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Blue Hydrogen's Carbon Capture Boondoggle

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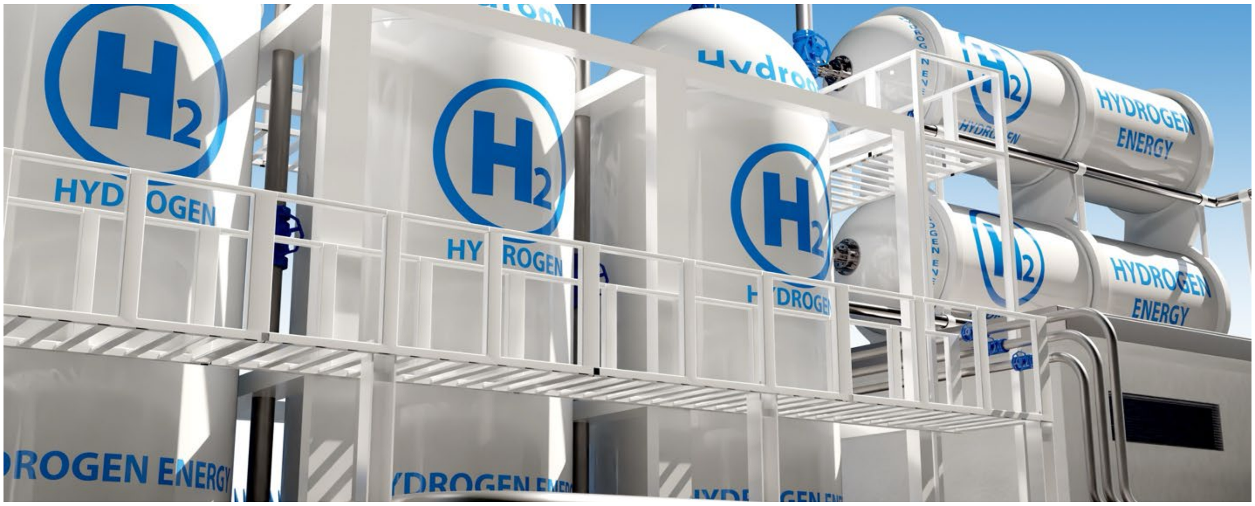
Key Findings

A major blue hydrogen project under development is a lose-lose proposition that would cost billions of dollars in subsidies for essentially zero environmental benefit.

An IEEFA analysis finds that the Louisiana Clean Energy Complex, is a potential money-making bonanza for Air Products but will have little if any environmental benefit, while costing taxpayers billions.

Air Products can benefit from generous federal tax credits under 45Q regardless of the project's net emissions impact.

The project will likely result in substantial new CO_2 emissions at enormous cost to taxpayers; Air Products could claim up to $440 million per year and $6.3 billion over a 12-year period.



Executive Summary

Legislators looking for a bipartisan issue should focus on blue hydrogen. IEEFA's latest analysis shows that the process, which uses methane gas with carbon capture to produce a supposedly cleaner fuel, is a lose-lose proposition that would cost billions of dollars in subsidies for essentially zero environmental benefit. It is an issue that both fiscal conservatives and environmental advocates should agree needs changing.

The focus of our analysis is Air Products' planned Louisiana Clean Energy Complex (LCEC), one of the largest blue hydrogen projects in development in the U.S. The company says the facility, estimated to cost $7 billion, will begin commercial operation in 2028 and produce almost 600,000 metric tons of hydrogen per year from methane gas. Air Products also says the facility will capture and store 5 million metric tons of carbon dioxide (CO_2) annually, which would qualify for generous federal tax credits under the existing 45Q program.

Our analysis shows that the project, while a potential money-making bonanza for Air Products, will have little if any environmental benefit, while costing taxpayers billions of dollars. Under optimal operating assumptions, particularly assuming very high carbon capture rates, the facility could produce a minimal reduction in net emissions. But if more realistic assumptions are used, reflecting real-world data and current scientific research, our evidence-based estimates find that this project will likely result in substantial new CO_2 emissions at enormous cost to taxpayers. Specifically, Air Products could claim up to $440 million per year and $6.3 billion over the 12 years of eligibility for the 45Q credit for the capture and storage of 5 million metric tons of CO_2, **even if the project achieves no net reduction in greenhouse gas emissions.**

The emissions profile of the project, analyzed on a life-cycle basis using realistic assumptions, shows that it will likely result in a net increase in emissions. Despite the company's promises, the hydrogen produced at the LCEC will be neither clean nor low carbon.

