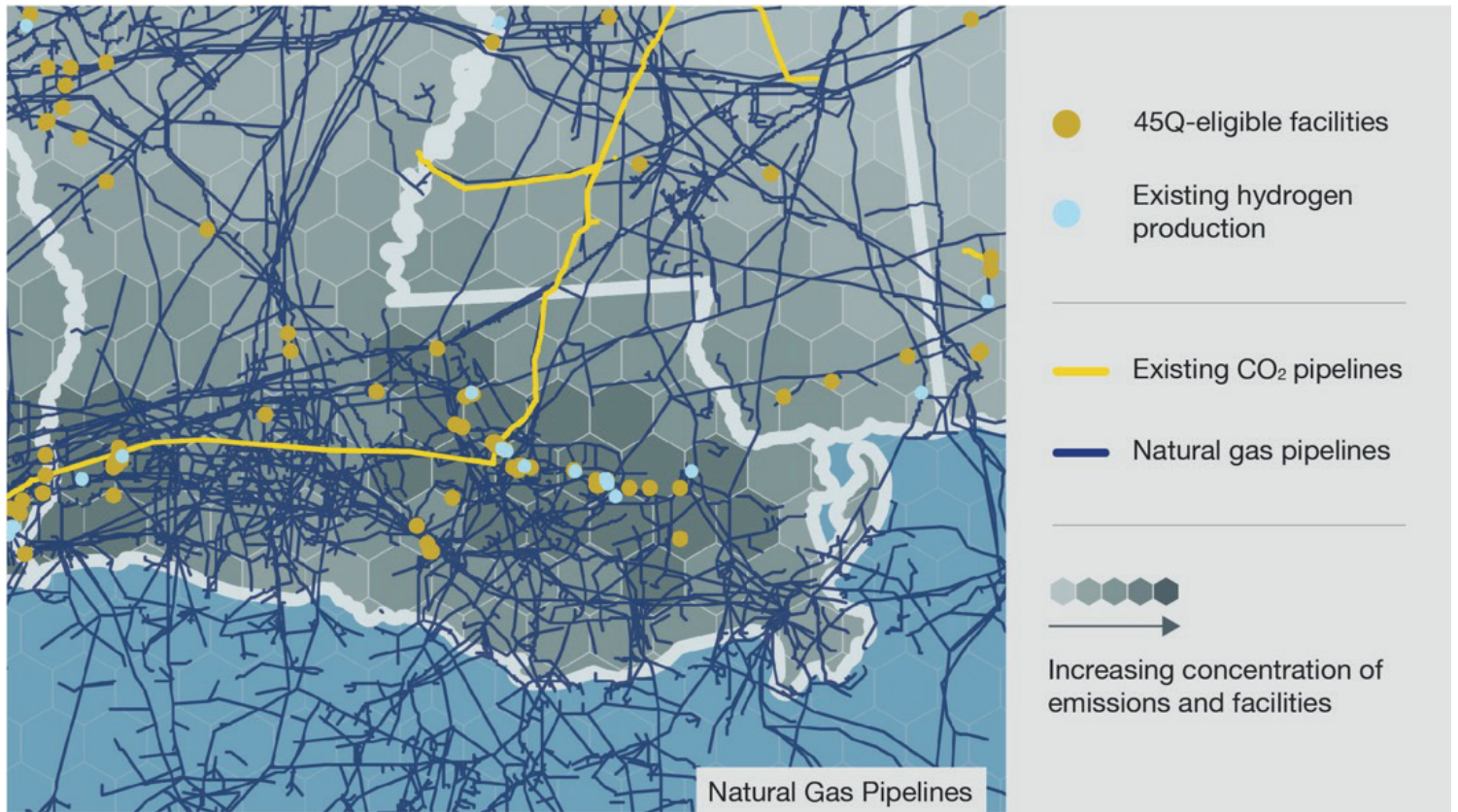
While leveraging south Louisiana's existing oil and natural gas pipeline network is a tremendous opportunity, state leaders and industrial partners must be mindful that the retrofitting process requires careful consideration and expertise. It is critical to ensure that existing pipelines are compatible with hydrogen, properly cleaned, modified to meet hydrogen transport requirements, and thoroughly tested before beginning hydrogen transport.

In addition to DOE's Regional Clean Hydrogen Hub funding opportunity, there are a number of other federal funding opportunities that could be pursued in south Louisiana to further optimize both existing pipeline infrastructure and other various components of the energy ecosystem, including but not limited to the following:

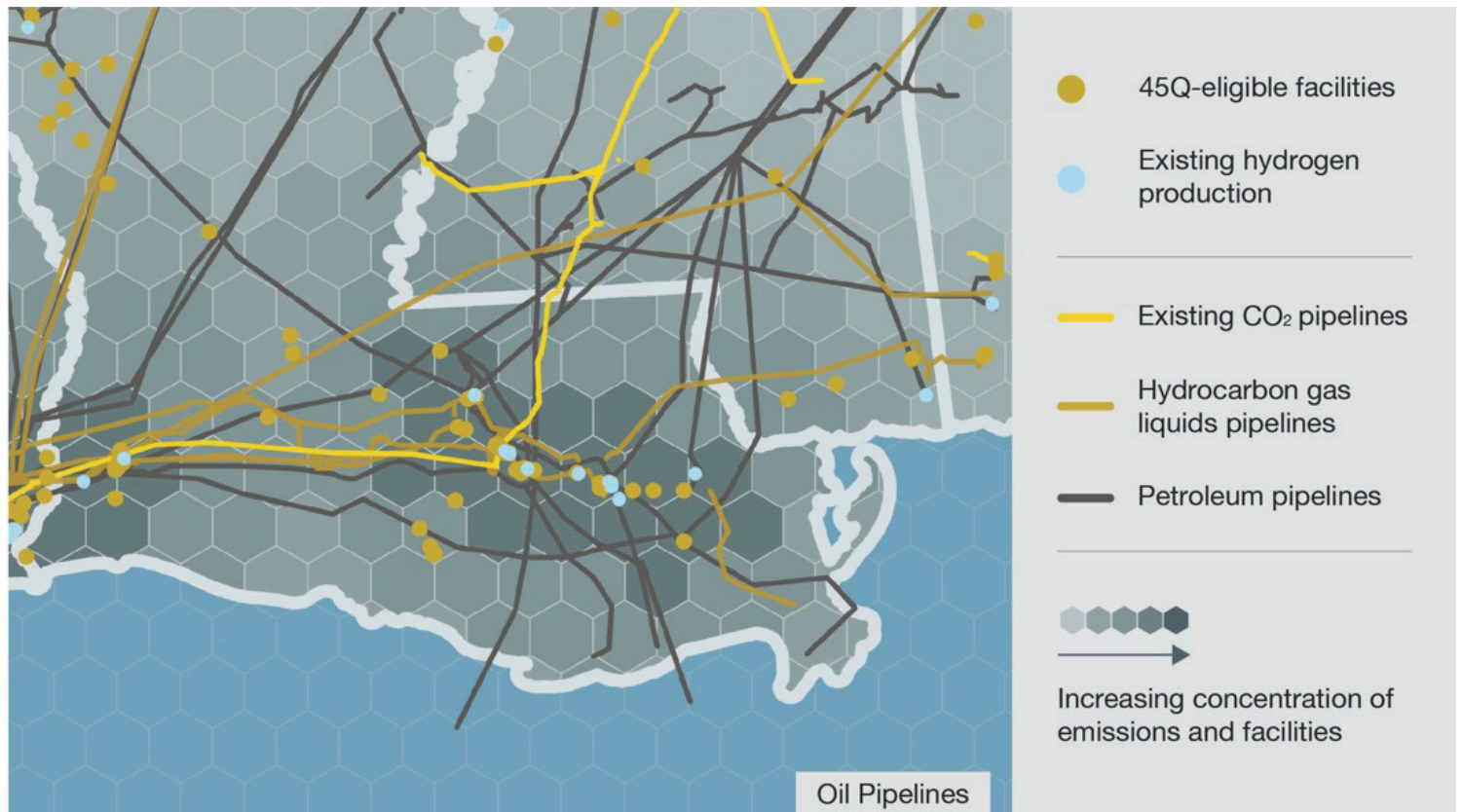
- **Energy Efficiency Revolving Loan Fund Capitalization Grant Program** – Funding for states and territories to establish revolving loan funds to invest in energy efficiency upgrades
- **Grid Innovation Program** – Funding to support projects that use innovative approaches to transmission, storage, and distribution infrastructure to enhance grid resilience and reliability
- **Energy Efficiency and Conservation Block Grant** – Funding for clean energy projects and programs in local communities. Funding can be used for a variety of projects, such as developing clean energy strategies, making buildings more energy efficient, installing renewable energy on government buildings, and funding a community solar campaign
- **Charging & Fueling Infrastructure Grants** – Competitive grants to states, local governments, metropolitan planning organizations, and other public-sector entities to support the installation of publicly accessible charging infrastructure—or stations for alternative fuels such as hydrogen or natural gas
- **The Energy Improvements in Rural or Remote Areas (ERA) Program** – Funding that seeks to improve the resilience, reliability, and affordability of energy systems in communities across the country with 10,000 or fewer people



NATURAL GAS PIPELINES



OIL PIPELINES



THE WORLD'S LARGEST HYDROGEN PIPELINE SYSTEM

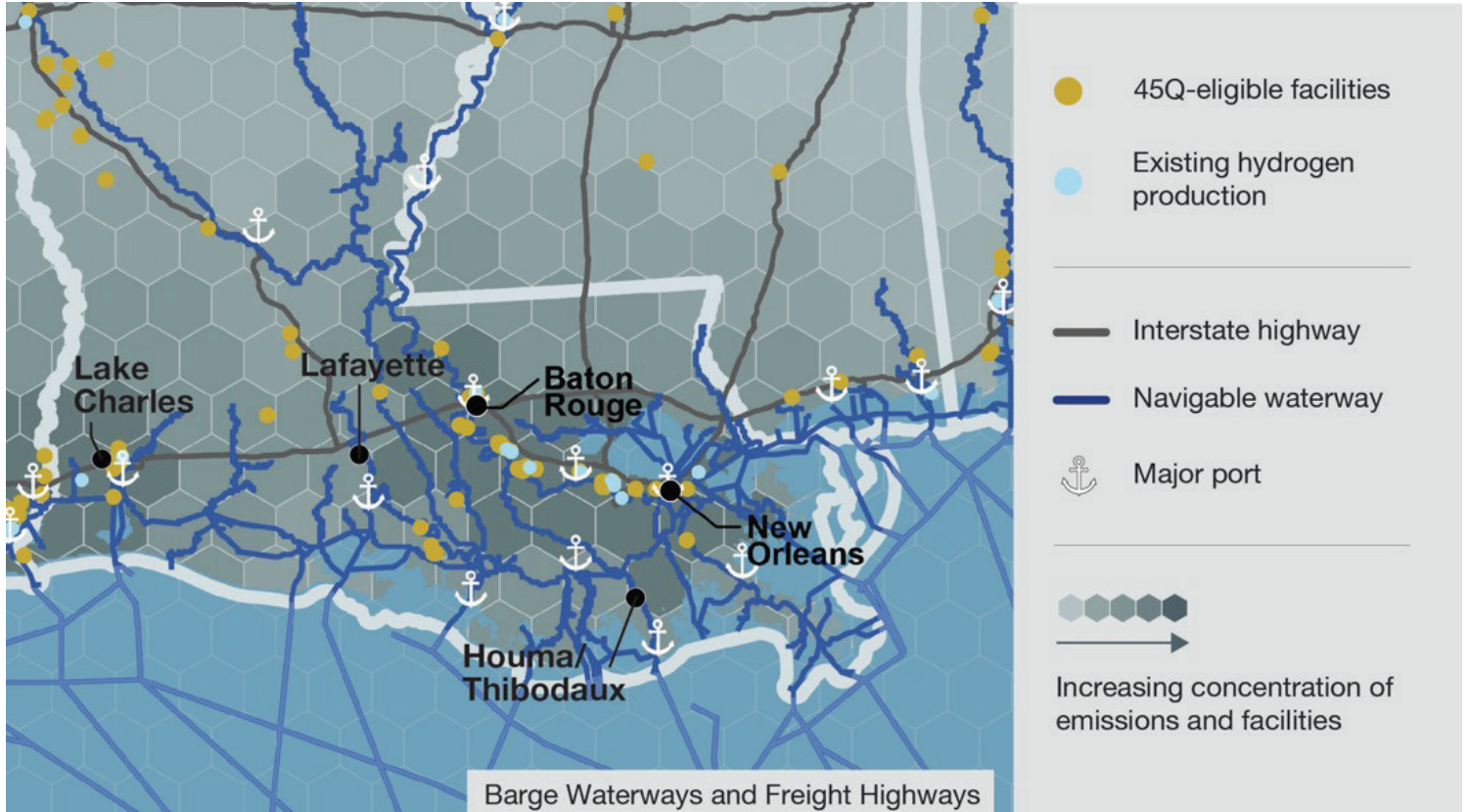
Air Products' 180-mile pipeline between Lake Charles and Plaquemine, completed in 2012, united the company's eastern and western Gulf Coast facilities to form the world's largest hydrogen supply pipeline network. This integrated system enhances Air Products' flexibility to shift hydrogen when and where needed, giving off-takers a reliable source of hydrogen delivered from nearly any facility along the system. With more than 20 hydrogen plants and over 600 total miles of pipeline, Air Products can supply industrial partners in Louisiana and Texas with more than 1 billion cubic feet of hydrogen per day. Overall, Air Products' hydrogen pipeline improves access to blue and green hydrogen in south Louisiana by providing a reliable and cost-effective means of transport.



