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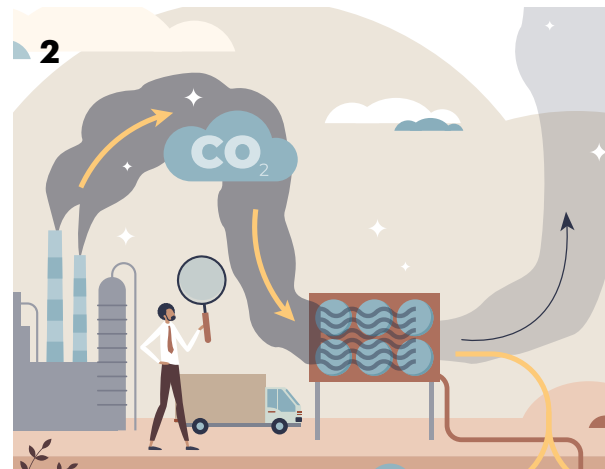
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Energy Sector Evolves as Sustainability Drive Ramps Up

Despite challenges such as maintaining social licenses to operate and permitting reform, companies are pushing forward with carbon management and ESG strategies.

VELDA ADDISON, SENIOR EDITOR, ENERGY TRANSITION

As sustainability gets woven into the ESG layers of companies' strategies, the face of energy is changing.

The latest energy transition sees the world moving toward lower-carbon energy sources in an effort to reduce global greenhouse gas emissions and slow global warming. While some are embracing an "all-of-the-above" energy policy, others are focused exclusively on ramping up renewable energy and integrating clean energy into grids. Energy security remains essential.

Regardless of the percentage of fossil fuels in the future energy mix, reducing emissions has become a necessity in all forms of energy production. And ESG is no longer an option when it comes to meeting the world's energy needs, with investors rewarding companies that succeed in creating value without compromising environmental stewardship and safety.

Though many agree that reducing emissions is a must, challenges remain.

Anti-ESG movements have made their presence known. Some environmental groups and others oppose not only infrastructure for fossil fuel-related projects, but renewable energy projects, as well. Permitting is a lingering concern.

Incorporating ESG strategy—whether it's choosing the right technology, building trust with communities or setting clear practices on accountability and transparency—into overall company ecosystems also remains a work in progress.

Still, companies are making headway and keeping sights on sustainability targets as ESG roadmaps take shape, technologies emerge and federal incentives are offered.

Permian Basin producer Pioneer Natural Resources, which acquired Parsley Energy in 2021, for example, is targeting zero routine flaring by 2030 as it electrifies field operations and works to reduce freshwater use in completions operations.

"Pioneer understands that we have an important role to play in the global challenge to mitigate climate change, and we take that role seriously," CEO Scott Sheffield wrote in the company's latest sustainability report. "Pioneer's board and executive leadership team acknowledge the global threats posed by climate change due to increasing GHG emissions and the resulting impact on rising global temperatures."

Sustainability is also engrained in the culture of Danos, a family-owned and managed oilfield service provider. When it comes to accountability in governance, safety is among its areas of focus. In 2022, Danos employees logged more than 7.7 million man-hours worked with a total recordable incident rate of 0.13, compared to the Gulf of Mexico industry average of 0.58.

"As a company, we're all about protecting investments—both professional and personal," Danos says on its website. "So, we go to great lengths to create an environment of safety and minimized risk and overall well-being for our most valuable assets: our employees."

Energy technology company Baker Hughes is also among



the sustainability leaders, having been recognized for its work in ESG performance; diversity, equity and inclusion; and innovation. The company's sustainability strategy is centered on people, the planet and principles that include a "culture of transparency and integrity—doing the right thing beyond compliance."

"We have been transforming our solutions portfolio by expanding our low-carbon technology portfolio and prioritizing emissions abatement considerations in our corporate strategy," Baker Hughes said in its 2022 Corporate Sustainability Report. "Our strategy is not only focused on financial and operational excellence. It is also heavily focused on sustainability leadership to enable us to deliver on our promises."

Pioneer, Danos and Baker Hughes are among the companies recognized by Hart Energy for their achievements this year. Others include Archrock, Aris Water Solutions, ChampionX, Crestwood Equity Partners, Honeywell, Integrity Bio-Chem, Kodiak Gas Services, MOL Group, MPLX, PureWest, Sentinel Peak Resources, Talos Energy and XRI Holdings.

Companies across the world are stepping up carbon management efforts, including carbon capture and storage projects.

"The main headline is there has been five solid years of growth in the project pipeline starting in 2017. Today we count 37 commercial CCS facilities that are operating, 20 in construction and more than 200 in development," Christina



"Pioneer understands that we have an important role to play in the global challenge to mitigate climate change, and we take that role seriously."

Scott Sheffield, CEO, Pioneer Natural Resources

Staib, global finance sector lead for the Global CCS Institute, said in June during a conference in Houston. "The total CO₂ capture capacity of CCS projects currently in development is more than 300 million tons per annum."

The estimates exclude transport and storage-only facilities.

Growth has been driven by a strong response from the private sector and governments' expectations to meaningfully act on climate change, she said.

Having business models that incorporate sustainability, embracing breakthrough and other technologies, and strengthening relationships with people will be essential to meeting the world's growing energy needs amid the threat of continued global warming. In this supplement, companies will share how they are doing that. ■

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Awarded SAG "Special Achievement in GIS" award for 2021 interactive digital ESG Report.



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ESG AWARDS

Environmental, social and governance (ESG) matters remain a critical—and sometimes, controversial—touchstone for companies across the supply chain as the energy transition cycle transforms the industry. Hart Energy’s annual ESG Awards highlight the findings of data analysis firm Clear Rating in its effort to categorize and quantify individual business efforts to improve ESG performance. These awards recognize advancements made in sustainable operation, local community engagement and positive workplace culture.

Clear Rating analyzed dozens of nominations and applied a weighted methodology to score nominated companies. In this assessment, more easily quantifiable environmental improvements were weighted the heaviest. The ratings still placed critical scoring metrics on social advancement, including community support and workforce sentiment, and on governance matters, such as board diversity. The final weighted score represents an average of the three ratings.

PUBLIC PRODUCER

PIONEER NATURAL RESOURCES

Pioneer Natural Resources

Final Score: 90

Pioneer Natural Resources’ CEO Scott Sheffield was one of the highest profile executives to call on the industry to reduce flaring in its operations. Calling flaring a “black eye” as much as five years ago, Sheffield has continued calls on industry colleagues to improve their environmental standards. Pioneer, a Permian Basin pure play, prioritizes emissions reductions, freshwater use and diminishing its physical footprint on the land.

E – Pioneer has committed to reduce methane emissions through facility design, operations and leak-management protocols. Flaring is less than 2% of Pioneer’s produced natural gas, one of the lowest rates in the Permian, and the company has eliminated routine flaring.

Category Score: 90

S – The firm strives to protect the environment from damage, as well as the lives of its employees and community members who live near its operations from injury and health risks.

Category Score: 90



Hart Energy

Pioneer, a Permian Basin pure play, prioritizes emissions reductions, freshwater use and diminishing its physical footprint on the land.

G – The board of directors is 23% racially diverse and 31% of its membership is female. Pioneer’s board was among the first U.S. producers to report annually on sustainability and climate risk, which is now common among public operators around the world. The board also has realigned its executive compensation calculations with ESG performance measurements.

Category Score: 90



Talos Energy

Final Score: 88.75

One of the leading independent operators in the Gulf of Mexico, Talos Energy strives to create and maintain a culture of ESG awareness with initiatives that foster corporate responsibility in daily operations.

E – Talos has demonstrated commitment to protecting the diverse ocean and coastal environments in which it operates. Through its safety and environmental management system, Talos actively monitors its operations to minimize impacts and ensure full compliance with applicable industry standards and regulations. Current environmental initiatives include a 30% reduction in greenhouse gas (GHG) emissions intensity by 2025 from baseline 2018 levels.

Category Score: 90

S – Talos was named one of Houston Chronicle’s Top Workplaces in Houston for eight consecutive years. In



Talos Energy Inc

The Bayou Bend CCS project was the first offshore lease in the U.S. dedicated to CO₂ sequestration.

June 2021, the company raised approximately \$70,000 through employee and company matching contributions to a local Houston children’s charity, Kid’s Meals.

Category Score: 85

G – The company has increased female representation on its board of directors to 30%. It has also increased its ESG-related performance metrics to account for 20% of management’s annual incentive plan.

Category Score: 85

PRIVATE PRODUCER



PureWest Energy

Final Score: 90.25

PureWest, a natural gas producer in the Rockies, incorporates its ESG principles into daily operations through voluntary initiatives to self-monitor and decrease GHG emissions, as well as through support of community volunteering programs. The company, which recently was acquired by a private investor group largely led by family offices, has cultivated a positive, productive and inclusive work environment and was honored with a Denver Business Journal “Best Place to Work” award in the 2023 Large Company category.

