

CCUS as part of climate change strategy

Louisiana is at an energy and manufacturing crossroads. We can continue down the path of traditional production and manufacturing of products goods and services, or we can begin to transition to cleaner, more sustainable forms of energy production and manufacturing. The former leads to what some analysts and research indicates will be a dramatic reduction in workforce and manufacturing in 15-20 years or Louisiana can choose to be bold and pivot and develop strategies and policies that focus on transition and putting Louisiana on a pathway to the production of lower carbon intensity products and fuels that the world uses and will continue to demand. This transition cannot be singular in focus. It cannot be only about climate, equity, sustainability or resilience. This transition defines how Louisiana moves forward and where we choose to be in 15-20 years. If the companies who do business in our state and the political leaders and NGO's want solutions to meeting long term energy demand, we must act decisively and definitively and employ technologies that reduce carbon, focus on communities and put our state in position to be viable in an ever changing geopolitically connected world. There is not a one size fits all or single solution to meeting energy demand. Our transition to renewable energy will take time and will require extensive capital investments. We have to be strategic and decisive about how we move forward and focus on the most promising technologies that support continued production of energy but also focus on reducing carbon and keep communities in clear focus as we make decisions.

A great deal of the concern we hear about using CCUS as a means to manage carbon in combating climate change seems to start from a set of mistaken assumptions that it is the primary strategy, if not the only one; that it is intended to be the permanent solution with nothing else changing in hydrocarbon use; and that the activities that create carbon emissions are not already happening without advanced strategies for carbon management. In Louisiana's case, CCUS is expected to be a tool in the overall climate change toolbox – a part of an overall long-term strategy to reach net-zero in carbon emissions. It is a strategy that includes building out electric vehicle infrastructure, encouraging greater use of hydrogen as a fuel and encouraging the growth of the wind and renewable energy industry both offshore and onshore. Louisiana has and will continue to employ a comprehensive approach to energy production paying special attention to using and employing any and all available technologies to reduce or eliminate emissions while focusing on workforce and having a plan for the future.

In terms of state, regional and national energy and economic needs, the chain of events we have seen since the Russian invasion of Ukraine has amply demonstrated that the people and economies of both the U.S. and our greater global community of nations still depend heavily on traditional fuels and feedstocks provided by oil and natural gas. The disruption in previous oil and gas distribution networks and reduction of Russia's energy exports to the U.S. and other nations, while a necessary response to Russian aggression, has created significant hardship on America's people and businesses as rising energy prices hobble the post-pandemic recovery – and those cost increases for basic daily expenses hit our most vulnerable populations and communities the hardest. Without question, this makes a case in the longer term for diversifying our energy sources and incentivizing development of renewables, but it also illustrates the continued need for our traditional sources until alternative energy sources are sufficiently available and affordable to take on the load. At present, the entire U.S. renewable supply makes up only about 12 percent of total domestic energy consumption (U.S. Energy Information Administration, Monthly Energy Review, Table 1.3 and 10.1, April 2022).

One of the primary arguments of those who oppose the concept of CCUS is that processes utilizing it in creating fuel and feedstock and drawing on traditional energy sources do not provide

the same reduction in carbon that energy sources such as wind or solar do. While that statement may be true as far as it goes, it ignores two critical facts – that the energy/feedstock production is already happening without any additional carbon controls and that the low-to-no-carbon options such as wind and solar are nowhere near a posture to support the energy consumption currently covered by traditional fuels.

It is probably one of the most perfect examples that can be found of the old adage that “the perfect is the enemy of the good.” It is well understood that CCUS is not a one-and-done solution to management of carbon and other greenhouse gas emissions, and we have to move toward a future with greater availability of renewable and low-to-no carbon energy sources. But while the technology and infrastructure and investment to build out those energy sources to make up more than a rough tenth of our current energy consumption, CCUS can certainly be a strategy to reduce the amount of carbon put into the atmosphere from the processes we are already dependent on. The arguments against CCUS seem to hinge on the assumption that if it does not cut carbon emissions completely and immediately, then it is not worth trying at all.