BARGE WATERWAYS AND FREIGHT HIGHWAYS

Louisiana's barge waterways and freight highways can provide important benefits for the state's hydrogen industry, including efficient and cost-effective transport of hydrogen, integration into the supply chain, accessibility to markets, reduced emissions, and opportunities for infrastructure development and economic growth.

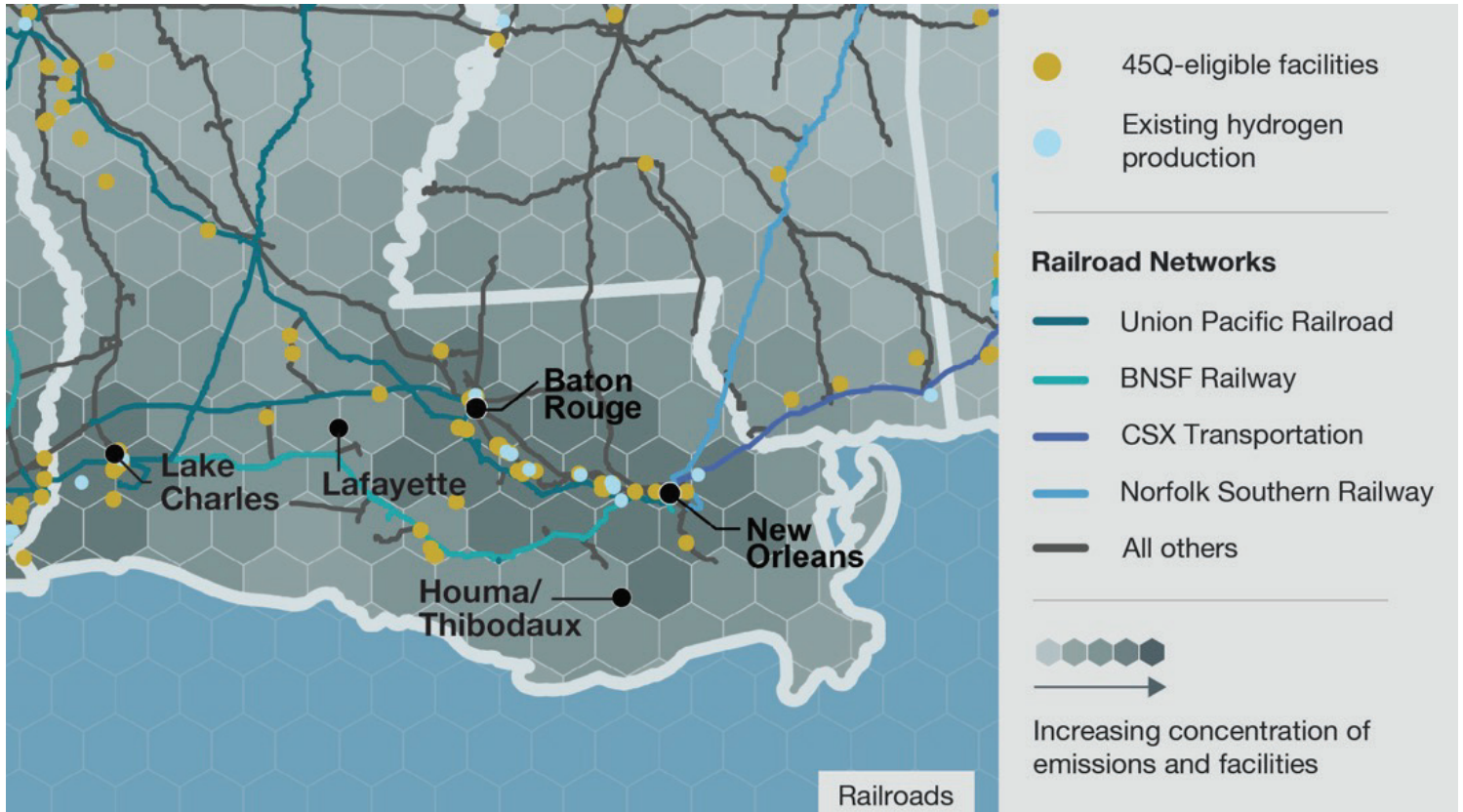
The hydrogen industry requires a complex supply chain that involves production, transportation, and distribution. Barge transportation can be integrated into this supply chain, connecting hydrogen production facilities to other transportation modes and distribution channels, such as pipelines, rails, or trucks.



RAIL ACCESS

Louisiana's rail transportation system contributes to the state's hydrogen industry, including efficient and cost-effective transport of hydrogen, integration into the supply chain, accessibility to markets, reduced emissions, and opportunities for infrastructure development and economic growth.

Louisiana's rail network connects to major cities and ports in the region, providing access to a wide range of potential customers and markets for hydrogen. This accessibility can help support the growth of the hydrogen industry in the state and the wider Gulf Coast region.

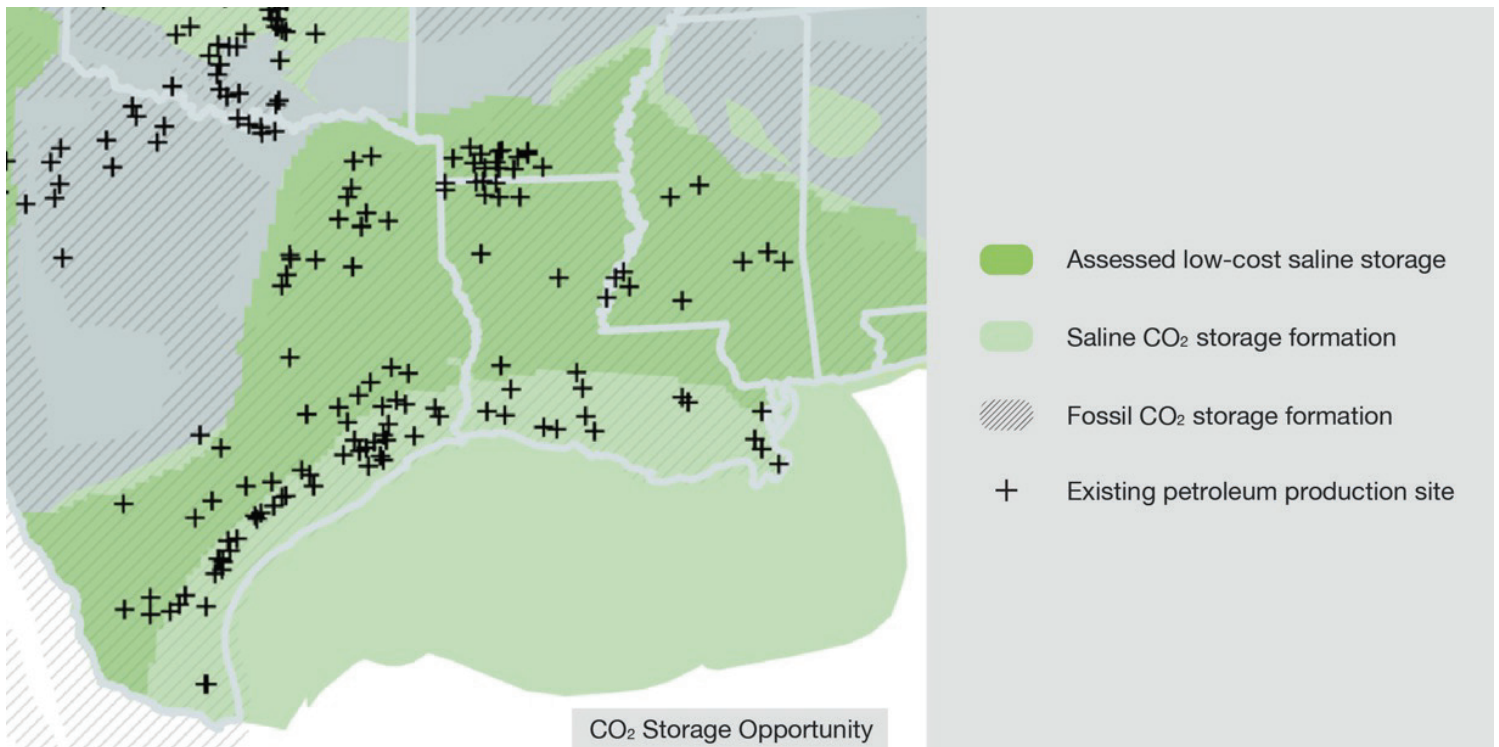


GEOLOGIC STORAGE OPPORTUNITIES

South Louisiana has significant opportunities for CCS, particularly through the use of geological storage. Geological storage involves capturing CO₂ emissions from industrial processes or power plants and injecting the CO₂ into underground rock formations, where it can be stored for long periods of time.

Louisiana's Gulf Coast region is particularly well-suited for geological storage due to its abundant offshore and onshore oil and gas fields. These fields contain porous rock formations that are suitable for CO₂ storage, and many of these fields are located close to industrial facilities that emit large amounts of CO₂.

Section 45Q of the United States Internal Revenue Code provides a tax credit for CO₂ storage. By encouraging investment in these important technologies, Louisiana can significantly reduce its carbon footprint and pave the way toward a cleaner, more economically diverse state.



ENERGY AND FEEDSTOCKS¹

Natural Gas

Louisiana is one of the top states in the United States for natural gas production and reserves. With the Haynesville Shale formation located mainly in the northwest region of Louisiana and northeast Texas, the state accounts for roughly 9% of the total natural gas production in the U.S. Additionally, Louisiana holds about 8% of the country's natural gas proved reserves. This abundant supply of natural gas is primarily distributed via pipelines to power industrial activities in southern Louisiana. In total, Louisiana has 19 underground storage sites located in depleted fields and salt caverns, providing 8% of the U.S.'s underground storage capacity. This infrastructure enables Louisiana to store natural gas during periods of low demand and quickly increase delivery when markets across the country require larger volumes of gas.

Petroleum

Louisiana is a significant contributor to the US oil industry, ranking among the top 10 states in both crude oil production and reserves. While the state's crude oil reserves make up only about 1% of the US total, its production accounts for a similar share. Most of this production takes place in the southern part of the state. Louisiana's heavy concentration of petrochemical manufacturing facilities also contributes to the state ranking third in total petroleum use and first in per capita consumption of petroleum.

¹ U.S. Energy Information Administration (2022, May 19). Louisiana State Energy Profile. <https://www.eia.gov/state/print.php?sid=LA>



Coal

Louisiana's coal reserves are relatively small, representing only 0.1% of the total coal reserves in the United States. However, the state's location and infrastructure play a significant role in the transportation of coal. The Port of New Orleans is a major hub for U.S. coal exports, shipping approximately 13% of the country's total coal exports in 2021. The majority of the coal used for power generation in Louisiana is sourced from out of state, with about 85% of that coal transported by rail from Wyoming. A small portion of the coal consumed in Louisiana is transported by barge down the Mississippi River from Illinois and Indiana.

Electricity

In 2021, natural gas was the primary fuel used to generate electricity in Louisiana, accounting for 65% of the state's electricity net generation. Natural gas fuels 7 of the 10 largest power plants in Louisiana, based on generation. Nuclear electric power surpassed coal as the state's second-largest source of in-state electricity in 2015. Louisiana's two nuclear power plants, which are both located along the Mississippi River, accounted for about 18% of the state's net generation in 2021. In 2021, the industrial sector consumed the most electricity in the state, accounting for about 42% of the state total, followed by the residential sector at 33% and the commercial sector at 25%. This consumption is heavily weighted in south Louisiana, which is home to the state's largest population centers and industrial activity along the Mississippi River.