E – PureWest worked closely with Project Canary and TrustWell to certify all of its wells as “Responsibly Sourced” by year-end 2022. A rigorous internal auditing program was established to evaluate leak detection and repair (LDAR) findings and conduct facility evaluations. PureWest voluntarily removed thousands of pneumatic pumps to replace them with solar-powered devices, and removed all of its high-bleed pneumatic devices. The company also deployed stationary methane detection monitors at select sites.

Category Score: 90



PureWest

PureWest is implementing new technology to help replace energy-intensive operations, including solar heat trace pumps and well automation, which allows the company to remove pneumatic devices—eliminating those operational emissions as well as the potential for fugitives.

S – PureWest’s charitable giving policy focuses on providing for basic human needs, such as food, shelter, healthcare and education. The company matches employee donations to more than 60 organizations.

Category Score: 85

G – PureWest seeks to encourage healthy debate and embrace the diversity of its workforce. The company says it fosters a workplace that encourages and rewards initiative, and provides authority to make decisions within areas of accountability. It empowers employees to adhere to the corporate commitment to operate responsibly and continuously improve the bottom line.

Category Score: 95



Sentinel Peak Resources

Final Score: 90

Sentinel Peak Resources is focused on the acquisition, development and exploration of oil and gas resources, primarily in California. The firm concentrates on operational excellence, serving as a steward of the environment and investing in its people and communities.

E – The company set a target of achieving carbon neutrality by 2030 through improved efficiencies, adoption of alternative energy sources and utilization of new technologies. Sentinel has improved its methane management with a five-tank vapor recovery system that reduced CO₂ emissions from crude oil storage tanks by 93%. In addition to GHG reduction, Sentinel minimized freshwater use, sourcing over 95% of its water from non-potable sources, including produced water from its own wells.

Category Score: 90

S – Sentinel supports multiple community youth programs, such as mentorship programs in local high schools, and a program to support emancipated young people develop skills required to obtain field or



Sentinel Peak Resources

Sentinel Peak Resources' oil and gas operation in the McKittrick oil field is located among the foothills of Western Kern County, Calif.

administrative work. The company supports the Los Angeles community by converting some non-operating sites into affordable housing and other socioeconomic needs.

Category Score: 90

G – Sentinel's regulatory compliance has allowed it to succeed despite the headwinds oil and gas companies face in California. The company adopted the California Air Resources Board reporting standards for GHG emissions, an LDAR program, groundwater monitoring, oil spill prevention and other programs. Sentinel employs a third-party whistleblower reporting service, Lighthouse Service, to ensure a safe space for employees to report concerns, and it says it is committed to adopting cybersecurity protocols to ensure system and source integrity.

Category Score: 90

PUBLIC SERVICES



Baker Hughes

Final Score: 92

The oilfield services giant demonstrates ESG leadership in its goal setting, its sustainability performance and its investments in new products and services. As an energy technology company, Baker Hughes is committed to not only improving its own ESG performance, but also helping customers meet their ESG challenges and opportunities in support of the energy transition.

E – In 2022, Baker Hughes reduced its Scope 1 and 2 CO₂ emissions 28% from the 2019 baseline, with 10 Scope 3 emissions categories reported with limited assurance. The company recycled 57,666 metric tons of waste and sourced 26% of its electricity from zero-emissions sources.

Category Score: 95

S – Baker Hughes pledged \$2 million in strategic grants through the Baker Hughes Foundation in support of the UN Sustainable Development Goals in 2022. The company gave



Baker Hughes

Baker Hughes's Massa, Italy, facility is part of the company's efforts to run more operations on renewable energies.

\$925,000 to support diversity and inclusion programs, as well as education and opportunity initiatives. It donated \$417,000 to support health, safety and wellness, and disaster relief. And it gave \$650,000 to support environmental programs.

Category Score: 80

G – Last year, 53,846 Baker Hughes employees had completed annual code of conduct training, including training on ethics, compliance and anti-corruption; 99% of the company's governance body members had received anti-corruption training; and 100% of enterprise security personnel, including full-time and embedded contractors, were trained in human rights policies.

Category Score: 85



CHAMPIONX

ChampionX

Final Score: 90

ChampionX is a global leader in upstream and midstream oilfield technology solutions, chemistry programs and services, drilling technology, artificial lift and automation technologies for the oil and gas industry. It defines its overarching corporate purpose as improving lives, and has built a sustainability culture from the ground up.

E – ChampionX says it embedded sustainability into its culture and promoted more sustainable operations internally. It launched an internal carbon footprint calculator, which enables employees to calculate the manufacturing carbon footprint associated with transporting products from facilities to customer assets. In many cases, the calculator has shown the positive impact the company's products have on reducing customers' carbon emissions in the field.

Category Score: 90

S – ChampionX supports nine resource groups with the voluntary participation of over 1,000 employees. The goal is to create a workplace culture that cultivates a sense of belonging and allows for more purposeful alignment with the principles of the company. ChampionX also launched



ChampionX

ChampionX chemical solutions and services provide chemistry, technology, engineering support and onsite expertise to improve outcomes for upstream and midstream oil and gas operations.

SEED (Sustainable Energy Empowers Development), a program that connects employees with opportunities to personally support environmental programs.

Category Score: 90

G – In support of their goal of continuous improvement and to strengthen the inclusivity of the company, ChampionX established an enterprise-wide Diversity and Inclusion Council, chaired by ChampionX CEO Soma Somasundaram. The council is made up of senior leaders from a cross-section of the company's business, including a rotating set of employee resource group leaders.

Category Score: 90

PRIVATE SERVICES



Danos

Final Score: 93.75

A family-owned oilfield service company, Danos views its commitment to ESG principles as fundamental to its success. The company is a founding member of the National Ocean Industries Association's (NOIA) ESG network, which shares and develops best practices across the offshore energy industry.

E – Danos works with wetland conservation groups, and is involved in a projects building artificial reefs—nicknamed Cajun coral—using 3-D printing that will help regrow coral beds, as well as protect against coastal erosion in Louisiana. Danos utilizes engine-calibration software to reduce its fleet's fuel consumption and cut its CO₂ emissions by 1,178 total metric tons a year.

Category Score: 95

S – The Danos Foundation has given over 1 million to 120 organizations and more than 350 employees in need since it launched in 2017. Danos partners with several technical and community colleges that offer degrees supporting



Danos

Danos works with partner Natrx in Louisiana's marsh to offload Cajun Coral, a restoration model that uses digital tools to work with mother nature to protect coastlines.

the industry, and the company has a robust on-the-job training program.

Category Score: 90

G – Danos' fabrication facility is fully certified to International Organization for Standardization quality management system standards and conducts rotating internal process audits to ensure compliance. The company is a multiyear winner of the NOIA Culture of Safety award for establishing an institutional safety culture through behavior-based safety programs and innovation.

Category Score: 90



Integrity BioChem

Final Score: 93.25

Integrity Bio-Chemicals appointed its first director of sustainability in fall 2021 and touts breakthroughs in sustainability initiatives throughout the organization, committing itself to sustainable natural product solutions for the full product lifecycle.

E – Integrity BioChem’s bio-based, 4x-concentrated surfactants reduce combustion engine footprint by 75%.

Category Score: 95

S – A small company, Integrity BioChem boasts that, at its core, it is a technology company. The company strives for employee safety, reporting zero lost-time incidents in 2022.

Category Score: 85

G – Integrity BioChem made an executive commitment to ESG with the creation of a new role, director of sustainability. Laura Kuri Benavides took on this charge to implement and document the company’s



Integrity BioChem

Integrity BioChem manufactures biopolymer products.

sustainability processes. She also provides guidance on emerging sustainability technologies.

Category Score: 90

PUBLIC MIDSTREAM

Archrock

Archrock

Final Score: 94.5

Houston-based Archrock’s mission is to “Power a Cleaner America.” The natural gas compression services provider’s 1,000-plus employees are spread across 21 states.

E – Archrock reduced its Scope 1 and 2 carbon intensity by 11% in 2021 compared to 2020 levels. Scope 3 emissions in 2021 were 37% below 2017 levels. In 2022, Archrock acquired a 25% equity position in Ecotec, a company that provides methane emissions monitoring, leak detection and environmental compliance. Archrock is working to connect Ecotec’s proven technology with its U.S. natural gas compression infrastructure and customer support network.

Category Score: 95

S – The Archrock Cares organization supports volunteer activities with organizations, such as the Houston Food Bank. In 2022, Archrock added a diversity and inclusion metric to its short-term incentive program, increasing the company’s percentage of employees that self-identify as members of underrepresented groups.

Category Score: 90



Archrock

Houston-based Archrock’s mission is to “Power a Cleaner America.”