The IEEFA analysis found:

- The LCEC project would likely capture between 33% and 52% of carbon (well-to-gate), depending on the level of upstream methane emissions. This is based on the project sponsor's assumption of a 95% CO_2 capture rate at the facility.

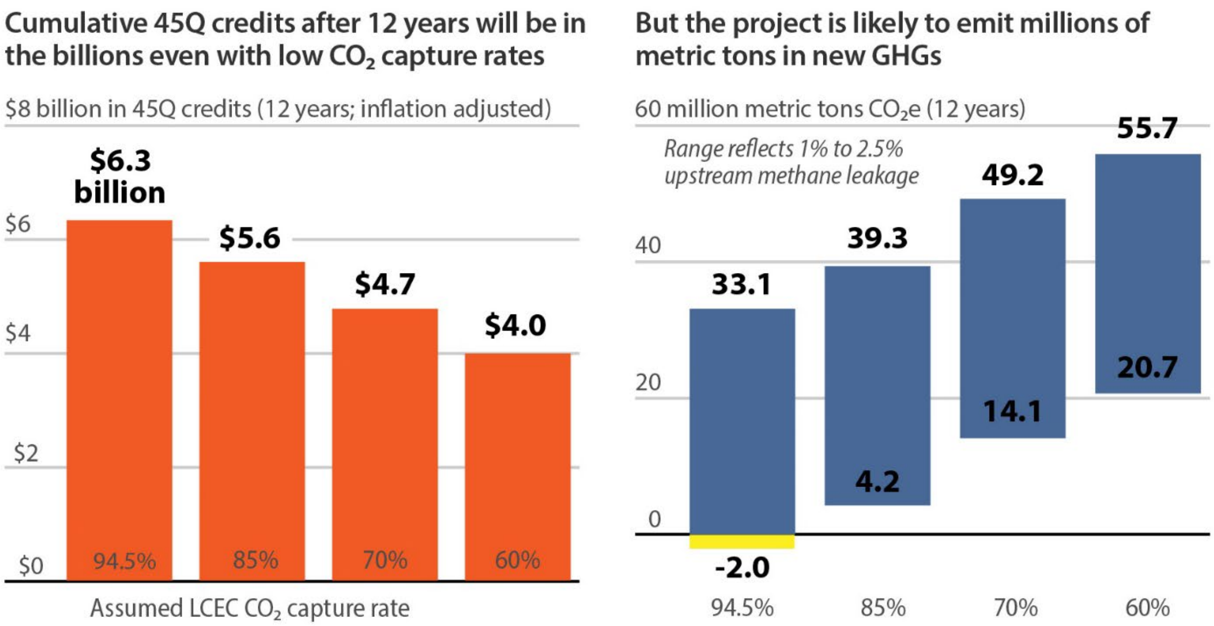
- Under a realistic scenario, which entails using lower carbon capture rates and higher projected emissions from upstream methane leakage, the project would result in a net increase of 7.5 million metric tons of carbon dioxide equivalent (CO_2e) per year. Even under a best-case scenario with very high carbon capture rates and minimal emissions from all other sources, the LCEC project would result in a net reduction of just 200,000 metric tons of CO_2e per year—roughly equivalent to just 5% of a typical coal plant's emissions per year.

- Air Products can benefit from generous federal tax credits under 45Q regardless of the project's net emissions impact. The 45Q tax credits are based solely on the number of tons of CO_2 stored per year. For 45Q tax credit purposes, it does not matter if the project

generates more CO_2e emissions than it captures. No demonstration of net emissions reduction is required to access the credit.

- For the single scenario in our analysis that results in a net emissions reduction, we calculate an astronomical cost of $2,600 per metric ton of avoided CO_2 under the current 45Q credit value of $85 per metric ton CO_2 stored. If the 45Q credit amount is increased to $100 per metric ton, the cost rises to $3,100.