Renewables

As of 2021, renewable energy sources contributed to nearly 4% of Louisiana's net electricity generation. The state is rich in biomass resources, with wood and wood waste being the primary sources of renewable electricity, accounting for almost 60% of the state's renewable energy output. South Louisiana's subtropical climate, characterized by substantial annual rainfall and fertile soil, creates vast opportunities for renewable energy generation via biomass for industrial, residential, and multimodal usage.

Hydroelectric power made up nearly one-third of Louisiana's renewable electricity generation in 2021. In the same time period, Louisiana's renewable energy mix saw solar power contribute just over 10% of the state's renewable electricity generation. Utility-scale solar power generation increased fourfold in 2021, thanks to the state's largest solar farm, which started operating near Baton Rouge in late 2020. With 50 megawatts in generating capacity from 197,000 solar panels, the solar farm played a significant role in boosting the state's solar power capacity.

A 2020 study by the National Renewable Energy Laboratory (NREL) revealed the Gulf of Mexico's advantages for offshore wind power development. Its favorable conditions, such as shallow, warm waters, below-average wave heights, and access to existing oil and gas infrastructure, have the potential to develop more than 500 gigawatts of electricity. This is twice the electricity consumption across the region from Texas to Florida, opening up a world of opportunities for offshore wind production.²

² U.S. Department of the Interior Bureau of Ocean Energy Management New Orleans Office (n.d.). Survey and Assessment of the Ocean Renewable Energy Resources in the US Gulf of Mexico. U.S. Department of the Interior. https://espis.boem.gov/final%20reports/BOEM_2020-017.pdf

DOE's Identified Growth Opportunities³

In its 2022 National Clean Hydrogen Strategy and Roadmap, the DOE developed a plan for the adoption of clean hydrogen in the United States, which involves three adoption phases or “waves,” with the First Wave representing today, the Second Wave representing the break-even period for clean hydrogen, and the Third Wave representing the long-term. The placement of end-use applications within each phase is determined by a variety of quantitative and qualitative factors, and will be regularly updated to reflect changes in the industry and policy landscape. South Louisiana can align its regional strategic assets with DOE's waves to sharpen the focus of its business development and expansion efforts. The following sections provide an overview of DOE's three adoption phases.

FIRST WAVE

Forklifts and Other Material Handling Equipment

Forklifts and other material handling equipment in warehouses, ports, and other industrial sites have a high utilization rate, require predictable refueling locations, and demand fast refueling times. This niche application has already been catalyzed in the U.S. by DOE, enabling the deployment of thousands of hydrogen fuel cell systems in the market and the emergence of a nascent infrastructure.

Refineries

Refineries represent the largest hydrogen market today and have no alternative for cracking heavy crude oil and for desulfurization. Switching to the use of clean hydrogen will create demand in the near term and immediately reduce emissions.

Transit Buses

Transit buses present an attractive use case for hydrogen, especially in regions that require long-distance operation and high uptime. Large bus fleets of transit agencies may face challenges with individual battery electric vehicle charging, making fuel cell electric buses a promising solution. As hydrogen

infrastructure continues to grow, transit agencies can realize the benefits of zero-emission transportation with hydrogen fuel cell buses.

Long-Haul Heavy-Duty Trucks

Heavy-duty trucks play a crucial role in commerce, but their frequent use, high energy demands, and need for fast refueling create significant environmental challenges. These vehicles, along with medium-duty vehicles (MDVs), are responsible for up to 20% of greenhouse gas emissions in the transportation sector in the United States. DOE is committed to finding sustainable and efficient solutions to address these challenges, making it one of its key focus areas.

Heavy Machinery in Mining, Construction, and Agriculture

Heavy machinery used in mining, construction, and agriculture could greatly benefit from fuel cell propulsion. These applications require high power output, fast refueling, and often operate in remote locations with limited access to power grids. The use of fuel cells in these industries can greatly reduce emissions and increase efficiency. The large volume of hydrogen required for these applications will also create significant demand.

³ U.S. Department of Energy (2022, September 1). DOE National Clean Hydrogen Strategy and Roadmap. <https://www.hydrogen.energy.gov/pdfs/clean-hydrogen-strategy-roadmap.pdf>

Ammonia Production

Today, ammonia production relies on carbon-intensive hydrogen as a feedstock, but this can be replaced with clean hydrogen without the need for retrofitting plants. Ammonia is the second-largest captive market for hydrogen after refining and can offer stable demand for clean hydrogen.

SECOND WAVE

Medium-Duty Trucks

Medium-duty trucks powered by hydrogen fuel cells are expected to become more widely available at scale as the heavy-duty transport sector leads the way in expanding hydrogen distribution and refueling infrastructure.

Regional Ferries

As hydrogen and fuel cell costs decrease, regional ferries powered by fuel cells, which can transport people or goods over short distances, are expected to become cost-competitive with internal combustion engines.

Industrial Chemical Production

Industries like plastic production depend on the use of high-temperature heat which is challenging to create through conventional electricity or from hydrogen derived from fossil fuels. A viable solution exists in the form of clean hydrogen, which can effectively decarbonize these industries, acting as a clean source of heat generation and a sustainable feedstock.

Steel Production

Clean hydrogen can aid in the decarbonization of steel production, particularly for iron ore-based steel production that requires carbon-free reductants and high temperatures. In cases where electrolytic production is not yet feasible, clean hydrogen can serve as a suitable alternative.

Energy Storage and Power Generation

As technology advances to produce low nitrogen oxide emissions, the power generation and energy storage industries can shift towards using gas turbines that are fueled with a mixture of natural gas and hydrogen or pure hydrogen. Fuel cells also offer a viable option as a power conversion technology. Clean hydrogen can play a pivotal role in seasonal storage, which is essential in completely decarbonizing the power grid and eliminating fossil-based power generation.

Aviation

Aviation can shift towards more sustainable fuels by using clean hydrogen and biomass or waste feedstocks. This will support the goal set by the Biden-

Harris Administration of producing 3 billion gallons of sustainable aviation fuel. Scaling up the production of clean hydrogen will also create a foundation for producing power-to-liquids in the future. According to industry feedback, certain market segments could directly utilize hydrogen, although cryogenic storage may be necessary to meet the energy density requirements.

THIRD WAVE

Backup Power and Stationary Power

Fuel cells can provide backup and stationary power, offering an alternative to diesel generators for ensuring the resiliency of critical 24/7 facilities such as hospitals and data centers. This switch to fuel cells also has the added benefit of improving air quality, particularly in disadvantaged communities. It's important to note that backup power differs from energy storage as its purpose is to provide resilience for a specific customer or microgrid, whereas energy storage supports the macro grid.

Methanol

Clean hydrogen can be used to produce methanol, which in turn can be utilized directly as a fuel or fuel supplement in various maritime applications such as container ships, rail, and other modes of transportation. Methanol also serves as an energy carrier.

Container Ships

Container ships are responsible for transporting approximately 90% of global trade by volume, but they also contribute to roughly 3% of global carbon emissions and a significant portion of sulfur dioxide emissions. In the future, during the third wave, cleaner alternatives such as clean ammonia, clean methanol, and liquified clean hydrogen may offer more sustainable options for the shipping industry.

Cement

Clean hydrogen can be utilized by the cement industry to reduce direct CO2 emissions in instances where electrification is not feasible due to high heat requirements.

Blending with Existing Natural Gas Networks

Blending clean hydrogen with existing natural gas networks can facilitate the targeted decarbonization of high-temperature heating systems, particularly in the industrial sector, where certain industries such as chemicals require high temperatures. Although this application can begin during DOE's First Wave, significant cost reductions are necessary to make it economically feasible.

Hydrogen Production In South Louisiana⁴

South Louisiana has a strong collection of companies that have invested in on-site hydrogen production facilities, such as steam methane reformers or electrolyzers, to meet their own demand for hydrogen. In some cases, these companies have begun selling excess hydrogen to nearby customers or to the local pipeline network. As demand for clean hydrogen grows in industries such as transportation and power generation, these existing hydrogen producers in south Louisiana will have the opportunity to expand their customer base beyond their own industrial activities and supply offtakers in new markets.

REGION	CITY	PARISH	FACILITY	2021 CO2 EMISSIONS (METRIC TONS)
Capital	Baton Rouge	East Baton Rouge	Air Products and Chemicals, Inc. - BR SMR	738,863
Capital	Geismar	Ascension	Air Products and Chemicals, Inc. - Geismar SMR	1,002,698
Capital	Geismar	Ascension	Air Products and Chemicals, Inc.	0
Capital	Geismar	Ascension	Air Products - Geismar 3 HYCO	270,671
Capital	Geismar	Ascension	Linde Inc - Geismar HYCO Facility	444,330
Southeast	Convent	St. James	Air Products and Chemicals, Inc. - Convent SMR	1,002,754
Southeast	Garyville	St. John the Baptist	Air Products and Chemicals, Inc. - Garyville	802,345
Southeast	Luling	St. Charles	Air Products and Chemicals, Inc. - Luling SMR Facility	711,367
Southeast	New Orleans	Orleans	Air Products and Chemicals, Inc. - Industrial Gas Production Facility	71,085
Southeast	Norco	St. Charles	Air Products and Chemicals - Norco SMR	934,629
Southeast	Norco	St. Charles	Linde Inc, St. Charles Facility	937,008

⁴ U.S. Environmental Protection Agency (n.d.). 2021 Greenhouse Gas Emissions from Large Facilities. Environmental Protection Agency. <https://ghgdata.epa.gov/ghgp/main.do#/listFacility?q=Find>

REGION	CITY	PARISH	FACILITY	2021 CO2 EMISSIONS (METRIC TONS)
Southeast	Norco	St. Charles	Valero Refining - New Orleans, L.L.C.	564,087
Southwest	Westlake	Calcasieu	Air Products and Chemicals, Inc. - Lake Charles Facility	1,003,013
Southwest	Sulphur	Calcasieu	Linde Inc.	345,235
Publicly Anticipated/Proposed				
Capital	Darrow	Ascension	Air Products Darrow Blue Energy Facility	N/A
Capital	St. Gabriel	Iberville	Olin Corporation and Plug Power JV - liquid hydrogen production facility	N/A
Southeast	Reserve	St. John the Baptist	AmmPower green hydrogen/ammonia production facility	N/A



South Louisiana Hydrogen End Users

Petroleum refineries and ammonia and methanol production facilities represent an overwhelming share of hydrogen demand. Hydrogen offtake agreements between producers and customers are often confidential and unavailable in the public domain. As such, to identify potential hydrogen end-users in south Louisiana, the following tables are centered on industries that have the highest demand for hydrogen.

REFINERIES

57% of U.S. hydrogen⁵ demand comes from the petroleum refining industry. Refineries use hydrogen to eliminate sulfur in their products and to convert heavy oil into more refined gasoline and other substances. The amount of hydrogen refineries use depends on the type of crude oil being processed and the variety of products being produced. Hydrogen is often a by-product of the refining process, which is especially true during catalytic reforming, a process that yields high-octane products.

REGION	CITY	PARISH	FACILITY	2021 CO2 EMISSIONS (METRIC TONS)
Acadiana	Krotz Springs	St. Landry	Alon Refining Krotz Springs Inc.	459,812
Capital	Baton Rouge	East Baton Rouge	ExxonMobil Baton Rouge Refinery and Chemical Plant	6,226,040
Capital	Port Allen	West Baton Rouge	Placid Refining Co. LLC - Port Allen Refinery	632,244
Southeast	Chalmette	St. Bernard	Chalmette Refining LLC Refinery	1,565,594
Southeast	Convent	St. James	Shell Convent Refinery	162,270
Southeast	Garyville	St. John the Baptist	Marathon Garyville Refinery	4,034,489
Southeast	Meraux	St. Bernard	Valero Meraux Refinery	710,508
Southeast	Norco	St. Charles	Shell Norco Manufacturing Complex	3,187,407
Southeast	Belle Chase	Plaquemines	Phillips 66 Co. Alliance Refinery	1,841,565
Southeast	St. Rose	St. Charles	St. Rose, LLC Facility	4,616
Southeast	Norco	St. Charles	Valero Refining New Orleans LLC	1,983,658

⁵ Bajema, B. et al (2023). *The U.S. Hydrogen Demand*. ENERGY FUTURES INITIATIVE.

REGION	CITY	PARISH	FACILITY	2021 CO2 EMISSIONS (METRIC TONS)
Southwest	Lake Charles	Calcasieu	Calcasieu Refining Company	165,164
Southwest	Westlake	Calcasieu	Citgo Petroleum Corp Lake Charles Manufacturing Complex	4,194,227
Southwest	Lake Charles	Calcasieu	Pelican Refining Co. LLC	0
Southwest	Westlake	Calcasieu	Phillips 66 Co. Lake Charles Refinery	1,538,260

AMMONIA PRODUCTION

Ammonia production accounts for roughly 20%⁶ of demand for hydrogen in the U.S. Hydrogen is a primary feedstock for producing ammonia, which plays a crucial role in the growth and maintenance of agriculture, as it is utilized in the production of fertilizers. As such, many ammonia production facilities incorporate hydrogen production within their operations.