G – Archrock’s majority independent and annually elected board of directors drive a focus on long-term sustainability and governance standards throughout the organization. Of the annually elected Archrock board of directors, three of the seven independent board members are either female or ethnically diverse, including audit and governance committees led by female board members. In 2022, Archrock increased the weight of safety and sustainability within its short-term incentive plan to 20%.

Category Score: 95



Crestwood Equity Partners

Final Score: 93.25

Crestwood Equity Partners made significant strides on its second three-year sustainability strategy, initiated in January 2022, including deliverables achieved through its comprehensive carbon management plan.

E – While the company's GHG emissions increased in 2022 due to the acquisitions of new gathering, compression and processing assets, Crestwood achieved a 5% reduction in its methane emissions intensity rate from 2021 levels and a 58% reduction since 2018. The company also made advancements on its continuous, methane-monitoring pilot and installed devices on 13% of its assets in 2022, enhancing its approach to methane detection.

Category Score: 95

S – In 2022, Crestwood donated \$1.5 million to the communities it operates in, and Crestwood employees volunteered over 2,800 hours.

Category Score: 85



Crestwood Equity Partners

Crestwood remains committed to seeking ways to enhance its emissions monitoring.

G – Crestwood continues to increase its female leadership representation and was included in the 2023 Bloomberg Gender-Equality Index for the third consecutive year. Crestwood continues to make significant progress in advancing its approach to corporate governance in alignment with best practices, enhancing disclosures in its annual proxy statement and maintaining a board composition of 89% independent directors, reflecting diverse perspectives and ensuring robust decision-making.

Category Score: 90

Supporting the leaders and innovators who are making a difference

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Aris Water Solutions

Final Score: 89.25

Aris Water Solutions, a leading developer and operator of critical water infrastructure assets in the Midland and Delaware basins, has committed to exceeding the high standards set by its customers, global regulators and the global investment community. This enables customers to exceed their own water, safety and community commitments and focus on their core businesses.

E – Aris recycled 4.6 billion gallons of water in 2022 to offset groundwater withdrawals, reduce wastewater disposal and cut carbon emissions. Aris led the formation of the largest joint industry beneficial reuse project, working with three major operators to develop, pilot and demonstrate desalination and polishing treatment technologies that aim to facilitate safe beneficial reuse of treated water outside of the oil industry. Also, Aris was able to reduce fresh and groundwater consumption by up to 90% in certain instances.

Category Score: 90



Aris Water Solutions

Aris Water Solutions is a leading developer and operator of critical water infrastructure assets in the Midland and Delaware basins.

S – Aris supports local communities by giving to and volunteering with first responders and local charities.

Category Score: 90

G – The company is committed to ensuring a diverse and inclusive culture, with over 50% minority and female representation, including at senior leadership and executive levels. Aris has an independent governance with a diverse board, including 33% gender and minority representation.

Category Score: 85

PRIVATE MIDSTREAM



XRI Holdings

Final Score: 88.75

XRI was founded in 2013 on the tenets of conservation of water resources, environmental sustainability, employee health and safety and corporate stewardship. XRI's mission is to provide the industry with an environmentally sustainable alternative to groundwater use for hydraulic fracturing operations.

E – The independent water midstream company's operations avoid the emitting of 225,000 metric tons of CO₂ per year, save over 400 million barrels of freshwater aquifers per year, and prevent reinjection of over 270 million barrels of wastewater.

Category Score: 90

S – XRI engages with the community it serves through volunteering and participating in economic development.

Category Score: 85



XRI Holdings

XRI has committed to a corporate culture and code of conduct ensuring the highest level of business ethics, including anti-bribery and corruption standards, stakeholder rights and social justice practices, as well as governance of sustainability initiatives.

G – XRI has committed to a corporate culture and code of conduct ensuring the highest level of business ethics, including anti-bribery and corruption standards, stakeholder rights and social justice practices, as well as governance of sustainability initiatives.

Category Score: 85



Honeywell Picks Up the Pace on CCS

The company's carbon capture and storage technology was selected for Exxon Mobil's blue hydrogen and CCS project in Baytown, Texas.

VELDA ADDISON, SENIOR EDITOR, ENERGY TRANSITION

Carbon capture technologies in the U.S. date back to the 1970s when they were used to remove CO₂ from gas streams, improving the value of natural gas, and for enhanced oil recovery in the Permian Basin.

Times are changing.

Though carbon capture is still used to help boost oil production today, focus is shifting to storing captured carbon as the world aims to reduce greenhouse gas emissions.

"Instead of trying to meet a natural gas product spec, we're identifying other CO₂-rich sources and trying to remove the CO₂ to make sure it never gets into the atmosphere," Jeff Guenther, project development director of carbon capture and blue hydrogen for Honeywell, told Hart Energy. "The U.S. is a leader in this space, given ample storage capacity and some CO₂ pipeline infrastructure in place along the U.S. Gulf Coast."

Hart Energy spoke with Guenther about carbon capture and storage technologies, which the International Energy Agency said are required to reach net-zero emissions targets. He called the state of affairs for CCS in the U.S. "quite good" with strong interest in developing carbon capture projects in other parts of the world, including Europe, as society and corporations get serious about reducing emissions.

Exxon Mobil selected Honeywell technology to capture CO₂ from a new blue hydrogen plant at its Baytown, Texas, complex. The project will have a capacity to store up 10 million metric tons of CO₂ per year.

Data from the Global CCS Institute show the number of CCS projects grew 44% through September 2022 compared to a year earlier, with North America leading the world in CCS development. However, more large-scale deployment is needed to hit net-zero emissions goals.

This interview was edited for length and clarity.

Velda Addison: Do you consider carbon capture underutilized globally? How do you see that changing, given the drive to lower emissions and net-zero initiatives?

Jeff Guenther: The key with carbon capture and a lot of these projects is there does need to be some supportive policy for projects to go forward. With the passage of the Inflation Reduction Act, the U.S. has very clear policy in place that gives project developers in the U.S. confidence. Europe also has pretty clear policy. Outside of that, there are many more question marks. I would agree it's an underutilized tool, and it's because policy in other regions are sort of lagging behind Europe and the U.S. in terms of clarity and magnitude of how they would support a project. ... It is moving, but just at a slightly slower pace because they're waiting [for] clarity on the policy side. It



is underutilized from that standpoint, but there seems to be global vision that it is a strong opportunity to reduce emissions, especially in sectors that have limited options to continue to operate while lowering their CO₂ footprint.

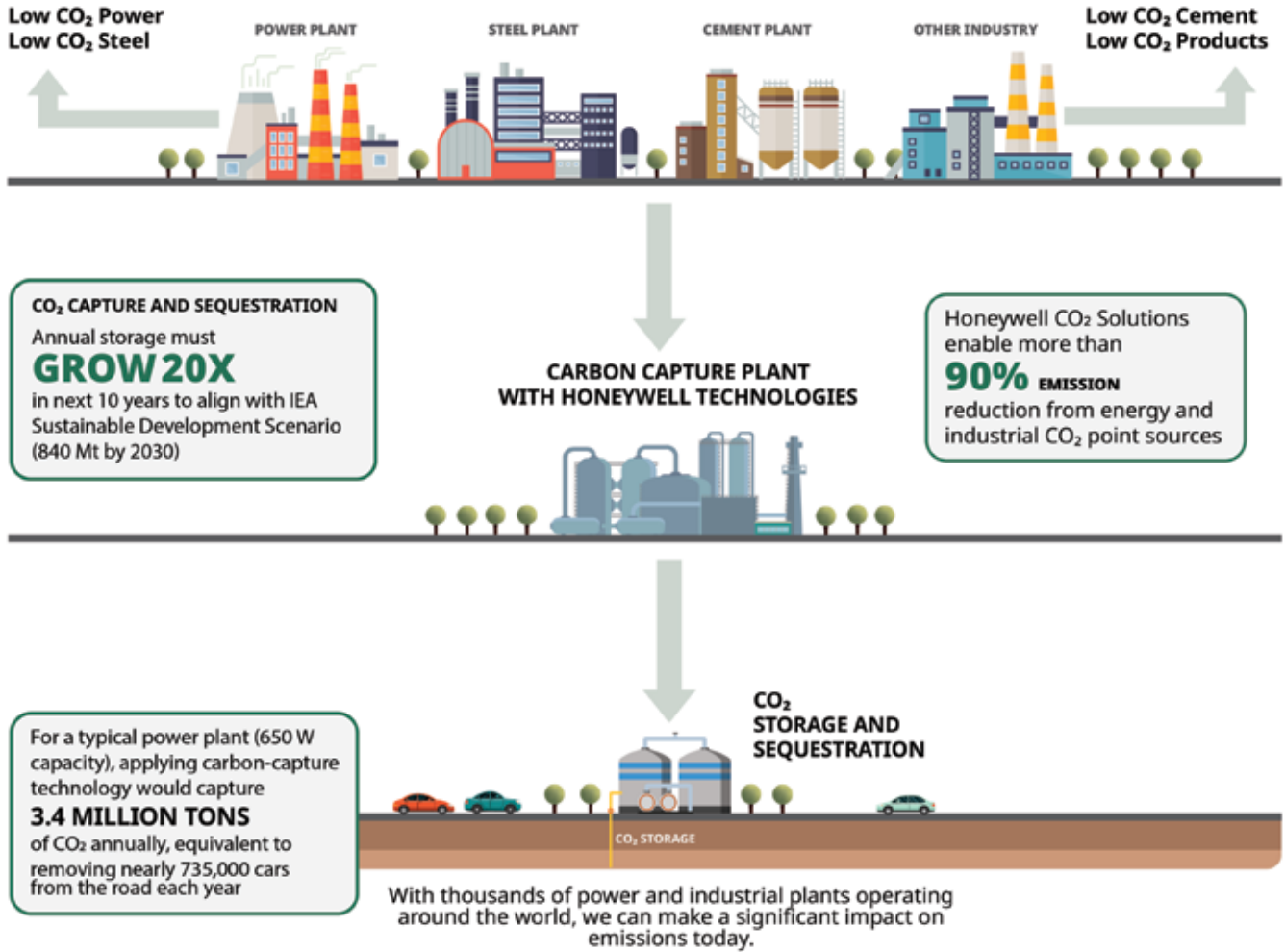
VA: In the energy industry, we often hear that CCS is expensive. What makes it expensive?