Examples of this can be found in recent studies calling into question the process known as “blue hydrogen” production – hydrogen produced from steam methane reforming with the waste carbon injected into underground layers. The idea behind “blue hydrogen” is that hydrogen can be produced with carbon capture and sequestration elements to cut emissions, and then used as an industrial feedstock or as a clean-burning fuel source, either on its own or mixed with a traditional fuel, such as natural gas, to cut the carbon footprint. Some of those studies claim that the “blue hydrogen” processes do not capture as much carbon as they were projected to or that they actually make greenhouse gas emissions worse because they still use natural gas as the supply for production and natural gas is likely the fuel used to generate the electricity such a facility uses. It is also often noted that “green hydrogen” production, using an electrolysis process on water, would be a much lower carbon process, especially if the energy provided was from solar or nuclear or other alternative sources. Those points sidestep the reality that the “green hydrogen” concept is not currently commercially viable on a wide scale and that hydrogen production is happening already, and will continue to happen, whether we use CCUS to cut those carbon emissions by any amount they can be cut or simply do what has always been done, producing it with relatively unchecked carbon emissions while waiting for the perfect zero-carbon solution.

Currently, the U.S. produces about 10 million tons of hydrogen per year, mostly through steam methane reforming, and that production is anticipated to grow, particularly as hydrogen is embraced as a significant clean fuel option. When the current 90 million tons of global hydrogen production, overwhelmingly steam methane reformation, is considered, CCUS seems to be an obvious opportunity to gain some ground on carbon emissions as the transition to newer energy sources and production practices advances. Louisiana is leading the bipartisan three state HALO effort (Hydrogen – Arkansas, Louisiana, Oklahoma) which is fundamentally founded on the concept that to build a regional hydrogen hub, you first need usable hydrogen. We all want to get to green and lower carbon production of hydrogen but to move the industry forward and develop economies of scale to drive down production costs, hydrogen needs to be available and infrastructure needs to be developed to support this build out. CCUS supports this buildout of hydrogen and puts Louisiana on a pathway to production of lower carbon intensity hydrogen which directly contributes to emission reduction and positive community impacts.

We have also heard the argument that pursuing CCUS options somehow instantly stifles the momentum toward investing in and building out other cleaner-energy alternatives. The reality is that investment in clean energy is gaining momentum, with the International Energy Agency (IEA) noting in its World Energy investment 2022 report that “Clean energy investment is – finally –

starting to pick up and is expected to exceed USD 1.4 trillion in 2022, accounting for almost three-quarters of the growth in overall energy investment. The report notes that, while clean energy investment growth has only been about 2% from 2015 to 2020, it has accelerated to 12% since. The report also notes that the U.S. clean energy investment in 2021 was \$215 billion.

It is possible, even necessary, to engage on many fronts in the transition to a lower-carbon future, and our current emphasis on CCUS is not indicative that it is the only, or even our primary, weapon in combatting climate change. It is simply a reflection of the fact that CCUS is the most mature and closest to ready for market of the options we see in the near term, and it has the potential to be a very effective tool in the transition from what we have always known to what comes next.

What CCUS offers is a great opportunity to act as a bridge between the era of relatively unchecked carbon emissions and the move toward low-carbon and no-carbon processes – a means of easing the transition from what we have done in the past to what we will be doing in the future.

CCUS in Louisiana

For more than a century, Louisiana has been among the nation's leaders in the production of traditional crude oil and natural gas for fuel and manufacturing feedstock, and a significant refining and petrochemical manufacturing footprint has grown in our state because of it. This has provided regular employment for our people and been an economic mainstay for generations. But, as with so many things, there were prices to be paid that we were not aware of until long after we had incurred the debt – in this case being an overreliance on traditional sources for too much of our energy and the dawning realization of the impact to our environment.

In Louisiana, we know very well the impacts of climate change, and the role that lack of carbon management has played in accelerating it. With four significant hurricane strikes in the past two hurricane seasons, and a coastline that erodes more every day, we understand that the threat of climate change is heavily driven by past practices at all levels that did not make management of carbon and other greenhouse gases a priority. This is why we have been working collaboratively with stakeholders, including environmental groups and the energy industry, to build lasting plans to address the challenges of climate change through the development and implementation of our \$50 billion Coastal Master Plan. And we have expanded on that effort by launching our own Climate Initiatives Task Force, setting ambitious goals for reducing carbon emissions to net zero by 2050.

As we move forward with those efforts, we understand that reaching those climate goals is a process, during which we will still rely a great deal on our traditional energy sources in a measured transition from the energy mix we currently have to what comes next, avoiding as best we can sudden shocks to a domestic and global energy matrix that has shown itself to be highly sensitive to supply and price instability, with undeniable ripple impacts to all sectors of the shared economies.

The EIA regularly ranks Louisiana in or near the top five states in annual carbon emissions, be that total or per capita – we believe that means that we have a great opportunity to take action that can make a real difference in the climate change fight and we want to start making that difference as soon as possible.