REGION	CITY	PARISH	FACILITY	2021 CO2 EMISSIONS (METRIC TONS)
Capital	Donaldsonville	Ascension	CF Industries Nitrogen, LLC - Donaldsonville Nitrogen Complex	7,209,715
Capital	Geismar	Ascension	PCS Nitrogen Fertilizer LP - Geismar Agricultural Nitrogen & Phosphate Plant	998,103
Southeast	Waggaman	Jefferson	Dyno Nobel Louisiana Ammonia LLC	994,103
Southeast	St. James	St. James	Tampa Port Services	594,024
Publicly Anticipated/Proposed				
Capital	Donaldsonville	Ascension	CF Industries and Mitsui - Blue Ammonia plant ⁷	N/A
Capital	Donaldsonville	Ascension	Denbury Carbon Solutions, LLC Ascension Clean Energy (ACE) Facility ⁸	N/A
Capital	Donaldsonville	Ascension	Clean Hydrogen Works production and export facility ⁹	N/A
Capital	Geismar	Ascension	Nutrien Clean Ammonia Production Facility ¹⁰	N/A
Southwest	Cameron	Cameron	G2 Net-Zero Energy Complex ¹¹	N/A

METHANOL PRODUCTION

Methanol production accounts for 10% of hydrogen demand in the U.S. The methanol industry, located primarily in the Gulf Coast, supports a stable domestic market while also witnessing a growing amount of exports to Europe and Asia.

6 Bajema, B. et al (2023). *The U.S. Hydrogen Demand*. ENERGY FUTURES INITIATIVE

7 CF Industries (2022, May 3). Mitsui & Co., Ltd. And CF Industries Announce Plans for New Blue Ammonia Capacity in the United States. <https://www.cfindustries.com/newsroom/2022/cf-mitsui-update>

8 Energy Tech (2022, November 2). Denbury gains CCS rights for proposed Hydrogen-Ammonia complex in Louisiana. <https://www.energytech.com/energy-storage/article/21253915/denbury-gains-ccs-rights-for-proposed-hydrogenammonia-complex-in-louisiana>

9 Fuel Cells Works (2022, November 1). Clean Hyrdorgen Works Exploring a Plan to Build \$7.5bn large-Scale Hydrogen-Ammonia Production and Export Facility in Ascension Parish, Louisiana. <https://fuelcellworks.com/news/clean-hydrogen-works-exploring-a-plan-to-build-7-5bn-large-scale-hydrogen-ammonia-production-and-export-facility-in-ascension-parish-louisiana/>

10 Nutrien (n.d.). Nutrien Announces Intention to Build World's Largest Clean Ammonia Production Facility. <https://www.nutrien.com/investors/news-releases/2022-nutrien-announces-intention-build-worlds-largest-clean-ammonia>

11 G2 Net Zero (n.d.). About-Overview. <http://g2netzero.com/about.html>

Methanol producers may also have integrated steam methane reformers that produce hydrogen, much like ammonia plants.

REGION	CITY	PARISH	FACILITY	2021 CO2 EMISSIONS (METRIC TONS)
Capital	Geismar	Ascension	Methanex USA, LLC - Geismar Methanol Plant	1,029,986
Southeast	St. James	St. James	Koch Methanol St. James	356,957
Publicly Anticipated/Proposed				
Southeast	Myrtle Grove	Plaquemines	IPG Methanol ¹²	N/A
Southeast	St. James	St. James	Koch Methanol One Expansion ¹³	N/A
Southwest	Lake Charles	Calcasieu	Big Lake Fuels Methanol Plant ¹⁴	N/A
Southwest	Lake Charles	Calcasieu	Lake Charles Methanol, LLC Blue Methanol Facility ¹⁵	N/A

12 IGP Methanol (n.d.). About-Overview. The World's Lowest-Emission Ultra-Clean Blue Methanol Facility

13 Worley (n.d.). Another step closer to a world-leading methanol plant in Louisiana. Worley.com. <https://www.worley.com/news-and-media/2020/yci-methanol-one>

14 Industry Net (n.d.). G2X Energy, Inc., Big Lake Fuels Plant (planned). <https://www.industry.net.com/listing/3906124/g2x-energy-inc-big-lake-fuels-plant-planned>

15 Lake Charles Methanol (n.d.). Low Carbon Hydrogen for Conversion to Blue Methanol. <https://www.lakecharlesmethanol.com/>



Recent Energy Announcements

ACADIANA

- March 2023: Lafayette Energy filed to raise \$7 million for an IPO
- December 2022: Aquaspersions (British-based chemical manufacturer) broke ground on first U.S. facility in St. Martin Parish

BAYOU REGION

- March 2023: Chevron, Exxon, and BP and purchased \$264 million in offshore drilling rights in the Gulf of Mexico
- February 2023: Crowley announced deal with Port Fourchon to build offshore wind terminal
- October 2022: Port of Morgan City announces \$10 million western dock expansion

CAPITAL REGION

- March 2023: DG Fuels proposed \$3.1 billion sustainable aviation fuel complex in St. James Parish
- March 2023: Entergy selects Iberville Parish as a potential site for solar power generation
- March 2023: Exxon announced its consideration to bring an advanced recycling facility to Baton Rouge
- March 2023: Placid Refining Company announced it was relocating its headquarters to Baton Rouge
- February 2023: Kindle Energy breaks ground on \$750 million power station in Iberville Parish
- December 2022: Exxon announced it successfully doubled polypropylene production in Baton Rouge
- October 2022: Clean Hydrogen Works proposed \$7.5 billion investment in Ascension Parish facility
- August 2022: CF Industries announced \$200 million Blue Ammonia Complex in Ascension Parish
- July 2022: Bercen announced \$17.5 million expansion in Denham Springs plant
- June 2022: Arbor Gas announced plan for \$800

million renewable fuels facility in Port Allen

- Anticipated announcements:
 - » Denbury Carbon Solutions, LLC Ascension Clean Energy (ACE) Facility
 - » Nutrien Clean Ammonia Production Facility

SOUTHEAST REGION

- March 2023: Gulf Wind Technology and Shell announce plans to establish offshore wind hub at Avondale Global Gateway
- March 2023: Venture Global received \$7.8 billion in additional funds and is moving forward with phase 2 of Plaquemines LNG terminal
- February 2023: Shell began production on new offshore oil platform Vito, where peak production will reach 100,000 barrels per day
- January 2023: Port of South Louisiana purchased Avondale Global Gateway to focus on renewable energy development
- September 2022: H2theFuture wins \$50 million grant, with an additional \$24.5 million match from the State of Louisiana
- Anticipated announcements:
 - » IGP Methanol Myrtle Grove Complex
 - » Koch Methanol One Expansion

SOUTHWEST REGION

- August 2022: Energy Transfer partnered with Shell to provide LNG from its Lake Charles export facility
- October 2022: Federal government selected an area south of Lake Charles for an offshore wind farm
- Anticipated Announcements:
 - » Big Lake Fuels Methanol Plant
 - » Lake Charles Methanol, LLC Blue Methanol Facility
 - » G2 Net-Zero Energy Complex

Regional Asset Inventories and Growth Targets

ACADIANA

NATURAL RESOURCES

Agriculture

The abundant biomass resources in Acadiana can support a range of clean energy production activities, including electricity generation, biofuel production, and bioproduct development. Wood and wood waste, sugarcane bagasse, rice straw, and corn stover can fuel biomass power plants to generate electricity. Acadiana's biomass resources can also support the production of biofuels and can be used to produce bioplastics, which are biodegradable and compostable plastics that can replace traditional petroleum-based plastics.

Natural Gas Reserves

Home to the Henry Hub, Acadiana has substantial natural gas reserves that provide several advantages for clean energy industrial prospects. Acadiana's natural gas can serve as a backup source of power to support intermittent renewable energy sources like wind and solar and can be used as a cleaner alternative to coal and oil to generate electricity, which can help reduce greenhouse gas emissions.

Geologic Storage^{16,17}

The Miocene Strata in the Acadiana Region consists of a series of sand, silt, and clay deposits that were

formed by the accumulation of sediments in ancient rivers, deltas, and shallow marine environments. The region is also home to the Tuscaloosa Marine Shale, which is a deep geological formation located approximately 10,000 to 14,000 feet beneath the ground. Both the Miocene Strata and Tuscaloosa Marine Shale present significant Carbon Capture and Sequestration (CCS) opportunities in Acadiana.

Access to the Gulf of Mexico

Acadiana's proximity to the Gulf of Mexico offers several opportunities in the clean energy industry. The region has the potential to tap into the vast offshore wind energy resources of the Gulf of Mexico. Acadiana's access to the Gulf of Mexico also provides opportunities for the development of ocean thermal energy conversion (OTEC) technology. OTEC harnesses the temperature difference between warm surface water and cold deep water to generate electricity. The Gulf of Mexico has a relatively stable temperature gradient, making it a potential location for OTEC development. Acadiana's access to the Gulf of Mexico also presents opportunities for the development of marine energy technologies, such as tidal and wave energy. The region's location along the Gulf Coast could provide access to the necessary infrastructure and expertise for the development of these technologies.¹⁸

16 American Association of Petroleum Geologists (n.d.). *An Emerging Field for Energy Professionals*. <https://www.aapg.org/videos/ccus/articleid/62964>

17 Louisiana Department of Natural Resources (n.d.). *Tuscaloosa Marine Shale*. <https://www.dnr.louisiana.gov/index.cfm?md=pagebuilder&mp=home&pid=909>

18 U.S. Energy Information Administration (2022, August 9). *Hydropower explained Ocean thermal energy conversion*. <https://www.eia.gov/energy-explained/hydropower/ocean-thermal-energy-conversion.php>

INFRASTRUCTURE

Multimodal Transportation

Acadiana's access to several ports, including the Port of Morgan City and the Port of Iberia can facilitate importing and exporting goods and equipment related to clean energy production. With close proximity to Interstate 10, Acadiana provides access to a range of support services and infrastructure, such as trucking companies, logistics providers, and warehousing facilities. This can make it easier and more cost-effective for clean energy companies to manage their supply chain and distribution networks and ensure that their products are delivered on time and in good condition. Several railway lines, including Union Pacific, can be used to transport equipment, materials, and products related to clean energy production.

Pipelines

Acadiana's dense pipeline network can provide a reliable and cost-effective means of transporting energy resources to clean energy production facilities. These pipelines can also be repurposed for carbon capture projects to transport captured carbon dioxide to underground storage sites, reducing greenhouse gas emissions and supporting the development of a low-carbon economy.

Industrial Sites

There are several Louisiana Economic Development (LED) Certified Sites in Acadiana, including the North Park Certified Site and Breaux Bridge I-10 Site, which can house clean energy-related businesses and facilities, including manufacturing plants and clean energy production facilities.

WORKFORCE DEVELOPMENT

The higher education and community and technical college system in the Acadiana Region can provide significant benefits to the clean energy industry through the development of a skilled workforce and research and development initiatives. Acadiana is home to several universities and community and technical colleges with programs focused on energy-related fields, such as the University of Louisiana at Lafayette's School of Energy, the South Louisiana Community College's Energy Services and Production Technology Program, and the Louisiana Technical College's Oil and Gas Production Technology Program. These programs provide students with the knowledge and skills needed to work in a variety of roles within the clean energy industry, such as renewable energy installation,

energy efficiency consulting, and energy production. Furthermore, many of these programs offer hands-on training and internship opportunities, allowing students to gain practical experience in their chosen field.

The universities in the Acadiana Region also conduct research and development initiatives related to clean energy. For example, the University of Louisiana at Lafayette's Energy Institute of Louisiana conducts research on renewable energy sources such as solar, wind, and biomass, and explores ways to integrate these sources into the state's power grid.

EXISTING INDUSTRY SECTORS POISED FOR TRANSITIONAL GROWTH

Agriculture

Crop production in the Acadiana Region generates more than \$296 million¹⁹ in annual gross regional product. The region's biomass resources such as agricultural waste, crop residues, and energy crops can be converted into energy through various processes such as gasification, pyrolysis, and anaerobic digestion. This can help reduce the carbon footprint of the agriculture sector and provide farmers with additional revenue streams. Acadiana's agricultural waste can also be used to produce biodegradable plastics, which can replace traditional plastics and help to reduce plastic waste in the environment. In addition, the region's farmland can be utilized to install solar panels, which can generate electricity and help agricultural activities offset energy costs. Solar-powered irrigation systems can also be used to save water and energy.