JG: Expensive is a relative term here, right? Everything needs to be compared to the impact of climate change, which is expensive in its own right if we don't do anything. So why is it expensive? There's a lot of CO₂ being emitted into the atmosphere. So, when you're talking about large-scale projects, there's a large capital investment to capture that much CO₂. Power plants are easily emitting over a million tons of CO₂ per year, in many cases over 3 million tons of CO₂ per year. That's



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a lot of gas to be able to process and a lot of CO₂ to handle.

Once you make the investment to capture it, you also need some type of infrastructure available, most likely via pipeline, to move the CO₂ to a suitable sequestration site. To answer your question, when the challenge is big, the solution is equally big.

VA: How is Honeywell working to make CCS more efficient for the industry, given that some projects don't end up not capturing as much CO₂ as originally planned. What are some of the key technologies to help improve cost and efficiency of these types of projects?

JG: At Honeywell, we have a full portfolio of technology solutions that we can use to capture carbon in both pre-combustion and post combustion applications. Pre-combustion applications are characterized as high CO₂ concentration

process streams. Typically, in hydrogen production or in natural gas processing, these types of streams are available. They might have 40 to 60% CO₂ and they offer a positive opportunity to capture that CO₂ at a low cost on a dollar per ton basis. To contrast that with post combustion carbon capture, where we have a fossil fuel that's being combusted in a fired heater, turbine or boiler, and we're capturing the CO₂ in the post combustion gas or the resulting flue gas from that process. That's the much larger market opportunity in the world but it's more challenging to treat because it's characterized by lower CO₂ concentrations, which mean capturing that CO₂ becomes a higher cost on a dollar per ton basis.

We use solvents, absorbents, membranes and fractionation technology for these applications. We can deploy those independently or in hybrid schemes. ... On the post combustion side, we have advanced solvent carbon capture technol-



ogy that offers some unique advantages in the marketplace. Our solvent has a very high mass transfer rate, allowing the absorption equipment to be smaller than previous first-generation solvents on the market. It also is very stable, meaning that we can operate our process at a higher temperature and pressure, which means we can produce the CO₂ at a higher pressure than other solvents on the market. That's really important because when you're talking about large quantities of CO₂, a million tonnes of CO₂ per year or more, that CO₂ needs to be compressed to very high-pressure levels—typically around 2,000 pounds per square inch—to be transported and stored. When we're able to produce the CO₂ at a higher pressure, it can actually significantly reduce the costs for compressing it before it is transported and stored, typically in the range of 30 to 40%, both in terms of the initial capex of that compression and in the annual operating expenses.

VA: You mentioned solvents, absorbents and fractionation technology. Is there any one technology that Honeywell is seeing more demand for, or is it all of the above?

JG: Two are really standing out. In the pre-combustion space, particularly when in large scale hydrogen production, we're getting a lot of positive feedback on our CO₂ fractionation technology because of the low cost of capture it enables, the possibility to integrate within the hydrogen production process to drive to very low carbon intensities, and to produce the CO₂ directly as a liquid product. On the post-combustion side, the proven technology in the market is solvent based. So, we're seeing many customers who are focused on evaluating solvents today to treat their post combustion flue gases.

VA: What specific technologies do you plan to use for the Exxon's blue hydrogen project?

JG: We are providing the hydrogen purification equipment called a Honeywell UOP polybed PSA unit. We're providing the dehydration unit, which is a Honeywell UOP Molsiv unit, a CO₂ fractionation unit, and a hydrogen membrane unit. Essentially how that process works is there is hydrogen-rich syngas that's produced by the auto thermal reforming (ATR) unit. Our hydrogen PSA unit will process that gas and separate out a high purity hydrogen product stream. It will also then reject the other components in a tail gas stream, including the CO₂, which will be dehydrated and compressed and head to our CO₂ fractionation column, where the CO₂ will be separated and produced as a high purity CO₂ liquid. From the top of that CO₂ fractionation column, we then can send the gas to a PSA and a membrane unit to further recover hydrogen as a product source. The rejected gas from that stream will be recycled back to the ATR so that any unconverted methane or carbon monoxide will continue to recycle in the unit so that it will be converted to CO₂ and captured by our technology. This results in a very low carbon intensity hydrogen product.

So in summary, if you picture our offering as one large box, the gas is going to come in and be separated into three streams: a high purity H₂ product; a high purity liquid CO₂



“I would agree [CCS is] an underutilized tool, and it's because

policy in other regions are sort of lagging behind Europe and the U.S. in terms of clarity and magnitude of how they would support a project.”

JEFF GUENTHER, PROJECT DEVELOPMENT DIRECTOR,
CARBON CAPTURE AND BLUE HYDROGEN, HONEYWELL

product; and a hydrocarbon free fuel stream with the remainder being recycled within the system. All of the CO₂ that leaves the system is essentially captured for storage. That's the unique and exciting aspect of that project. We can drive to slow carbon intensities of hydrogen production, providing an opportunity for hydrogen to become a fuel substitute and a high value commodity.

VA: Are you finding that more companies are focused on sequestering CO₂ instead of utilizing it? How can captured carbon be used?

JG: Most companies that we're talking to are focused on sequestration, especially in the U.S., because we have a suitable geological environment to enable that. Additionally, in the U.S., there are different incentive levels available. The U.S. offers a tax credit of \$85 per tonne for CO₂ that is permanently stored and \$60 per ton of use for enhanced oil recovery. Most of our customers are looking to permanently store it in the ground. Most climate and market models take the assumption that the majority of CO₂ that's going to be captured is going to be permanently stored because one, that is the surefire way to prevent it from making its way eventually into the atmosphere and two, the amount of CO₂ that we need to abate is just so large that market outlets don't really exist for it today in the quantities that people are planning to capture.

With that said, CO₂ can be used in the beverage and food preservation markets. We're also seeing some interest from customers about using CO₂ as a feedstock for fuels. We recently announced our e-fining process technology that can convert CO₂ and green hydrogen into methanol and eventually into sustainable aviation fuel. So, we continue to look into different ways to utilize CO₂ as a fuel as well as different pathways to produce other chemicals needed by our society. But the near-term focus for most of our customers, especially at the quantities required to make a significant impact on their emissions, is to store the CO₂ permanently. ■



Talos Energy Makes Landfall to Tackle CCS Projects

Low-carbon strategy executive Robin Fielder explains how different pieces—engineering, stakeholder engagement, funding—come together.

JORDAN BLUM, EDITORIAL DIRECTOR

Roughly two years ago, Gulf of Mexico producer Talos Energy took a strategic leap of faith and started picking up acreage both onshore and off with the mindset of injecting—not extracting—carbon.

And, thus, were born a slew of developing carbon capture and storage (CCS) projects: the flagship Bayou Bend CCS offshore of Port Arthur, Texas; River Bend CCS in Louisiana; Coastal Bend CCS near Corpus Christi, Texas; and a point-source project with Freeport LNG in Texas.

As potential pioneers in offshore CCS with Bayou Bend, Talos and partner Carbonvert found themselves in the enviable position of being approached by Chevron to join the team, said Robin Fielder, Talos' executive vice president for its low carbon strategy and the chief sustainability officer.

Chevron came onboard last year as a 50% project owner and, in March, the expanded team added to Bayou Bend's 40,000 offshore acres with 100,000 onshore acres between Houston and Port Arthur.