That is why Louisiana has made such an effort to set itself up to host potential CCUS operations – because that strategy is the closest to being ready to make a dent in our carbon output and Louisiana does not believe that our state or the nation have time to waste in doing what we can

as soon as we can. It represents an opportunity to not only make a big change in Louisiana's carbon footprint, but a noticeable difference in the nation's total carbon emissions.

Louisiana has extraordinarily favorable geology for injection, with strong confining layers of shale and clay; comparatively young geology that is less brittle than other areas of the country; almost no seismic activity; and deep sand layers with the thickness, horizontal extent, porosity and permeability to accept and hold injected carbon dioxide safely.

Our state also has thousands of miles of pipelines already in place and operating, some of which are already transporting CO₂ across our state and to and from other states, and more of which could be upgraded. Beyond that, the established rights-of-way and pipeline routes will make for readily accessible connections between CO₂ emitters and suitable sites for sequestration facilities. In addition to that infrastructure, our state is home to a wealth of companies and workers with generations of expertise in pipeline operations, including decades of lessons learned and best practices.

In addition to pipeline transportation expertise, Louisiana's Office of Conservation has also maintained state primacy of our Underground Injection Control (UIC) program since the early 1980s, under the oversight of the U.S. Environmental Protection Agency (EPA). This gives Louisiana a staff with a deep background in dealing with our state's unique geology and how best to engineer injection wells and facilities to maximize protection of the public and the environment. In anticipation of the potential interest in CCUS, our Office of Conservation submitted an application to the EPA in fall 2020 for state regulatory primacy over carbon sequestration wells, also known as Class VI injection wells. Our staff worked closely with the EPA over the course of several years in crafting a set of Class VI injection rules that not only meet the standards set by the EPA's baseline Class VI rules, but exceed them.

At the most basic level, our Class VI injection rules mostly mirror the EPA's Class VI rules, but our Office of Conservation has made additional requirements and restrictions for prospective operators based on Louisiana's history with injection and specific knowledge of our state's geology. The core tenet of any UIC program is protection of Underground Sources of Drinking Water (USDW), ensuring that sufficient confining layers that do not allow for upward migration of injected gases or fluids to the base of a USDW, ensuring that the injection zone is appropriate for the type and amount of fluid or gas being injected and that the pressure created by injection is not enough to fracture the formation or its upper confining layers.

To start the process of getting a permit to construct a Class VI well, Louisiana's rules require establishment of an Area of Review (AOR) that is bounded not only by the edges of the area the injected CO₂ is expected to permeate, but beyond that to the edges of the area the excess pressure and displaced fluids created by the injection is expected to be felt. In simpler terms, we are not just looking for the splash, but also the ripple.

Within that AOR, the site must be thoroughly characterized in terms of geologic structures, stratigraphy, lithology and faulting in the injection zone and confining layers. This also includes well penetrations assessment, actual core samples of the injection zone and confining layers to verify assumptions on those characteristics. This information must be used by the applicant in generating computer modeling of how the proposed well and geologic formations will respond to the planned rates and amounts of injection. This modeling process must be repeated at least every five years with the latest available data (including injection volumes and pressures), or more often if there are substantive changes to the operation or if the Office of Conservation directs it.

Once an operation is granted permits to construct and to inject, monitoring is required for integrity of the well, analysis of the CO₂ stream, injection rates and pressures, corrosion of the well casing, ground water quality above the injection site and tracking of the CO₂ plume and the overall pressure front.

Generally speaking, these rules are the same as the EPA's, but aspects of Louisiana's Class VI rules also include:

- A requirement that all reports, plans, evaluations and other submittals by applicants/operators be prepared, sealed and signed by a licensed Professional Geoscientist, in the case of geoscience work, or a licensed Professional Engineer, in the case of engineering work – not a requirement of EPA
- Denial of confidentiality on information that deals with presence of contaminants in ANY formation outside the injection zone – EPA denies confidentiality only on information about contamination in USDW
- Not allowing waivers of injection depth requirements for Class VI wells – EPA allows waivers
- Not allowing Class VI permitting by rule (i.e. “grandfathering in” wells), area permits for multiple wells or automatic transfers of class VI well permits – EPA allows each of those
- When a permit is modified by Office of Conservation, the entire permit may be re-opened and subject to revision – EPA may only re-open specific permit conditions subject to the modification
- Office of Conservation may require permit modifications based on information received, whether the information was available to the operator at the time of permitting or not – EPA may only do so if the information was available at the time of permitting
- Requiring injection to cease immediately upon Office of Conservation giving notice of lack of mechanical integrity in a well – EPA does not specify course of action
- Not allowing CO₂ sequestration in solution-mined salt caverns – EPA does not have this restriction
- Requiring tabulation of all wells penetrating USDW for site characterization – EPA only requires wells that penetrate injection or confining zones