The Acadiana Region's agriculture sector can leverage its existing infrastructure and expertise to become a leader in sustainable agriculture and clean energy production. By collaborating with universities, community colleges, and industry partners, the agriculture sector can access funding and resources to support the transition to cleaner energy practices and secure job growth and investment opportunities across the region.

Manufacturing

The Acadiana Region's manufacturing sector employs more than 21,000 residents²⁰ and has a unique opportunity to capitalize on the global energy transition by embracing cleaner energy practices, investing in renewable energy technology, and diversifying product offerings to meet the growing demand for clean energy solutions. The manufacturing sector can leverage its existing infrastructure, skilled workforce, and proximity

19 Lightcast (n.d.). Industry Snapshot. https://analyst.lightcast.io/analyst/?t=49RJJ#h=nNRPW&page=edo_industry_snapshot&vertical=edo&na-tion=us&login=1.

20 Lightcast (n.d.). Economy Overview. https://analyst.lightcast.io/analyst/?t=49RJW#h=nNRJR&page=edo_economy_overview&vertical=edo&na-tion=us&login=1.

to key resources such as natural gas to position itself as a leader in the clean energy industry.

To transition to cleaner energy practices, manufacturers can adopt more energy-efficient production processes, invest in renewable energy sources such as solar and wind power, and utilize advanced technologies such as smart grid systems to optimize their energy use. They can also explore opportunities to reuse or recycle waste materials, reducing their environmental impact and creating new revenue streams.

In addition to implementing cleaner energy practices, manufacturers can also expand their product offerings to include clean energy solutions such as energy storage systems, electric vehicle components, and renewable energy equipment. This can help to diversify their revenue streams and create new job opportunities in emerging industries.

Transportation and Warehousing

Acadiana's transportation and warehousing sector saw the most job growth between 2017 and 2022, increasing from roughly 8,200 jobs to 9,800 jobs, or by 20%.²¹ This booming sector is poised to capitalize on global energy shifts in several ways.

The sector can pivot towards electric vehicles (EVs) or other forms of low-carbon transportation. This will not only reduce the carbon footprint of the sector but also reduce the reliance on fossil fuels. The region can incentivize the adoption of EVs by providing charging infrastructure and financial incentives to businesses that use EVs.

The transportation and warehousing sector can deploy fuel cell systems as an alternative power source for forklifts and other material handling equipment at warehouses, ports, and other industrial sites in the Acadiana Region. Fuel cells convert the chemical energy of hydrogen fuel into electrical energy without combustion, producing only water and heat as byproducts. The sector can invest in alternative fuels such as biodiesel or hydrogen fuel cell technology. Biodiesel, which can be produced from agricultural waste or other renewable sources, can be used as a cleaner alternative to diesel fuel in heavy-duty vehicles. Hydrogen fuel cell technology can be used in transportation vehicles as well, and the region can leverage its existing hydrogen infrastructure to support this transition. The transportation and warehousing sector can explore opportunities in the logistics and supply chain of clean energy products. As demand for clean energy products such as solar panels and wind turbines continues to grow globally, the region can position itself as a logistics hub for the transportation and storage of these products.

POTENTIAL BUSINESS EXPANSION TARGETS AND CLEAN ENERGY PLAYS

- Acadian Companies — Adopting hydrogen fuel cell electric vehicles for ambulance fleet and using hydrogen-powered backup generators for ambulance stations
- Cameron Valves — Producing specialized valves for hydrogen pipelines and equipment, as well as providing maintenance and repair services for hydrogen-related infrastructure
- Dupre' Logistics — Providing logistics and transportation services for hydrogen-related materials and equipment, including hydrogen storage and transport
- McIlhenny Company — Utilizing green hydrogen in its manufacturing process and hydrogen-powered forklifts in its warehousing operations, as well as leveraging agricultural waste for biomass
- Omega Protein — Adopting hydrogen fuel cells and green hydrogen in its operations
- PHI, Inc. — Developing new maintenance and repair services for hydrogen-related infrastructure, such as offshore wind turbines and hydrogen pipelines, and exploring the development of hydrogen-powered drone technology for offshore oil and gas operations
- Stuller, Inc. — Utilizing green hydrogen in its manufacturing process
- Supreme Rice — Utilizing green hydrogen in its manufacturing process and leveraging agricultural waste as for biomass
- United Vision Logistics — Utilizing hydrogen-powered trucks and forklifts and developing innovative logistics solutions for hydrogen transportation and distribution

BUSINESS DEVELOPMENT OPPORTUNITIES

CCS

The Tuscaloosa Marine Shale and Miocene Strata are potential targets for carbon capture and storage (CCS) due to their favorable geological characteristics, including high porosity and permeability, as well as their location close to major sources of carbon emissions. Deploying CCS in Acadiana could offer significant environmental benefits by reducing carbon emissions from industrial sources in the region, particularly with power generation, oil and gas operations, and industrial processes. It could also provide an economic opportunity for the region by creating jobs and

21 Lightcast (n.d.). Economy Overview. https://analyst.lightcast.io/analyst/?t=49RJW#h=nNRJR&page=edo_economy_overview&vertical=edo&nation=us&login=1

attracting investment in CCS technology. However, CCS deployment faces could face several challenges, including high upfront costs, regulatory uncertainties, and public acceptance.

Renewable Energy Production

The region's abundant natural resources, including solar, wind, and biomass, can provide a competitive advantage for the production of renewable energy. Given the increasing demand for clean energy, investing in renewable energy production can attract new businesses and create jobs in the region.

Hydrogen Production

The region's existing natural gas infrastructure and extensive pipeline network can be repurposed to

produce hydrogen, a promising alternative fuel for transportation, industrial processes, and power generation. With the growing interest in hydrogen as a clean energy source, developing hydrogen production facilities in the region can attract significant investment and create high-paying jobs.

Clean Energy Manufacturing

The region's existing manufacturing base, skilled workforce, and transportation infrastructure can support the production of clean energy technologies, such as solar panels, wind turbines, and batteries. With the global demand for clean energy technologies on the rise, investing in clean energy manufacturing can create new business opportunities and high-quality jobs in the region.

BAYOU REGION

NATURAL RESOURCES

Oil and Gas

The oil and gas industry has long been a cornerstone of the Bayou Region's economy. The area contains significant oil and gas reserves, and the oil and gas industry has been a major employer in the region for many years. While there is a renewed focus on cleaner sources of energy, the existing oil and gas infrastructure in the region presents opportunities for utilizing carbon capture and storage technology to reduce emissions.

Agricultural Resources and Biomass

The Bayou Region's robust agriculture industry presents a significant opportunity to deploy biomass to grow jobs and investments. The region's agriculture industry generates significant amounts of agricultural waste, such as sugarcane bagasse and rice straw, that could be used as feedstock for bioenergy production. In addition, rice straw, another byproduct of agricultural production, can be used as a feedstock for bioenergy production. It is estimated that Louisiana produces around 400,000 tons of rice straw annually, which could be used to produce biogas, biofuels, and other bioproducts.

Deploying biomass in the Bayou Region's agriculture industry could create new job opportunities and attract investment in bioenergy production and related industries. It could also help to reduce greenhouse gas emissions by displacing fossil fuels with renewable bioenergy sources.

In order to fully capitalize on this opportunity, the Bayou Region would need to invest in research and development of bioenergy technologies and infrastructure, as well as in workforce development and training programs to support the growth of bioenergy.

Renewable Potential

The Bayou Region also has wind and solar resources, which can be harnessed to generate renewable energy. The region's coastline also presents opportunities for offshore wind energy development.

Abundant Water Resources

The region is home to several major rivers, including the Mississippi, Atchafalaya, and Lafourche Rivers, which provide a significant water supply for the region's energy production and manufacturing industries. The extensive waterways in the Bayou Region offer a competitive advantage for the transportation of goods and resources, particularly in the shipping of liquefied natural gas (LNG).

INFRASTRUCTURE

Waterborne Access

The Bayou Region's waterborne connectivity and infrastructure, supported by the Louisiana Offshore Oil Port (LOOP), offers significant advantages for the clean energy industry. LOOP is the only deepwater port in the United States capable of offloading crude oil from ultra-large crude carriers (ULCCs) and very large crude carriers (VLCCs). It provides access to international markets for crude oil produced in the region, as well as for imported crude oil that can be refined at the many refineries in the area. Port of Morgan City, Port of Terrebonne, and Port of West St. Mary provide access to the Gulf of Mexico and beyond, while the Intracoastal Waterway also runs through the region, providing a reliable and cost-effective mode of transportation for goods and materials.

Highway Connectivity

The Bayou Region's highway and interstate system provides an advantage in the emerging energy industry by enabling efficient transportation of goods and resources. The region is served by several major highways, including U.S. Highway 90, which connects the region to New Orleans and Lafayette, and Interstate 10, which runs east to west across the southern United States and connects the region to major markets such as Houston, Texas, and Mobile, Alabama.

The highway and interstate system also provide access to the region's ports, including Port Fourchon, which is a major hub for offshore oil and gas operations and is also developing as a center for the emerging offshore wind industry. The port's strategic location provides access to the Gulf of Mexico and facilitates the transportation of goods and resources to and from the region.

Pipeline Network

The Bayou Region's extensive oil and natural gas pipeline network positions the region for continued investments and job creation. Its existing pipeline infrastructure can be leveraged for carbon capture and storage (CCS) projects, providing a cost-effective means to transport captured carbon dioxide from industrial facilities to storage sites in saline formations. The pipelines can also transport alternative fuels such as hydrogen or renewable natural gas, which can be produced from biomass or organic waste. Finally, the Bayou Region's pipeline network can transport crude oil and natural gas produced from offshore platforms in the Gulf of Mexico that can be processed and refined into low-carbon products such as biofuels or petrochemicals.

Rail

The Bayou Region's rail connectivity can support the region's energy transition by providing a critical mode of transportation for goods and materials related to the clean energy industry. The region is served by several major rail lines, including the Burlington Northern Santa Fe Railroad and the Louisiana and Delta Railroad, which provide connections to major markets throughout the United States.

Industrial Sites

The Bayou Region currently has two LED Certified Sites. The 700-acre Rebecca North Development Park and the 234-acre Rebecca South Development Park are adjacent to U.S. 90 at LA-311. The sites are less than 12 miles from the Houma-Terrebonne Airport & Industrial Park, with access to the Gulf Intracoastal Waterway via Bayou Lafourche. The sites have available electric, water, sewerage, natural gas, and fiberoptic capacity, and the Burlington Northern Santa Fe Railroad is less than four miles away.

WORKFORCE DEVELOPMENT

The Bayou Region's higher education institutions, including Nicholls State University and Fletcher Community College, offer a variety of programs and resources to support the workforce pipeline of the clean energy industry. Nicholls State University offers a Bachelor of Science in Environmental Science with concentrations in Environmental Biology and Environmental Chemistry. Additionally, the university offers a minor in Sustainability Studies, which focuses on environmental awareness, natural resource management, and sustainable development. These programs provide students with a foundation in environmental science and sustainability, skills that are essential to many sectors of the clean energy industry.

Fletcher Technical Community College, located in Schriever, offers certificate and degree programs in fields such as process technology, instrumentation technology, and welding. These programs provide students with the technical skills and knowledge needed to succeed in emerging energy sectors.

The Bayou Region's Coastal Technical Assistance Center (CTAC) is playing a role in supporting the region's energy transition and job creation efforts by providing technical assistance, resources, and training to businesses, organizations, and communities in the coastal region. CTAC provides a wide range of services to support the development and implementation of sustainable practices in industries, including energy, fisheries, and tourism. These services include environmental monitoring, data analysis, and technical assistance in areas such as coastal restoration, ecosystem management, and hazard mitigation.

EXISTING INDUSTRY SECTORS POISED FOR TRANSITIONAL GROWTH

Oil and Gas

The Bayou Region has a long history of oil and gas exploration and production, and this industry is expected to continue to play a major role in the region's economy. However, there is also a growing trend toward using enhanced oil recovery techniques, which can involve the injection of carbon dioxide into oil reservoirs to increase production. This presents an opportunity for the region to develop expertise in CCS technologies.

Manufacturing

The Bayou Region's existing manufacturing industry can benefit from the energy transition in several ways. As the demand for clean energy solutions continues to increase, there will be a growing need for the production of various renewable energy components, such as solar panels, batteries, and wind turbines. The region's existing manufacturing industry can leverage its expertise in production, assembly, and fabrication to meet this demand.