Fielder sat down with Hart Energy for an exclusive interview on CCS topics.

JORDAN BLUM: I don't think there's been a whole lot of public focus on the extra acreage on the east side of the Houston Ship Channel. Most of the emphasis is on offshore and the Chevron partnership.

ROBIN FIELDER: Yeah. It was the expansion of Bayou Bend, but with it they became operators. So we had two operators.

JB: I was interested in—separate from the Chevron component—delving into the expansion itself. Could I get you to elaborate on just how important, how big a deal it is with the proximity to the ship channel and everything?

RF: It's a great expansion. It unlocked a whole second industrial region for us. So now, we're in that onshore acreage that crosses Chambers and Jefferson counties. It's right there on the eastern side where you've got Beaumont, Mont Belvieu. So, a lot of power, a lot of fractionation and a lot of industrials. And a large storage site is needed to address that market. We could have taken it to offshore, but it would've been on much farther transport and and higher costs. So, it would've been harder to be competitive there. Now that we've got the onshore, we can address both markets. But, also, we see at some point we can connect both stores up via pipe and have that flexibility if we need to swing volumes, for instance. We have some built-in redundancy because our customer base really wants to see that.

JB: Was there any legacy ownership of the onshore acre-

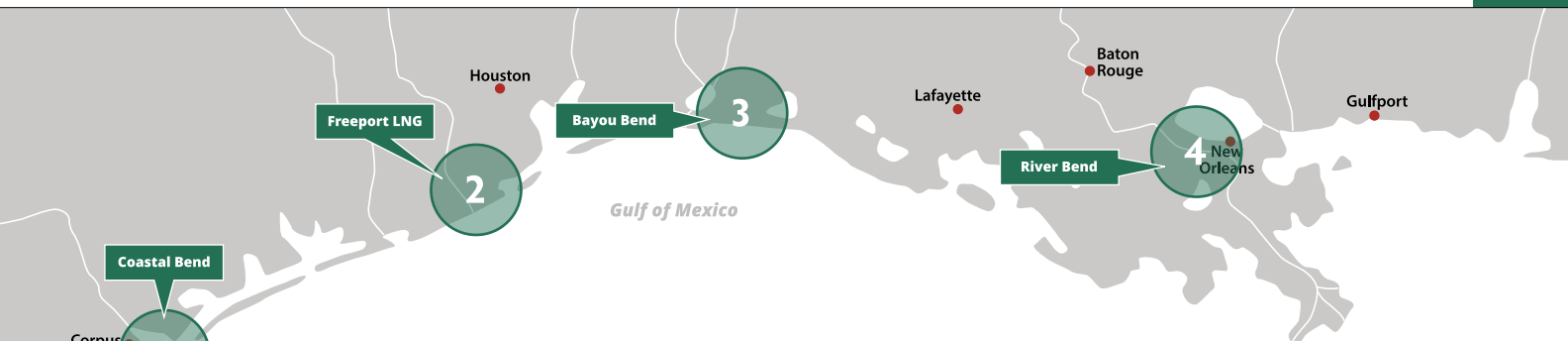


age before the Chevron deal?

RF: It came in through our joint venture, so our joint venture decided to go and purchase that. Chevron was the lead on a lot of that, but we, as Talos, were working with them on that as well.

JB: Would you take me through the next steps from here? Bayou Bend is the biggest project, obviously, but you're moving multiple levers at the same time. So, take me through how you see the timeline from here. I know nothing is set in stone.

RF: Each project has its own project manager, subsurface team. So, you've got a lot of parallel processes in each project. You're working through emitter agreements, commercial negotiations. We're talking with the insurance market and what that can look like. We're talking with the EPCs (engineering, procurement and construction)—sometimes it's ourselves—on doing the actual pre-FEED or FEED studies to get the more detailed cost estimates and full designs where you've got all the P&IDs (piping and instrumentation diagrams) and everything mapped out for what the location modifications need to be, where the pipe is going to go in the ground, where the right-of-way would be. So, it's really getting all that detailed process engineering and process work done while we're building a stakeholder engagement plan and engaging. You've got all these parallel pieces and then, oh yes, there's the funding piece. So, we're keeping the door open for each of these projects to have project-level funding or financing if you've got the contracts that are long



Talos CCS Project Portfolio: 800 Million MT CO₂ Storage

Supporting 150 MTPA of regional emissions on ~80,000 acres

	1. Coastal Bend	2. Freeport LNG	3. Bayou Bend	4. River Bend
Industrial Region	Corpus Christi	Brazoria Co. (TX)	Beaumont / Port Arthur	Baton Rouge / New Orleans
Regional Emissions (MTPA CO ₂)	~20	~20	~30	~80
Lessor	Port of Corpus Christi	Freeport LNG	Texas	Private Landowner
Footprint (Acres)	13,000 Onshore	~500 Onshore	40,000 + Offshore	26,000 Onshore ⁽¹⁾
Storage Capacity (MM MT CO ₂)	50 - 100+	~25	225 - 275	500+
Annual Injection Rate (MTPA CO ₂)	1.0 - 1.5+	0.5 - 1.5	5.0 - 15.0	5.0 - 15.0
Estimated First Injection	Late 2026	Late 2024	Late 2025	2026
Partners	Howard Energy	Storegga	Carbonvert, Chevron	Storegga, EnLink Midstream

(1): River Bend CCS acreage additionally includes 63,000 on right of first refusal in addition to leased 26,000 acres.

Source: Talos Energy



“This whole energy transition subsector is about partnering and collaboration. There’s not one single company

that’s best suited to do all the different pieces. So, you have to work and think across the value chain.”

ROBIN FIELDER, EXECUTIVE VICE PRESIDENT OF LOW CARBON STRATEGY, CHIEF SUSTAINABILITY OFFICER, TALOS ENERGY

term and underwritten by investment grade counterparties. That’s exactly what sets itself up for project-type lending.

So, we kind of keep that end in mind as we’re negotiating these agreements to make sure that that’s an option. The stakeholder piece is important. It’s sort of early and often. One of the nice things, for instance, in partnering with the Port of Corpus Christi is they are a huge stakeholder for that region. They were able to introduce us to all of the local mayors and commissioners, and start making those introductions before we even announced we were thinking about a project last year. It was good just to have the early dialogue so no one gets surprised by a press release that we’re going to go explore carbon management or CCS projects. So, when we signed the lease this year, there were no surprises.

People want to just understand what it is you’re trying to do, and to let them know before they hear it in the news. Part of it’s just getting the buy-in, and it’s just the best way to do business. We’ve got folks that have worked in or even grew up or lived in these various regions. It’s just approaching it with that stakeholder mindset that we’re a community partner, we’re a neighbor. But it’s very important and part of the EPA process, frankly. If you’re going to seek any Department of Energy funding, they certainly want to see your thoughts around environmental justice and what does your community engagement programs look like.

JB: Will you compare and contrast the onshore versus offshore CCS and how a lot of the things are the same, but what factors are different as well?

RF: In general, when you’re drilling wells onshore, it’s a little bit cheaper when you’re thinking about the rigs. The availability is fairly good to drill a somewhat shallow onshore well, and you can lay a pipeline fairly easily in the states like Texas and Louisiana. Offshore is a little bit more expensive when you’re thinking about the rig rates. The luxury of onshore is, when you get a nice big contiguous piece of leasehold that’s not shopped up by a lot of private landowners. You’ve got a single landowner from the pore space through the minerals. So, you’ve got that luxury of working with one counterparty, building your stakeholder plan, building all of that permitting. But that’s harder to find.

For offshore, we meet with the GLO (Texas General Land Office) every six months and update them on the proj-



ect. It's one entity. And you're farther away from potential communities where you have trucks driving in someone's neighborhood. We're all offshore. So, you're kind of away from that when it comes to some of the nuisance things. So, there's a plus and minus to both. We think we'll need both to be successful across the U.S. portfolio. We think there's a luxury in both. Today, the California Low Carbon Fuel Standard (emissions trading mechanism) requires an onshore solution. I think one day that could be expanded to offshore. But it comes down to cost and having a single contiguous landowner where you can put together an onshore position, but there's usually a lot of parties involved.

JB: Are you looking anywhere beyond the Gulf Coast?

RF: We've also looked very briefly at a few international projects. But what's really turned was the (U.S.) Inflation Reduction Act last year. A lot of the focus is now back on doing projects here in the States because of the incentives and the Department of Energy's willingness to fund some of these projects or lend against it through the (DOE) Loans Programs Office. The real excitement is here and the Gulf Coast has some of the best geology. So, it makes sense that that's where the focus continues to lie.

The Gulf Coast has some of the best geology for storage. You've got conventional rock. It's got really good porosity, really good permeability in these very contiguous, continuous sandstone reservoirs that are filled with water. Contrast that to shale: very low permeability and porosity, very tight formations. The (offshore) reservoirs are large. You have a lot of storage capacity, which means ability to scale these projects.