The Office of Conservation's Class VI rules also require applicants to conduct and submit an environmental justice review of any communities located within the established AOR, where the EPA does not have an equivalent requirement. The results of that review will be part of the determination as to whether to implement an enhanced public comment period, with a more inclusive public participation process, involving targeted public outreach. In addition to the environmental justice review, a weighing of siting, environmental effects and cost-benefit analysis is required, based on the Louisiana legal precedent set by the “Save Ourselves Inc. vs Louisiana Environmental Control Commission” Louisiana Supreme Court case of 1984. That decision guides nearly all environmental regulatory permitting actions in the state since it came down and, in part, requires that certain questions, commonly referred to as the “IT questions,” be answered:

- Have the potential and real adverse environmental effects of the proposed project been avoided to the maximum extent possible?
- Does a cost benefit analyses of the environmental impact costs versus the social and economic benefits of the proposed project demonstrate that the latter outweighs the former?
- Are there alternative projects which would offer more protection to the environment than the proposed project without unduly curtailing non-environmental benefits?

- Are there alternative sites which would offer more protection to the environment than the proposed site without unduly curtailing non-environmental benefits?
- Are there mitigating measures which would offer more protection to the environment than the proposed project without unduly curtailing non-environmental benefits?

These additional safety and environmental measures are part of the reason that the Office of Conservation has sought primacy from the EPA for Class VI wells. Additionally, Louisiana believes its own Office of Conservation is better positioned to effectively regulate injection and sequestration operations just as a matter of having more subject-matter-specific science and inspection staff (including gaining legislative approval to expand that staff) to concentrate on operations in our state, than the EPA's Region 6 Office has for our area – where it has 5 states to cover, including Texas. Obviously, when and if Louisiana received primacy for Class VI wells, the EPA will still have oversight over the program and the Office of Conservation will continue to work closely and communicate regularly with our federal partners.

Louisiana CCUS near-term outlook

Over the past few years, potential operators and support industries have made regular contact with the Office of Conservation about interest in the future of CCUS and progress of state legislation, rulemaking and progress toward primacy. At present, we are aware of more than a dozen Class VI permit applications filed with the EPA for our state, with more likely to come.

Operators have also reached out to Louisiana to arrange for use of injection pore space for sequestration operations below state-owned lands and water bottoms – and just last fall, Louisiana engaged in the first two operating agreements in the history of the state for use of the state's subsurface for sequestration of CO₂ – one of the agreements for a hydrogen production facility that will sequester its waste carbon and the other for a biofuels facility that will do the same thing.

Other proposed projects with CCUS aspects we have been made aware of include, LNG liquefaction and export, other biofuels projects and at least one project that would be a general commercial-use facility for sequestering industrial waste carbon.

CCUS is also seen as a linchpin process for the success of initiatives encouraging the wider use and accessibility of hydrogen as an energy source, as steam methane reforming is currently the most-effective manner of hydrogen production – and hydrogen has been identified as a focus area for Louisiana going forward.

As stated before, Louisiana recognizes that CCUS is not the turnkey solution for carbon management, but it must also be recognized that our nation and the wider global community are still heavily dependent on traditional fuels and feedstock and will continue to be for some time, even as the transition to low-carbon and no-carbon continues. And it should also be understood that there will probably always be a need for at least some hydrocarbon-intensive processes with the potential to emit carbon into the atmosphere, and CCUS will continue to be a valuable tool to help manage that in the future.

As we move forward and focus on this energy transition, it is imperative that our Federal partners across the board continue to focus time and resources to the build out of clean energy infrastructure and ensure that permitting is done in reasonable time frames. Louisiana does not want to cut corners on permitting, we want to ensure that the Agencies that are reviewing clean energy projects are staffed and have the resources to deliver on timelines to move projects

forward. The 45Q provisions and tax credits that were passed in 2018 have led to unprecedented interest from companies who want to do business in Louisiana. Although these tax credits are generating tremendous interest in CCUS we must continue to monitor costs of capture equipment and capital costs of these projects to ensure that this build out of cleaner energy continues and dramatically reduces our carbon dioxide emissions. We will only be successful if these projects work and have the infrastructure and permitting support to happen. Our industries are at the table and the time to act is now to move our state and our nation forward so that our future generations have an area to live that not only has an economy, but has energy that is clean, affordable and sustainable for generations to come. We need every tool in the tool box to make this happen, and like we saw on our climate task force, people need to work together on solutions and our communities need to be informed and continue to be first in focus.