Additionally, as the energy industry continues to shift towards cleaner sources of energy, there will be an increased demand for energy-efficient products and technologies. This can include everything from LED lighting and energy-efficient HVAC systems to electric vehicles and smart home systems. The Bayou Region's existing manufacturing industry can expand its offerings to include these types of products, creating new opportunities for growth and job creation.

Agribusiness

The Bayou Region's agribusiness sector has the potential to capitalize on existing agricultural resources in the energy transition, particularly in the production of biofuels and bioproducts. The region's abundant sugarcane crop, for example, could be used to produce ethanol, a renewable fuel that can be blended with gasoline. This would not only create new markets for the sugarcane industry, but also reduce the region's dependence on fossil fuels.

POTENTIAL BUSINESS EXPANSION TARGETS AND CLEAN ENERGY PLAYS

- Bollinger Shipyards — Constructing and retrofitting vessels for the transportation and installation of offshore wind turbines and equipment
- Danos — Providing maintenance and repair services for offshore hydrogen production and transportation infrastructure and equipment
- Edison Chouest — Constructing and retrofitting vessels for the transportation and installation of offshore wind turbines and equipment
- Grand Isle Shipyard — Building and installing offshore hydrogen infrastructure
- John Deere — Developing and producing hydrogen fuel cell-powered equipment for the agriculture and construction industries

TOP BUSINESS DEVELOPMENT OPPORTUNITIES

Offshore Services

The Bayou Region's offshore oil and gas service companies can benefit from investments in offshore wind development by leveraging their existing expertise, infrastructure, and workforce to support the emerging offshore wind industry. These companies have experience in offshore construction, installation, and maintenance of oil and gas infrastructure, which are transferable skills to the offshore wind industry.

Offshore wind farms require similar installation and maintenance processes as offshore oil and gas

platforms, including the use of specialized vessels, equipment, and skilled workers. By investing in the offshore wind industry, these companies can diversify their services and revenue streams, while also potentially creating new job opportunities in the region.

Renewable Energy Manufacturing

The Bayou Region has the potential to support the manufacturing of renewable energy components like offshore wind turbines through its existing manufacturing base, infrastructure, and workforce. The region has a long history of supporting the offshore oil and gas industry, which has created a skilled manufacturing workforce, and a strong network of suppliers and support services.

With the growing demand for offshore wind energy, the region's existing manufacturing companies could pivot to produce components for wind turbines such as towers, blades, and nacelles. Additionally, the Bayou Region's location along the Gulf of Mexico provides easy access to offshore wind farms, making it an attractive location for companies looking to manufacture and assemble wind turbines.

Bioenergy

The Bayou Region's robust agriculture industry can be leveraged to produce biomass, which can be used to generate electricity and produce biofuels. With the region's abundant land and water resources, there is significant potential for the development of biomass energy projects. The Bayou Region's Coastal Technical Assistance Center can provide support for these projects, including feasibility studies and project development.

Hydrogen Production and Transport

The Bayou Region's existing oil and gas pipeline infrastructure can be repurposed to transport hydrogen, which is a clean and renewable energy source. The region's abundant natural gas resources can also be used to produce hydrogen through a process called steam methane reforming. The region's transportation and logistics sector can also benefit from the deployment of hydrogen fuel cell technology for forklifts and other material handling equipment.

Energy Storage

The Bayou Region has a significant potential for energy storage, with the ability to store large quantities of oil and gas. Additionally, the region's existing infrastructure can be utilized for the storage of other forms of energy, such as battery storage or compressed air energy storage.

CAPITAL REGION

NATURAL RESOURCES

Mississippi River

The Mississippi River is a major shipping channel for goods and commodities, including energy-related products. Baton Rouge's location along the river provides easy access to transportation for the clean energy products produced in the region. This can help reduce transportation costs and make the products more competitive in the global market.

The Mississippi River can be used as a source of hydropower, which is a renewable and clean energy source. The U.S. Army Corps of Engineers operates several hydroelectric dams along the Mississippi River, which can be used to generate electricity. This can help diversify Baton Rouge's energy mix and provide a source of clean energy for the region. The Mississippi River is also a source of freshwater, which is important for the production of biofuels and other clean energy products, which can help support these industries and make them more competitive.

Geologic Storage

The Capital Region has significant geological storage advantages that can support carbon capture and storage (CCS) projects. CF Industries recently announced a CCS project at its Donaldsonville Nitrogen Complex in Ascension Parish, which highlights the region's geological storage potential. One of the primary geological storage advantages in the Capital Region is the presence of saline formations, which are porous and permeable rock formations that can store large volumes of CO₂ deep underground. The Tuscaloosa Formation, which underlies much of Louisiana, is known to contain thick and extensive saline formations that have been identified as potential sites for CCS projects.

Oil and Gas Reserves

The Bayou Choctaw site of the U.S. Strategic Oil Reserve is situated in Iberville Parish, about 12 miles southwest of Baton Rouge. This site currently has six storage caverns with a total authorized capacity of 76 million barrels and an inventory of over 55 million barrels. Additional oil and gas reserves are major contributors to the regional economy, and there are numerous oil and gas pipelines and refineries throughout the region. The production and transportation of these resources can also support the development of carbon capture and storage technologies, which can reduce the carbon footprint of oil and gas extraction.

RENEWABLE ENERGY RESOURCES

In addition to oil and gas, the Capital Region also has significant renewable energy resources and potential. The region's climate and flat terrain make it well-suited for solar energy production, and there are several large-scale solar projects in development or under construction across the region. The combination of these natural resources can provide competitive advantages in the global energy transition. By leveraging its existing oil and gas infrastructure while also investing in and expanding its renewable energy resources, the Capital Region can position itself as a leader in the transition to a low-carbon economy.

INFRASTRUCTURE

Highways

The Capital Region is strategically located along Interstate 10, one of the nation's major east-west transportation corridors. This proximity to a major interstate highway system provides a competitive advantage for businesses in the region, including those in the clean energy industry. The region's location along I-10 provides access to other important highways, such as I-12, I-49, and I-55, allowing for easy transportation throughout Louisiana and beyond. This connectivity is crucial for businesses in the clean energy industry, which often require access to multiple sites for construction, installation, and maintenance.

Port of Greater Baton Rouge

The Port of Greater Baton Rouge is a major port on the Mississippi River and offers access to international markets. The port is a multi-modal transportation hub, with facilities for barge, rail, and truck transportation, handling a variety of cargoes, including chemicals, petroleum, and agricultural products. The port's deep-water draft and extensive cargo-handling capabilities make it an attractive option for heavy-lift projects in the renewable energy sector, such as the transportation of wind turbine components and large solar panels.

Pipelines

The region is home to a significant pipeline infrastructure, with the ability to transport various forms of energy, including crude oil, natural gas, refined petroleum products, and hydrogen. The pipelines connect the region's oil and gas production facilities to the major transportation hubs, such as the Port of Greater Baton Rouge, facilitating the efficient and cost-effective movement of energy products. This pipeline network provides significant value to the clean energy industry by enabling the distribution of clean energy

products, such as biofuels and renewable natural gas, to consumers and industries. The pipeline infrastructure can transport these energy sources safely and efficiently, reducing transportation costs and emissions associated with transportation.

Industrial Sites

The Capital Region is home to several LED Certified sites, including the 17,000-acre River Plex Mega Park of Louisiana in Donaldsonville and the more than 1000-acre Sullivan Site in Baton Rouge. Such sites have been qualified based on zoning restrictions, title work, environmental studies, soil analysis and surveys, and provide transitional energy investors with confidence that a considered track of land is near-development ready.

Railways

The Capital Region of Louisiana has a robust rail network that offers competitive advantages for clean energy investments. The region's railway system is anchored by the Kansas City Southern Railway and Union Pacific Railroad networks, providing connections to major markets across the U.S. and Mexico. This rail connectivity offers several benefits for clean energy investments. It provides an efficient mode of transportation for the transportation of raw materials and finished products in the clean energy industry, such as wind turbine components, solar panels, and batteries. This can help lower transportation costs and increase the competitiveness of clean energy companies in the region.

WORKFORCE DEVELOPMENT

The Capital Region is home to several higher education institutions that can benefit the clean energy industry. Louisiana State University and Southern University, in particular, offer programs and research opportunities that support the development and deployment of clean energy technologies.

LSU's Craft & Hawkins Department of Petroleum Engineering has made history as the first in the United States to offer an official concentration in carbon capture, utilization, and storage (CCUS).²² LSU's strategic location in Louisiana's CCUS epicenter provides unparalleled opportunities for students to shape the future of Louisiana's energy landscape and workforce.

Southern University's College of Sciences and Engineering has significant research ability in the fields of environmental, geotechnical, and water resources engineering, which directly relates to the Capital Region's energy landscape. Additionally, a Southern University professor has received a research grant from the U.S. Department of Energy to perform frontier research on materials and energy, which has applications in the solar energy industry.²³

Additionally, Baton Rouge Community College (BRCC) offers a certificate program in solar energy technology, and other community and technical colleges in the region offer training in energy efficiency and renewable energy technologies. These programs provide a pipeline of skilled workers for the clean energy industry and help meet the growing demand for clean energy jobs in the region.

EXISTING INDUSTRY SECTORS POISED FOR TRANSITIONAL GROWTH

Ammonia Production

The Capital Region's low-carbon ammonia production sector is positioned for continued growth due to several factors. Ammonia is an important building block for many industries, including fertilizers, chemicals, and energy storage, which have a strong presence in the region. Additionally, there is a growing global demand for ammonia as a clean energy carrier, as it can be used to store and transport renewable energy from sources such as wind and solar. Offtakers have increasing interest in low-carbon ammonia produced by using renewable energy or carbon capture and storage technologies, which the Capital Region's geologic storage opportunities and industrial clusters can facilitate.

Refining, Petrochemicals, and Manufacturing

The Capital Region has a strong manufacturing industry, particularly in the production of chemicals, plastics, and other materials. As demand for low-carbon products grows, Capital Region companies can shift their focus towards producing more sustainable materials and products. The region's central location and extensive transportation infrastructure, including highways, railroads, and ports, make it well-positioned for the production and distribution of low-carbon fuels and products.

22 Louisiana State University (2023, January 26). LSU FIRST TO OFFER CARBON CAPTURE, UTILIZATION, AND STORAGE (CCUS) CONCENTRATION. <https://www.lsu.edu/scholarship-first/blog/2023/01/26ccusconcentration.php>

23 Southern University (2018, January 25). SUBR professor and dean receives research grant from the U.S. Department of Energy. <http://www.subr.edu/news/1083>

Transportation and Material Moving

The Capital Region's transportation and material moving sector, supported by more than 35,000 employees,²⁴ can decarbonize its operations by adopting fuel cell technology, which has been proven to be a reliable, efficient, and clean energy source. By using fuel cells, the transportation and warehousing sector can reduce their carbon footprint and operating costs, while also improving operational efficiency and worker safety. To encourage the adoption of fuel cell technology, the Capital Region can provide incentives, grants, and other financial support to businesses that are willing to invest in these clean energy solutions. The region can also work with fuel cell manufacturers and distributors to ensure an adequate supply of hydrogen fuel and promote the development of hydrogen infrastructure, such as hydrogen refueling stations. This could spur the decarbonization and energy efficiency of current efforts made by existing Capital Region economic drivers, such as the Port of Greater Baton Rouge and Amazon's distribution facility.

POTENTIAL BUSINESS EXPANSION TARGETS AND CLEAN ENERGY PLAYS

- BASF — Producing hydrogen as a byproduct of its chemical manufacturing processes, and providing technologies and materials for hydrogen storage and transportation
- Brown Eagle — Building and operating hydrogen fueling stations, as well as providing maintenance and repair services for hydrogen-related infrastructure
- CF Industries — Producing green hydrogen from renewable energy sources for use in their own industrial processes, as well as supplying hydrogen to other industries
- Epic Piping — Manufacturing and supplying specialized pipes, valves, and fittings for hydrogen pipelines and equipment
- Methanex — Converting natural gas into blue hydrogen for use in industrial applications, and exploring the potential for green hydrogen production from renewable energy sources

- Nutrien — Producing green hydrogen from renewable energy sources for use in their own industrial processes, as well as supplying hydrogen to other industries
- Shell Chemical — Producing blue hydrogen from natural gas with carbon capture and storage technology, exploring the potential for green hydrogen production from renewable energy sources, and building and operating hydrogen fueling stations

TOP BUSINESS DEVELOPMENT OPPORTUNITIES

CCS

The Capital Region's proximity to large industrial emitters, access to saline formations for geologic storage, and recent investment in CCS infrastructure by companies like CF Industries in Donaldsonville, make CCS a top opportunity for the region. The region should focus on building a supportive regulatory environment, investing in workforce development, and attracting additional CCS investment to the area.