JB: I know the devil is in the details a bit. The insurance component is an obvious part. But, can you talk about why that is so critical and potentially tricky dealing with the Class VI CCS wells?

RF: Part of it is for the EPA permit. Some of it's just ... large investment-grade industrial counterparties ... want some assurances that if they're going to do a large investment, particularly on the capture side, they want to make sure they can get access to that tax credit. In order to have the credit, the IRS has a clawback period. For three years, you've got to ensure the CO₂ is still being permanently sequestered. They're not going to give you a credit for something that obviously didn't work. And so, we have to show and demonstrate through our monitor, reporting and verification (MRV) plan both to the EPA and the IRS that the CO₂ is still being stored in this reservoir. But then we also need to have assurances in place if something changes. And so, that's where you can have insurance products. I'd say it's still fairly immature as far as how those are developing with the market, but all the major insurance providers are working on various products right now.

JB: It almost seems like we're in a little bit of the wild, wild west for carbon capture where everybody's trying

to get a piece of the funding. Talos is more advanced, so that's different. But is there a concern about some bad actors potentially giving CCS a bad name down the line?

RF: I think early on, some folks tried to compare the CCS game to the shale revolution. There were a lot of independents and private equity, in particular, going out [and] leasing up acreage, trying to develop a project and flip it. I don't think that's going to be successful long-term because of the long-term liabilities to the assurances that are required here. Your customers are, in most cases, large industrials that make a product day in and day out. They just need to know that this waste product is being taken care of. While there are a few smaller guys trying to get started and they've submitted some permits, I would bet that they're not all going to be at the same rigor that we're expecting to put together with our partners. So, I don't know how successful they'll be over the long term. Will they be able to monetize some of that acreage? Perhaps somebody can bolt on some of that, but I don't think they're going to be making it to FID [final investment decision] unless they have the right counterparty or balance sheet partner that will be willing to take that on.

JB: You're doing stratigraphic test wells. How important is it economically to have those multitask so the test wells can eventually become the CCS injection wells?

RF: So, you can reuse it? That is important. We drill these stratigraphic test wells that are data acquisition wells. We have that mindset where we're trying to have them as keeper wellbores where you can convert them to be either the injector wellbore of the future or a monitoring wellbore. And so, as we're choosing our location to drill those test wells, it's important to have that broader picture and development plan in mind. You could have kind of a throwaway well as you sometimes do in deepwater exploration, but it's not the most economic version. So, we'd like to keep it. What that does mean though is, up front, we're looking for some of the specialty metallurgy and anticorrosive pipe to run in some of these. That way, when we come back, it can handle the CO₂ in the future.

JB: Can you kind of summarize the Talos CCS strategy?

RF: This whole energy transition subsector is about partnering and collaboration. There's not one single company that's best suited to do all the different pieces. You have to work and think across the value chain. We're not a technology developer, so we need to work with the technology providers. We can be a liaison to those different EPCs or capture tech developers. I think that's the key. It's about collaborating with your stakeholders, all the government bodies. These are big infrastructure projects, so they have a lot of moving pieces and parts. And a lot of thought needs to go into all these parallel processes. So, you just have to have a lot of good collaboration. That's why sometimes it makes sense to bring in your major partner (Chevron) and lean on some of those great resources. ■

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Crescent Begins to Shine Bright After Rapid, But Quiet, Growth

CEO Jerry Ashcroft is guiding the offshore pipeline player toward carbon-neutral status by year-end.

JORDAN BLUM, EDITORIAL DIRECTOR

Despite its origins dating back nearly two decades, Crescent Midstream only entered the public spotlight less than a year ago when it began touting offshore carbon capture and storage (CCS) projects and aggressive net-zero goals for a fossil fuel company.

An offshore Gulf of Mexico and Louisiana pipeline player, Crescent is rapidly growing since its 2021 emergence from parent Crimson Midstream, which was sold along with its California pipeline assets to the CorEnergy Infrastructure Trust.

Crimson founder John Grier, who started the company in 2005, joined CorEnergy and then-veteran midstream executive Jerry Ashcroft eventually took over what is now an independent Crescent.

By the end of 2021, private equity player Carlyle Group, which first invested in Crimson in 2019, took majority ownership of Crescent just as Crescent was quickly, but quietly, growing.

Crescent acquired the Grand Isle Gathering System as part of the CorEnergy deal, and then Crescent scooped up a large minority stake in the big, Genesis Energy-operated Cameron Highway Oil Pipeline System, called CHOPS, in the Gulf.

At the time, Genesis cited the sale of the 36% stake for \$418 million to an “undisclosed buyer.” CHOPS primarily delivers crude from the Green Canyon area offshore Louisiana to Texas refinery hubs.

As of late 2022, Crescent was partnered with Spanish energy giant Repsol and offshore producer Cox Operating to develop a CCS hub in the Gulf of Mexico within Cox’s existing leasehold.

Cox filed for bankruptcy protection in May, but Crescent contends the filing will not impact the offshore project.

The plan is for Crescent to build a 110-mile CO₂ pipeline from refining and petrochemical plants in Geismar, La., to the coastline in Grand Isle, utilizing existing Crescent pipeline rights of way.

The U.S. Department of Energy selected the project in May—providing \$8.4 million in federal funding—to help demonstrate the feasibility of offshore CCS in the Gulf. The project is expected to have a capacity of 300 million metric tons (MMmt) of CO₂.

The DOE is supporting the project, officially known as the Louisiana Offshore CO₂ Hub Repurposing Infrastructure to Decrease Greenhouse Emissions—intentionally creating the “Project Lochridge” acronym—through its CarbonSAFE program.

In March, Crescent teamed up with the Well Done Foundation for carbon credits to help sponsor its work for orphaned oil well plugging and site restoration in Louisiana.

Now, the aim is for Crescent to become the first known carbon-neutral midstream company by the end of 2023 with carbon credits, while factoring in only Scope I and 2 emissions.

Ashcroft is the former CEO of EQT Midstream—now Equitrans Midstream—who left to head up the Carlyle-backed Lone Star Ports projects. Then he moved over to Crescent.

Ashcroft sat down with Hart Energy for an exclusive Q&A on his company’s growth and goals.

JORDAN BLUM: I know Crescent dates back to 2005, but you just got the Carlyle backing a few years ago. How has the growth rapidly sped up in the last few of years?

JERRY ASHCROFT: It really started out with John Grier, our founder and chairman. John saw an opportunity in the market, like many of the MLPs did, to buy assets from the integrated oils. So John bought midstream assets both in California and in the Gulf of Mexico, and kept building and



growing upon that. And then, there came a time to look for other shareholders to continue that growth engine. And that’s when Carlyle came in, in 2019. And so we’ve really had rapid growth, especially over the last three years. We’ve tripled our size, and

it’s come both through organic growth in the Gulf of Mexico where we decided to focus, and it’s come from acquisitions.

JB: Can you talk about some of the acquisitions? I feel



“We look at this as, ‘we’re going beyond compliance.’ Sometimes that comes in the form of the charity that we do, but in this case, it was for us to actually be better stewards of the environment, too.”

JERRY ASHCROFT,
CEO, CRESCENT MIDSTREAM

Hart Energy

like they haven’t been really publicized that much.

JA: You’re right. So, we made a decision to sell our California assets to a REIT [real estate investment trust] called Cor. And with that we received the Grand Isle Gathering System, which is a crude oil pipeline system on the shelf, which was really complementary to the other assets we had. Plus, it fed into our main transmission line that we call Bonefish that runs from Empire to St. James [in Louisiana]. So that was kind of a bolt-on acquisition that we did. And then we also bought a 36% interest in CHOPS, which is the Genesis-owned deepwater pipeline, which really fit our strategy of trying to get farther into the Gulf.

That’s a great team with Genesis. We’ve really enjoyed working with them and watching the growth of that system.

JB: It’s just a matter of time before the Gulf of Mexico hits new production records, it seems.

JA: I think you’re absolutely right. I think that’s kind of where that energy transition piece connects with the Gulf of Mexico. It’s such a low-carbon intensity to bring oil from offshore to onshore just because of how it’s done compared to the Permian, for example. A lot more carbon intensity goes into pulling a barrel out of the Permian versus what it takes in the Gulf. That kind of goes into where we are in 2023. We’re going to be carbon neutral. I think we’re the first one in the midstream sector that can say that. We really drove our numbers down by looking at how we can run more efficient pumps and motors. How can we do vapor recovery? And then, finally, for that last part, we’ve

bought offsets from the Well Done Foundation.

JB: Can you elaborate on that offset process?

JA: Basically, we were looking for ways to buy carbon credits in our own backyard. We talked with Ducks Unlimited and they’ve got a number of projects going on, and we’ve done work with them in the past. But a lot of times those credits were further out in the future. The Well Done Foundation is plugging old abandoned wells that have methane releases. We were able to convince them to come to Louisiana and do that. It’s really a great fit for us that we can continue to be a steward of our environment there in Louisiana.