Low-Carbon Ammonia and Hydrogen Production

The region's existing chemical production industry and access to low-cost natural gas position it well for continued growth in low-carbon ammonia and hydrogen production. Expected online in 2026, Air Products' blue hydrogen energy complex offers confirmation of the Capital Region's ability to attract low-carbon ammonia and hydrogen producers. To leverage this momentum, the region can focus on providing support to new and existing producers, incentivizing low-carbon production methods, and supporting research and development in this sector.

Renewable Energy Manufacturing

With access to major transportation infrastructure, including highways, ports, and pipelines, the Capital Region is well-positioned to secure investments and create jobs in renewable energy manufacturing. The region could focus on attracting manufacturers of solar panels, wind turbines, and other renewable energy equipment, as well as companies that produce energy storage technologies such as batteries and fuel cells. The region can leverage its existing industrial sites and skilled workforce to attract this type of investment.

²⁴ Lightcast (n.d.). Economy Overview. https://analyst.lightcast.io/analyst/?t=49RJW#h=nNRJR&page=edo_economy_overview&vertical=edo&nation=us&login=1

SOUTHEAST REGION

NATURAL RESOURCES

Mississippi River

The Mississippi River serves as a critical transportation artery, connecting the region to markets throughout the United States and the world. The river is also a potential source of hydroelectric power, and there is significant potential for the development of new renewable energy projects along its banks.

Natural Gas Resources

The Southeast Region has significant natural gas resources, with many of the major pipelines that transport gas from the Gulf of Mexico to markets throughout the United States passing through the region. This abundance of natural gas provides opportunities for the region to develop new gas-fired power plants and other energy-intensive industries.

Salt Storage

The region is home to substantial underground salt domes, which provide a critical resource for energy storage and other industrial applications. The salt domes could be used to store hydrogen, compressed air, and other forms of energy, making them a key resource for the development of new clean energy technologies.²⁵

Oil Reserves

The Southeast Region has significant oil reserves, particularly in the Gulf of Mexico. While the region's oil industry has faced challenges with recent hurricanes and COVID-19, it remains an important part of the local economy and will play a role in the energy transition as new technologies are developed to extract oil more sustainably.

Offshore Wind

The Southeast Region, particularly the coastal parishes, has significant offshore wind potential due to its location along the Gulf of Mexico and proximity to the Atlantic Ocean. An NREL study²⁶ in 2020 highlighted the Gulf of Mexico's potential for offshore wind power development. The region's offshore wind assets, including shallow, warm waters, below-average wave heights, and access to existing oil and gas

infrastructure, could potentially generate over 500 gigawatts of electricity. This is double the electricity consumption of the entire region from Texas to Florida, presenting vast opportunities for offshore wind production in southeast Louisiana.

INFRASTRUCTURE

Ports and Pipeline Connectivity

The Port of New Orleans is a vital economic driver for the region, generating over \$100 million in annual revenue through its rail, cargo, cruise, and industrial real estate activities. It has a significant impact on the local economy, supporting over 19,000 jobs and contributing \$3.9 billion to the output of Jefferson, Orleans, and St. Bernard parishes. The port handles a diverse range of imports, including steel, coffee, furniture, natural rubber, forest products, and non-ferrous metals, while its primary exports include plastic resins, frozen poultry, paper, and pulp.²⁷

In addition to the Port of New Orleans, the region is home to several other ports, including the Port of South Louisiana, which is one of the largest tonnage port districts in the western hemisphere.²⁸ The port system is connected by an extensive network of pipelines that transport oil, gas, and other products across the region and beyond.

Highway and Rail Access

The Port of New Orleans is strategically positioned at the nexus of six Class 1 railroads and major highways, including I-10, I-12, I-55, and I-59, providing easy access to markets throughout the country. This infrastructure makes the region a hub for transportation and logistics, with the capacity to move goods and materials quickly and efficiently. The region's rail access is particularly important for transporting large and heavy components used in renewable energy projects, such as wind turbine blades, tower sections, and nacelles. The region's rail infrastructure connects to major markets in the United States and allows for efficient transportation of goods and materials.

Industrial Sites

The Southeast Region is also home to a vast selection of LED Certified sites, including the 6,000-acre Bilton

25 U.S. Department of Energy Office of Scientific and Technical Information (2006, March 1). *Geologic technical assessment of the Chacahoula Salt Dome, Louisiana, for potential expansion of the U.S. Strategic petroleum reserve*. U.S. Department of Energy. <https://www.osti.gov/biblio/902213>

26 U.S. Department of the Interior Bureau of Ocean Energy Management New Orleans Office (n.d.). *Survey and Assessment of the Ocean Renewable Energy Resources in the US Gulf of Mexico*. U.S. Department of the Interior. https://espis.boem.gov/final%20reports/BOEM_2020-017.pdf

27 Port Nola, the Port of New Orleans (n.d.). *Creating Jobs, Driving the Economy*. Port Nola. https://portnola.com/assets/pdf/PORT-NO-LA-2019-ECONOMIC-IMPACT-BOOKLET_V2-FINAL-low-res.pdf

28 Port of South Louisiana (n.d.). *Overview*. <https://portsl.com/overview/>

Park in Lacombe, the 2,300-acre Welham Site in Convent, and the PSL St. James Property in Vacherie. These development-ready industrial sites can accommodate a host of clean energy projects.

WORKFORCE DEVELOPMENT

The Southeast Region has a strong higher education system that can provide a skilled workforce for the clean energy industry. The University of New Orleans (UNO) is a comprehensive research university with a focus on science and engineering, making it a prime institution to develop and educate students for the clean energy sector. In particular, UNO has a Center for Energy Resource Management that provides research and training in energy resource management, renewable energy, and energy efficiency. UNO's Boysie Bollinger School of Naval Architecture and Marine Engineering (NAME) was established in response to the strong demand from local industry. It was a natural progression of the region's abundant resources and the depth of UNO's engineering expertise. Over the years, NAME has expanded significantly in size and reputation, and today is one of the premier schools in the country, and the only one in the Gulf South, where students can learn the art of building ships and other self-sustaining offshore structures. UNO recently launched the Louisiana Wind Energy Hub, positioning itself as a leading institution in efforts to harness wind energy from the Gulf of Mexico. The Louisiana Wind Energy Hub provides a collaborative space for students, engineers, and companies to work together in bringing offshore wind to the Gulf and addresses the challenges facing the burgeoning offshore wind industry. Tulane University has a strong research focus on sustainability and renewable energy, with faculty members engaged in a wide range of interdisciplinary research in areas such as green chemistry, sustainable engineering, and environmental law. This research can provide valuable insights and guidance for businesses and policymakers seeking to develop and implement clean energy projects and policies in the region.

New Orleans' Historically Black Colleges and Universities (HBCUs) - Southern University of New Orleans, Xavier University, and Dillard University - are uniquely positioned to contribute to the growth and development of the clean energy economy in southeast Louisiana. These institutions have a strong track record of providing education and training opportunities for underserved and minority communities, which are often underrepresented in the energy industry.

Additionally, these institutions can serve as a bridge between the clean energy industry and local communities, helping to build trust and facilitate collaboration. They can act as a platform for engagement, providing a forum for industry leaders, policymakers, and community members to come together and discuss the challenges and opportunities

associated with the transition to a clean energy economy.

The Southeast Region also has a strong network of technical colleges that provide training for careers in the energy industry. Northshore Technical Community College offers a program in industrial instrumentation technology, which can prepare students for careers in the energy and manufacturing sectors. Delgado Community College offers certificate and associate degree programs in sustainable technologies, including solar energy, wind energy, and energy efficiency. Nunez Community College has collaborated with the H2theFuture coalition to establish a Wind Energy Technology program aimed at fulfilling the workforce requirements of the clean energy sector. River Parishes Community College's Pathways in Technology Early College High Schools (PTECH) can help prepare students for careers in the clean energy industry, which requires a skilled workforce in fields such as engineering, construction, and maintenance. PTECH can also provide students with industry-recognized credentials and work experience, giving them a competitive edge when seeking employment.

EXISTING INDUSTRY SECTORS POISED FOR TRANSITIONAL GROWTH

Petrochemical Refining

The region's petrochemical refineries are well positioned to leverage the global energy transition through decarbonization and job growth due to several factors. These refineries have access to abundant natural gas resources, which can be used as a feedstock for the production of chemicals and fuels that emit fewer greenhouse gases than traditional petroleum-based products. This positions them to capitalize on the increasing demand for low-carbon alternatives as the world transitions to cleaner energy sources. The Southeast Region's refineries have existing supply chain and logistical advantages, with access to pipelines, railroads, and waterways that can transport feedstocks and products to and from markets. This infrastructure can be repurposed and optimized for the transport of low-carbon feedstocks and products, further strengthening the region's position in the energy transition.

Hydrogen Production

Hydrogen production in the Southeast Region, led by Air Products' substantial investment and job creation activities, is poised for additional growth due to several factors. Hydrogen is becoming an increasingly important energy source in the transition to a low-carbon economy, and the Southeast Region's existing industrial infrastructure, including refineries and chemical plants, provides an ideal location for hydrogen production. Additionally, Air Products' investment in a new hydrogen production facility in the region is a clear

indication of the potential for growth in this sector, and it will create hundreds of new jobs in the area.

The region's access to natural gas, which is a feedstock for hydrogen production, provides a competitive advantage in the production process. The increasing demand for hydrogen in transportation, including fuel cell vehicles, as well as in industrial applications such as steel production, makes hydrogen production a promising opportunity for growth and job creation in the Southeast Region.

Ammonia Production

Ammonia production in the Southeast Region is poised for additional growth due to several factors. Ammonia is a key input in the fertilizer industry, and with the region's abundance of agricultural resources, there is a significant demand for fertilizer production. Additionally, ammonia is a crucial ingredient in the production of other chemicals, such as polymers and plastics. With the region's well-developed petrochemical industry, there is a growing demand for ammonia as a feedstock.

Dyno Nobel has made significant investments in the region, including its ammonia production facility in Jefferson Parish. This investment has not only led to job creation but also serves as a catalyst for further growth in the industry. With the increasing demand for renewable energy, ammonia production could play a crucial role in energy storage. Ammonia can be easily stored and transported, making it an attractive option for energy storage and transportation.

POTENTIAL BUSINESS EXPANSION TARGETS AND CLEAN ENERGY PLAYS

- Air Products — Producing and supplying hydrogen via its hydrogen pipeline, building hydrogen fueling stations, and investing in hydrogen production technologies
- Chalmette Refinery — Producing and supplying hydrogen for use in refineries and chemical plants
- Dyno Nobel — Producing hydrogen for use in the production of ammonia, a key ingredient in fertilizers, and exploring the use of hydrogen in explosives manufacturing
- Linde — Building hydrogen infrastructure, producing and supplying hydrogen for industrial and transportation applications, and investing in hydrogen production technologies
- Marathon — Producing and supplying hydrogen for use in refineries and chemical plants, and investing in renewable hydrogen production technologies
- Phillips 66 Co. — Producing and supplying hydrogen for use in refineries and chemical plants, and investing in renewable hydrogen production technologies.

- Shell Chemical — Investing in hydrogen production and infrastructure technologies, and exploring the use of hydrogen in its refining and chemicals businesses
- St. Rose, LLC — Producing and supplying hydrogen for use in refineries and chemical plants
- Valero Meraux Refinery — Producing and supplying hydrogen for use in refineries and chemical plants
- Valero Refining — Producing and supplying hydrogen for use in refineries and chemical plants

TOP BUSINESS DEVELOPMENT OPPORTUNITIES

Offshore Wind Development and Manufacturing

The region's Gulf of Mexico has been identified as having favorable conditions for offshore wind power development, with the potential to generate over 500 gigawatts of electricity. Southeast Louisiana has a significant opportunity to manufacture components of offshore wind turbines as the demand for renewable energy continues to grow. The region's existing infrastructure, including ports, transportation networks, and skilled workforce, provides a competitive advantage for attracting investment and companies interested in developing the offshore wind industry.

Southeast Louisiana has the potential to become a hub for the assembly and installation of offshore wind turbines. The Port of New Orleans, for example, could serve as a base for offshore wind construction vessels, providing a strategic location for turbine installation and maintenance operations in the Gulf of Mexico.

Blue Ammonia Production

Dyno Nobel's facility in Jefferson Parish is one of the largest producers of ammonia in the world, providing a competitive advantage for the region in the production of blue ammonia, which is made from renewable energy sources such as wind and solar power. This presents an opportunity for companies to invest in the production and distribution of blue ammonia, which can be used as a fertilizer and in fuel cells.

Petrochemical Refineries

The region's existing petrochemical refineries are well-positioned to capitalize on the clean energy transition by investing in technologies such as carbon capture, utilization, and storage to reduce emissions, and by diversifying into new products such as biofuels and green chemicals. This presents an opportunity for companies to invest in these technologies and for local businesses to provide the necessary support services.

Port Infrastructure

The Port of New Orleans is the only international container port in Louisiana and has a strategic

alignment with the New Orleans Public Belt Railroad. With the growing interest in hydrogen fuel cell technology, the port is well-positioned to capitalize on this trend by investing in fuel cells to power forklifts and other material handling equipment, reducing emissions, and increasing efficiency. Additionally, the Port of New Orleans has the infrastructure, location, and expertise to become a key player in the export of hydrogen, helping to drive the growth of the clean energy industry in the region.

The Port of South Louisiana is strategically located at the intersection of the Mississippi River and the Gulf of Mexico, making it a vital component of the region's transportation infrastructure. The port's extensive network of terminals and storage facilities can provide critical infrastructure for the shipment and storage of goods related to the clean energy industry, such as wind turbine components, solar panels, and hydrogen

tanks. In addition, the Port of South Louisiana is addressing a crucial need in the hydrogen maritime fueling infrastructure by introducing a specialized barge for e-methanol (a hydrogen fuel derivative), marking the first instance of a U.S. port featuring a dedicated hydrogen fueling barge.

At the former Avondale Shipyard site, Gulf Wind Technology (GWT) and Shell have partnered to establish a research, training, and technology demonstration program for offshore wind energy at GWT's Avondale Global Gateway facility in Jefferson Parish. Shell has invested \$10 million in the project, which will focus on designing the first offshore wind products optimized for the Gulf of Mexico's conditions. The facility will also offer offshore wind workforce education and training, with the first turbine expected to be ready for demonstration by next year.

SOUTHWEST REGION

NATURAL RESOURCES

Natural Gas

The Southwest Region is home to significant natural gas reserves. The region has access to pipeline infrastructure that can transport natural gas to industrial and residential consumers in Louisiana, Texas, and other parts of the United States. Natural gas is an important fuel source for electricity generation and can also be used to produce hydrogen, which is a clean fuel that can power fuel cells and vehicles.

Geologic Formations

Southwest Louisiana has unique geological formations that make it an attractive location for carbon capture and storage. The region sits on top of geological formations that can be used for CCS, including deep saline formations, depleted oil and gas reservoirs, and coal seams.

Oil

The Southwest Region also has significant oil reserves. The region has a long history of oil and gas production, and the oil industry has been an important part of the local economy for decades. As the energy transition progresses, the oil industry in the Southwest Region can adapt by investing in clean energy technologies such as carbon capture and storage and renewable energy.

Wind Capacity

The Southwest Region also has potential for wind energy development. The region has strong wind resources, particularly along the coast, which could support the development of offshore wind farms. Wind energy can also be harnessed onshore through wind turbines. In February of 2023, the U.S. Department of the Interior's Bureau of Ocean Energy Management (BOEM) identified a 188,000-acre tract off the coast of Lake Charles to develop an offshore wind farm. According to BOEM, the project has the potential to power nearly 800,000 homes.²⁹

Biomass

Southwest Louisiana has abundant biomass resources, including wood waste from the timber industry, agricultural waste from the region's sugarcane and rice industries, and municipal solid waste from its population centers. These resources can be used to produce renewable energy, including electricity, transportation fuels, and bioproducts.

INFRASTRUCTURE

Ports

The Lake Charles Harbor & Terminal District, also known as the Port of Lake Charles, spans across 203 square miles and is the 14th busiest port district in the nation by tonnage. It manages the Calcasieu Ship Channel, extending 36 miles inland and 32 miles into the Gulf of Mexico. The port is a prime destination for breakbulk,

²⁹ Federal Register (n.d.). Proposed Sale Notice for Commercial Leasing for Wind Power Development on the Outer Continental Shelf in the Gulf of Mexico (GOMW-1). <https://www.federalregister.gov/documents/2023/02/24/2023-03842/proposed-sale-notice-for-commercial-leasing-for-wind-power-development-on-the-outer-continental>

specialty, and project cargo, catering to global industrial demands and international lumber shipments. As the top LNG export area in the world, it has rightfully earned its title as “America’s Energy Corridor.”

The Cameron Parish Port, Harbor and Terminal District offer a comprehensive solution for product transport, serving industrial companies of all sizes, and facilitating access to global markets. Its extensive network of ports provides unparalleled opportunities for seamless intermodal connectivity, efficient storage, and streamlined movement of goods.

Interstate and Highway Connectivity

Highway connectivity in Southwest Louisiana is facilitated by several major interstate highways, including I-10, I-210, and I-49. These highways provide easy access to the port and other key industrial areas. Additionally, the region is served by several state highways, including LA-27, LA-14, and LA-108, which provide connections to neighboring parishes and other parts of the state.

Rail Access

Southwest Louisiana has a well-developed rail network that provides a competitive advantage to companies in the clean energy industry. The region has access to major Class I railroads, including Union Pacific, Kansas City Southern, and BNSF Railway, which connect to the rest of the country and major ports for global distribution.

The region’s rail infrastructure also supports the transportation of raw materials and finished products for various industries, including the petrochemical and LNG sectors, which can provide synergies and opportunities for clean energy companies. Additionally, the rail network allows for efficient movement of heavy equipment and large-scale components for renewable energy projects, such as wind turbines.

Oil Reserves and Pipelines

Strategic Petroleum Reserve’s West Hackberry storage site is located in Cameron Parish, approximately 25 miles southwest of Lake Charles, Louisiana. The site was acquired in April 1977 and became operational in 1988. West Hackberry currently has 21 storage caverns, an authorized storage capacity of 220.4 million barrels, and a cavern inventory of 173.6 million barrels.

The region is also well-connected to the national pipeline network, which allows for the transport of crude oil, natural gas, and other energy products. Several major pipelines run through the area, including the Colonial Pipeline, the Explorer Pipeline, and the Sabine Pipeline. These pipelines are critical to the energy industry and provide a reliable means of transportation for products.

Industrial Sites

Southwest Louisiana is home to a strong collection of LED Certified sites, including a cluster of sites at the Chennault International Airport and the 560-acre T.O. Allen Industrial Park North in Jeff Davis Parish. These development-ready industrial sites can accommodate a host of clean energy projects.

WORKFORCE DEVELOPMENT

The higher education and community and technical college system in the Southwest Region, anchored by McNeese State University and SOWELA Technical Community College, plays a crucial role in supporting the workforce pipeline of the clean energy industry.

McNeese State University, located in Lake Charles, is a comprehensive public university that offers a range of undergraduate and graduate programs, including engineering, environmental science, and natural resource management. The university’s College of Engineering is home to the Center for Energy Research, which focuses on research and development in areas such as renewable energy, energy efficiency, and carbon capture and storage. McNeese also has partnerships with industry leaders, such as Cheniere Energy and the National Renewable Energy Laboratory, to advance research and provide students with hands-on experience in the clean energy sector.

SOWELA Technical Community College, also located in Lake Charles, offers technical and vocational training programs in areas such as welding, electrical technology, and process technology. The college has received financial support from local industry leaders, such as Sasol and CITGO, to provide students with real-world experience and job opportunities in the clean energy sector.

EXISTING INDUSTRY SECTORS POISED FOR TRANSITIONAL GROWTH

Petrochemicals

Southwest Louisiana’s petrochemical sector is positioned for growth in the global energy transition. The region has access to abundant and affordable natural gas, which is a key feedstock for the petrochemical industry. Southwest Louisiana’s existing petrochemical infrastructure is already well-established, providing a solid foundation for further growth and expansion. Additionally, the demand for petrochemical products is expected to increase as the world transitions to cleaner forms of energy, as petrochemicals are used in the production of many clean energy technologies such as solar panels, wind turbines, and electric vehicle batteries.

Liquefied Natural Gas

As the world continues to shift towards cleaner energy production and technologies, Southwest Louisiana's liquefied natural gas (LNG) industry is well-positioned to play a significant role in meeting global energy demand while reducing carbon emissions. Natural gas, which is the primary feedstock for LNG production, is a cleaner-burning fossil fuel compared to coal and oil. This makes LNG an attractive option for countries seeking to reduce their carbon emissions while still meeting their energy needs. The growth of the LNG industry in Southwest Louisiana is expected to create new jobs and increase economic activity in the region. This includes jobs in construction, operations, and support services. Additionally, the development of new export markets for LNG can provide a boost to the regional economy and create opportunities for local businesses.

Transportation and Warehousing

The Southwest region's transportation industry, including trucking and shipping, can benefit from the transition to cleaner fuels, such as natural gas and hydrogen. The region's existing infrastructure and expertise in transportation and logistics can also support the deployment of electric vehicle charging stations and other clean transportation solutions.

POTENTIAL BUSINESS EXPANSION TARGETS AND CLEAN ENERGY PLAYS

- Big Lake Fuels — Expanding into production of blue or green hydrogen as an additional revenue stream
- Canfor — Using hydrogen as a fuel source for its operations, as well as exploring opportunities to produce hydrogen from biomass
- Chennault International Airport (Logistics/warehousing tenants) — Attracting tenants involved in the production, storage, and transportation of hydrogen, as well as providing infrastructure for hydrogen refueling and logistics
- Lake Charles Methanol — Producing blue hydrogen through the process of steam methane reforming, as well as exploring opportunities for carbon capture and storage
- Sasol — Producing blue hydrogen from natural gas, exploring opportunities for carbon capture and storage, and using hydrogen as a feedstock for chemical manufacturing operations
- Sempra — Investing in hydrogen production and storage infrastructure, as well as exploring opportunities for hydrogen blending in its natural gas pipelines
- Venture Global LNG — Producing green hydrogen using renewable energy sources, providing infrastructure for hydrogen storage and

transportation, and using hydrogen as a fuel source for its liquefaction operations

TOP BUSINESS DEVELOPMENT OPPORTUNITIES

Wind Energy and Components Manufacturing

Southwest Louisiana has significant business development opportunities in offshore wind due to its location near the Gulf of Mexico and existing infrastructure and industry presence. The region has significant potential for offshore wind development, with some of the strongest and most consistent winds in the state. With the Port of Lake Charles and Cameron Parish Port's ability to accommodate large vessels, the region is a prime location for offshore wind components manufacturing and installation vessels.

Southwest Louisiana's existing manufacturing sector could benefit from offshore wind, as the components for offshore wind turbines, such as blades and towers, can be manufactured locally. This would not only create jobs in the manufacturing sector but also reduce transportation costs. Additionally, the region's skilled workforce and existing expertise in offshore oil and gas could easily transfer to the offshore wind industry. McNeese State University and SOWELA Technical Community College could provide training and education programs for the workforce to meet the needs of the offshore wind industry. By leveraging its location and existing infrastructure, southwest Louisiana could position itself as a hub for offshore wind development in the Gulf of Mexico, attracting investment and creating jobs in the clean energy sector.

Biomass

Southwest Louisiana has significant opportunities to leverage biomass for job creation and economic growth. The region has an abundant supply of biomass resources, including the forestry industry, rice and sugarcane farming, and the petrochemical industry. These industries produce significant quantities of waste materials, such as sawdust, rice hulls, and sugarcane bagasse, which can be used as feedstock for biomass energy production.

CCS

Southwest Louisiana's unique geological formations, particularly its deep saline formations and depleted oil and gas reservoirs, make it an attractive location for CCS investments. By utilizing these formations, the region can potentially reduce greenhouse gas emissions while also supporting economic growth through job creation and investment in clean energy technologies.

Conclusion

South Louisiana is uniquely positioned to become a hub for hydrogen production due to its rich history in the energy sector, pre-existing assets and resources, industry leaders, and skilled workforce. South Louisiana's geographic location and infrastructure afford exceptional and distinctive opportunities to fulfill all components of the hydrogen value chain. The region has abundant and diverse energy and resources that can be utilized as feedstocks for hydrogen production. Many prominent companies in the industry have established large-scale hydrogen and ammonia production facilities. The hydrogen produced in the area, as well as surrounding areas, is easily transported and stored through the region's existing pipeline infrastructure and storage facilities. In addition to production, transportation, and storage, South Louisiana has a wide range of hydrogen end users, primarily in the chemical and refining industries. Federal opportunities for hydrogen hub funding, the growing demand for use of hydrogen as a fuel for transportation vehicles, anticipated private investments, and subsequent economic opportunities such as job creation, further demonstrate that the region is well-positioned to be a key player and leader in the global energy transition.