JB: So the objective is to be—by year-end—the first carbon-neutral midstream company?

JA: That’s correct. Yeah, I’m really excited about it.

JB: As a private company, why is it so important to have that carbon-neutral and ESG focus?

JA: We kind of look at it from our own strategy of being a safe, reliable, compliant business. We look at this as, “we’re going beyond compliance.” Sometimes that comes in the form of the charity that we do, but in this case, it was for us to actually be better stewards of the environment, too. I will say that what we have seen is, we’re more welcomed as a partner when it comes to getting insurance for our facilities and our pipelines. We’re more welcomed as a partner when we go to banks to get debt. But I don’t know whether there’s a real dollar value that I could point to.

**JB: Is there more of a business case longer-term with that focus?**

JA: Absolutely. I just think that it's where society is going in general, right? I think we see it all the time, whether it's your own electricity bill at home and they're saying, "Well, would you like green energy?" Or whether it's recycling programs in neighborhoods. So, when we look at our own business what we can do to lower the carbon intensity, it's just the right thing.

JB: In that vein, can you talk about everything you're doing with the carbon capture focus?

JA: We've got so much momentum with what we're doing. We've got a management team and personnel with the capabilities to run safe and reliable pipelines. And we also have the strategic footprint. You've got a lot of emitters from Louisiana all along the Mississippi River. So, we're making that natural industrial logic link between the emitter and the sink. We think we really have a first-mover advantage because we already have a license to operate pipelines there in Louisiana.

JB: Apart from you and the Chevron-Talos Energy partnership, you don't hear a lot about offshore CCS yet.

JA: There's a great consortium called Carbon-Zero that we support. You've got Cox [Operating], and Repsol was brought in. They've got a lot of downhole knowledge from the geology standpoint, and Europe has really been a leader in decarbonization. Plus, we're linked up with LSU and Southern University and the University of Texas to develop this plan, and we're lucky to receive funding from the DOE CarbonSAFE [Initiative] grant plan.

JB: I know it's relatively early goings, but how do you see the timeline playing out?

JA: That's a great question. We've been working with the DOE hand-in-hand saying this would be great to have as a pilot project. I think a lot of the emitters are looking to hit goals at that 2030 stage. I think that some of the earlier projects may come in as soon as 2027. I'm thinking that you see this surge of projects between 2027 and 2030.

Cox already has the oil and gas extraction leases. The conversation with the DOE is using those for sequestration, especially since you've already got the surety bonds and legal documents done. It makes sense to me.

But we're really the one linking the emitter to the sink. When you're looking to move 2 million mt a year to offshore, you're most likely going to build new pipelines. We have the synergy of the personnel and the rights of way. So, we've got the corridors that we're able to repurpose for CO₂ pipelines.

JB: Are you seeing a lot of customer interest?

JA: I think it's really been very collaborative. When you talk to the refineries, the petchems, the power plants, it's something that's on everyone's radar screen. So, it's pretty open door coming in to talk about your project and how it may fit.

I think once there's a better structure on what that permitting looks like offshore, I think that it would take off then.

JB: And can you elaborate on just how important some of the recent federal legislation has been the last couple years?

JA: The IRA [U.S. Inflation Reduction Act] was really a positive for pushing these projects forward. The \$85 [per MT of CO₂] for 45Q has allowed a lot of projects that just weren't going to be able to make it economically, now to be in play. And so, now it's kind of taking those appraisals stages into better-defined stages to understand how much will the technology cost, the pipeline cost and the sequestration cost.

JB: So what are the next steps at this point?

JA: The next steps on CCS are, we'll continue to work with DOE on the CarbonSAFE study with them. We're getting a better feel for the geology, and also spending more time creating the least-disruptive right of way for the pipeline to go offshore. And then, finally coming to an agreement with an emitter for how many tonnes a year they plan to capture. And, what do those connection agreements look like?

JB: How does Crescent's growth strategy look overall?

JA: We've really had this hyper-growth mode, which we're excited about from the organic growth and the acquisitions. We want to really take that same momentum into energy transition. I think there's a couple of ways for us to do that. One is our becoming carbon neutral. I think that bodes well for us when we're seeking partners in CCS. And that's really the part two of it. We feel as though that we've got the capabilities to run CO₂ pipelines and the personnel to do that and the resources in Louisiana. We are blessed enough with the strategic footprint that actually already connects the emitters to the offshore sink. We're already in that corridor, except we're kind of reversing the flow a little bit. This is a new product that we'll be needing to safely transport.

JB: Can I get you to compare and contrast the benefits of CCS offshore versus onshore?

JA: I think the benefit onshore is that there's already a permitting process. The EPA has done a really good job in their technical reviews on being thoughtful to that. But you're more limited from a spacing standpoint, right? You've got a lot more things to take into consideration. I think offshore ends up being kind of that longer-term opportunity just because of the amount of geography that you have out there, and the lack of encumbrances that are out there on continuing to grow those saline beds for sequestration. But there isn't a process yet on how to do that offshore. So, I think that's kind of where you are. I really see onshore as possibly being step one, and offshore being step two, and that being really the growth for the Gulf Coast. If you're in the Dakotas, it may be a different point of view. ■



Foster, McIntyre: The Intersection of Corporate Sustainability and Environmental Justice

WADE FOSTER AND KRISTA MCINTYRE, STOEL RIVES LLP

Corporate sustainability, meaning the ability of a business to manage risks and opportunities to promote long-term enterprise durability and value creation, is manifesting in many organizations through ESG commitments. The guiding principles of ESG are rooted in the United Nations Global Compact (2000) and subsequent report, “Who Cares Wins” (2004). Both encourage ESG-focused leaders to create a continuous improvement cycle that places measurable goals at the center of corporate decision-making and action to mitigate enterprise risks and emphasize enterprise opportunities.

As detailed by the International Financial Reporting Standards Foundation’s SASB Standards, which “guide the disclosure of financially material sustainability information by companies and their investors,” relevant environment factors within the oil and gas sector may include greenhouse gas emissions, wastewater management or ecological impacts. Relevant social factors focus on human rights and community relations. Relevant governance factors may address business ethics, regulatory compliance and incident management. At the convergence of the ESG categories lies Environmental Justice (EJ) and the role of businesses in improving the lived experiences of fence-line communities.

Environmental justice

The term “environmental justice” emerged during the civil rights movement of the 1960s, when the Rev. Dr. Martin Luther King Jr. brought attention to environmental injustices borne by predominately black garbage workers at a Memphis, Tenn., sanitation facility. Later, a national study by the United Church of Christ’s Commission for Racial Justice, “Toxic Wastes and Race in the United States,” (1987) found a positive correlation between subjects’ race and their proximity to hazardous waste sites.

Overburdened communities are not only in black and brown or urban neighborhoods. EJ is defined by the U.S. Environmental Protection Agency (EPA) as the “fair treatment and meaningful involvement of all people regardless of race, color, national origin, or income with respect to the development, implementation and enforcement of environmental laws, regulations and policies.”

Persistent gaps among communities with different lived experiences and varying access to meaningful involvement in environmental processes are the focus of recent reem-



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A display in the National Civil Rights Museum in Memphis, Tenn., commemorates the 1968 sanitation workers strike. The term “environmental justice” emerged from the civil rights movement and this strike, in particular.

phases on EJ across federal and state government. EJ is no longer only a subject of activism and academia. EJ is at the forefront of minds in the White House, state legislatures and even boardrooms.

Unpacking the definitions of “environmental,” “justice” and “community” reveals meanings that are broader and more complex than generally understood. EJ touches nearly all aspects of society: pollution, food security, energy, disaster relief, housing access, internet access, tribal sovereignty, urban planning, socioeconomic growth, political representation, transportation, education, climate change and resiliency. EJ targets every facet of the lived experience and an individual’s ability to enjoy a safe, healthy community and to access opportunity, as Seema Kakade, a law professor at the University of Maryland, wrote in her article, “Defining environmental justice communities,” in the American Bar Association’s “Trends” newsletter.

Tools for identifying overburdened communities include EPA’s ECHO database and EJSCREEN, the Climate and Environmental Justice Screening Tool (CJEST), and the U.S. Census. No tool is perfect or complete. Additional data on health outcomes, education levels, access to healthy food and the Internet, plus language proficiency can supplement these tools and help identify EJ communities.

It’s just good business

Companies are implementing EJ strategies that yield real benefits to communities and support ESG objectives. Robert Har-



ris, vice president of environmental affairs at Pacific Gas and Electric wrote that implementing environmental and social justice strategies can improve long-term business durability. In his article, “Environmental Justice is Good Business,” in the American Bar Association’s “Human Rights Magazine,” Harris said that stakeholders, including shareholders, employees, supply (or value) chain partners, customers and community members are increasingly demanding that companies be good corporate citizens. Ahead of regulatory mandates, businesses are confronting pressure to articulate corporate sustainability principles and execute on them. Social impact assessments that include EJ evaluations are also emerging in transaction due diligence, influencing commercial dynamics.

Companies that support EJ initiatives can manifest real opportunities. In today’s tight labor market, for example, nearby communities represent a potential local pool of employees that can contribute to operating innovations that reduce impacts on the surrounding area. Implementing effective strategies that improve lives within nearby communities can reinforce ESG goals, leading to diversity in a company’s workforce and durable community-driven innovation.

Instead, many fence-line communities are experiencing barriers to economic advancement. Neglecting investment in disproportionately impacted communities deters growth of economic power, diminishes community welfare and slows advancement of the next generation of contributors, consumers and leaders. Ignoring environmental and social

impacts on underserved communities perpetuates an unvirtuous cycle in which poor health outcomes, poverty and societal conditions repeat for generations—a cycle that is very much inconsistent with corporate sustainability.

Conclusion

As government and stakeholders urge business to narrow the disparities among communities in America, commitments to EJ can cultivate stakeholder support and fuel value creation. Weaving meaningful EJ objectives into ESG-driven business decision making will also better position a company for success when regulatory and policy changes inevitably emerge. Focusing on EJ complements ESG objectives, aligning environmental impacts, social equity and governance with community-centric investments and metrics to enhance corporate sustainability. ■

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Building the Energy Company of Tomorrow

Producing the energy needed today and advancing low carbon solutions for tomorrow



Wood's Devil in the Details with CCS

Transporting huge volumes of CO₂, tracking impurities in the system and managing carbon systems in varied geographies—Wood's experts on how they plan to make the complicated process work.

JORDAN BLUM, EDITORIAL DIRECTOR

In a Hart Energy exclusive, Editorial Director Jordan Blum sat down with Stephen Stokes and Dale Erickson of Wood to delve into the intricate details of carbon capture projects, and how they are approaching those technical challenges as the industry scales up.

Jordan Blum: We're talking about carbon capture projects, all the money that's going into it, but the devil's in the details. So, what are the biggest technical challenges with pumping all of this CO₂ into the ground that we're talking about?

Stephen Stokes, global head of CO₂ transport and storage, Wood: There is a growing industry trend right now for economies of scale for [carbon, capture and storage] projects. And that is where multiple emitters—so power plants and manned factories, industrial users—need a home for their CO₂ emissions. And they're looking at sending that CO₂ to common infrastructure, so, a common transport pipeline. Each of those emitters is going to have a cocktail, essentially, of different impurities. Now, we control that somewhat with a specification on the pipeline and say, "Can you please reduce your impurity levels?" But at the end of the day, we're going to have a very different composition daily and with different sources of CO₂ entering the system. So, over time, we'll have a different set of components in the system, and that causes us a big challenge in CO₂ transportation.

Dale Erickson, intelligent operations technology development lead, Wood: Just think of the volume. In other words, people that drive through Pasadena [Texas], that corridor, see all those plants and just picture all those plants going into one pipeline, all those emissions. It's going to be a huge amount of emissions going into one pipeline and the mix of impurities is really going to be the interesting thing because these impurities may interact with one another.

JB: And how do digital solutions factor into all these wellbore integrity concerns? I think we're talking about a lot of thermodynamic modeling much more as well?

SS: Digital application of thermodynamic models is, we see,



critical to support operations and their quests to protect integrity of their assets. What Wood is trying to do in that area is empower the operator with much more information than just physical instrumentation [by] feeding in pressure and

temperature and flow into an algorithm, essentially a digital twin, which then tells them much more in terms of the conditions in the system, how those impurities are affecting the fluid that's in the system, and how that might give concerns in terms of phase split in the system, in terms of low temperatures, in terms of corrosion, and ultimately, in terms of protecting their asset.

DE: Yeah, because one of the things that's going to be potentially possible is even blending these things. It may be like a rail line that you stop some for a little while until you have something better to blend with it. It's going to be very complicated, this whole thing of tracking the impurities in the pipeline network.

And in some ways, it's possible, if you have bad impurities, they may not even let them in. There's going to be this whole business that's going to develop of what we call, basically, nominations. Just like you have [with] gas, there's going to be potentially trading and everything else that you may get charged more if you have the bad gas. So, there's a whole industry that will develop on this.

JB: You were talking about lots of flow management issues, concerns about mixing gas and liquids within the reservoirs. You were even talking about factoring in wind, rainfall. Can you elaborate a little bit just on all the different dynamics at play?

SS: The ultimate answer there is, it's complicated. It's a complex system, but it's not new. These systems that we're talking about here—digital applications to support operations in the



“CCS is complicated, as I’ve mentioned, and I would say in some ways more complicated than conventional hydro-

carbon projects. And what we need to do as an industry is collaborate and also reduce hard basis of design between disciplines.”

STEPHEN STOKES, GLOBAL HEAD OF CO₂ TRANSPORT AND STORAGE, WOOD



“Your whole project floats on your worst well, and so you need to get that balance right. Because if you don’t do

it right, well, some power plant may not build the storage CO₂.”

DALE ERICKSON, INTELLIGENT OPERATIONS TECHNOLOGY DEVELOPMENT LEAD, WOOD

conventional hydrocarbon industry—[are] a common practice.

With CO₂, it gets more complicated. The complex system becomes even more complicated because we have what we like to call a very narrow phase envelope. What that means is we need to rely on numerically stable and accurate simulations to tell us what phase we have in the system. Do we have gas CO₂, do we have dense phase CO₂, liquid CO₂, or do we have a combination? And if we have that combination, then we have to understand what the implications are. We can get not really slugging, like we would refer to in the conventional hydrocarbon space, [but] more intermittent flow. It causes cycling, it causes dynamic loads, axial loads.

DE: The other thing that makes CO₂ a challenge, its critical point is about 80 F. And so, as you move across that phase boundary, you literally can get a 10X change in density. It’s a lot less dense on the gas side than the liquid, and most fluids aren’t like that, conventional oil and gas. So, you can have these huge changes. And that just, as [Stokes] was indicating, [makes] the slugging worse and the behavior in the wells worse.

JB: And this is a global challenge, too. I mean, we’re talking about all different kinds of geographies, the U.S. Gulf Coast, Canadian oil sands, the Persian Gulf. Can you elaborate on all those different factors, the need to do everything on a global scale?

SS: I’m lucky in my role to have a global remit. I see proj-

ects in every continent, essentially. And we see them in the onshore environment, the offshore environment. Some of the interesting work we’ve done is on depressurization. So, if we have to do maintenance in the system, we have to go from pressure to ambient pressure to allow access and intervention. If we’ve got a project in the Middle East, very dry sand, that system’s going to behave completely differently to something in Canada, in Alberta, for example, where it’s very cold, and it’s going to behave very differently to something in the North Sea where it’s covered in seawater and cold, but with very high heat transfer. We see very different behavior in very different regions. And it’s a great question because that does need expertise to understand how the system’s going to behave.

DE: People are also talking about transporting CO₂, not just in pipelines, but on rail cars. We’ve looked at some projects there. There are projects where they’re looking at shipping. Because again, CO₂ is potentially generated and there’s no storage in some locations, so they’re going to have to transport it the most efficient way possible where they have the good reservoir.

JB: I know Wood recently announced a new partnership with CMG, the Computer Modelling Group. Can you touch a little bit on just what that’ll entail, how important that’ll factor into everything?

SS: CCS is complicated, as I’ve mentioned, and I would say in some ways more complicated than conventional hydrocarbon projects. And what we need to do as an industry is collaborate and also reduce hard basis of design between disciplines. So, where we do pipeline work in isolation, generate a document and then subsurface [has] to interpret that, and vice versa as well, we have to interpret that. What we’re trying to do is create soft boundaries between disciplines. So, an end-to-end solution. And Wood, I should mention, do[es] carbon capture, carbon compression, dehydration. Now, we do reservoir engineering through our CMG partnership. We have an end-to-end CCS solution which is a very powerful offering and a very important offering in an industry that really needs that seamless integration between project components.

DE: Yes, because, again, the thing you have to remember is, unlike oil and gas where you just pull it out of the ground, you have to put this CO₂ down there and keep it there thousands of years. That’s partly the thing that these reservoir engineers do, is look at the long-term stability of storing the CO₂. It’s very important.

The other thing is the number of wells you need. In other words, your whole project floats on your worst well, and so you need to get that balance right. Because if you don’t do it right, well, some power plant may not build the storage CO₂. In other words, it’s getting that whole balance right. And in conventional engineering, if you’re off a well or if you have a crappy well, it’s not so bad, you live with it. But here, if you’re very tight, it may be a problem. So, that’s very critical to get all that correct. ■