Figure ES 1: Cumulative 45Q Credits vs. GHG Emissions After 12 Years



Source: IEEFA analysis

Louisiana Clean Energy Complex

Air Products' Louisiana Clean Energy Complex (LCEC), if permitted and constructed, would be one of the world's largest blue hydrogen production facilities. It was initially announced as a $4.5 billion project in 2021; the projected cost rose to $7 billion in 2023 due to inflation and an expansion of the project's footprint.[1]

The LCEC would be a new facility, slated to produce about 585,000 metric tons of hydrogen per year, and it would convert a portion of the hydrogen into ammonia. The facility would use methane gas as a feedstock to produce hydrogen with an autothermal reforming (ATR) system. Carbon capture equipment would be installed on the ATR. The company states the equipment would achieve a 95% capture rate, totaling about 5 million metric tons of CO_2 per year. The captured CO_2 would be piped almost 40 miles away to Air Products' planned sequestration site beneath Lake Maurepas. [2]

The project is currently in the process of acquiring permits for the construction of the facility and associated infrastructure for carbon sequestration. Last year, the company announced it will seek tax credits for the LCEC under the 45Q program for carbon sequestration rather than the 45V clean hydrogen production tax credit.[3]

Recent developments on the Air Products board, including the replacement of its long-time CEO Seifi Ghasemi, were partly motivated by concerns about the lack of firm, long-term offtake contracts in place for the LCEC.[4] Despite changes in leadership and recent cancellation of several green hydrogen projects, the company remains committed to the LCEC project and expects it to come online in 2028.[5] In a shift from its previous financing strategy under Ghasemi, Air Products announced it is currently seeking an equity partner for the LCEC and is targeting companies based in Japan and Korea.[6]

[1] Carbon Herald. Air Products To Go Ahead With $7 Billion Hydrogen Project In Louisiana With Carbon Capture Included. November 16, 2023.
[2] Air Products. Louisiana Clean Energy. Accessed March 19, 2025.
[3] Hydrogen Insight. 'We will not claim the US hydrogen production tax credit on our $4.5bn blue H2 plant in Louisiana': Air Products. May 20, 2024.
[4] D E Shaw & Co. Advancing Air Products and Chemicals. October 2, 2024.
[5] Air Products. Air Products to Exit Three U.S.-Based Projects. February 24, 2025.
[6] Hydrogen Insight. Air Products in 'active' talks to sell equity stake in $4.5bn Louisiana blue hydrogen project. February 7, 2025.

What Is the Carbon Intensity of Blue Hydrogen?

The Department of Energy (DOE) uses the GREET model to calculate the carbon intensity of hydrogen along several production pathways,[7] including those that utilize CCS. Carbon intensity calculations based on the GREET model's assumptions minimize the potential climate impact of hydrogen production. This, in turn, provides faulty rationale for the huge federal investment in carbon capture and storage and the so-called hydrogen economy.

Our previous research highlighted several key parameters that are integral to the GREET calculation of carbon intensity but do not accurately reflect current science or real-world performance of hydrogen projects.[8] These include assumptions around 1) very high carbon capture rates, 2) very low upstream methane emissions, 3) long-term global warming potential (GWP) horizon, and 4) exclusion of emissions related to hydrogen compression and leakage. In addition to challenging the assumptions of the GREET model, the analysis in this report also incorporates calculations of the emissions "benefit" from utilizing the produced hydrogen. These shortcomings and our alternatives are discussed in the following sections.

Carbon Capture Rates

Similar to other projects involving carbon capture and storage, Air Products promises a 95% carbon capture rate for the LCEC. This figure, however, only pertains to the capture rate on a single stack at the facility's methane reformer. It does not include emissions from any other sources such as upstream methane leakage, operation of the carbon capture equipment, or the required compression and transport of the produced hydrogen. The capture rate figure is intended to reflect the average operational performance of the carbon capture equipment over the lifetime of a project.

Our analysis of real-world commercial-scale projects finds no evidence that 95% carbon capture rates are realistic. Operational hydrogen production facilities have achieved average capture rates between 40% and 68%. It should be noted that those hydrogen projects use carbon capture on steam methane reformers (SMR). The LCEC project proposes using an autothermal reformer (ATR) system instead. There are no existing commercial-scale projects using ATR with carbon capture.

In this study, we assumed sustained average annual capture rates of 60%, 70%, and 85%. These are still quite high, given the actual performance of commercial-scale projects, but they more accurately account for planned and unplanned equipment downtime and capacity factors.

[7] U.S Department of Energy. Greenhouse gases, Regulated Emissions, and Energy use in Technologies (GREET). Accessed March 19, 2025.
[8] IEEFA. Blue hydrogen: Not clean, not low carbon, not a solution. September 12, 2023.

Upstream Methane Leakage Rates

The GREET model assumes a very low upstream methane leakage rate of 0.9% to represent a U.S. average. Our survey of current literature found an average national estimate of 2.5% for upstream leakage, as well as substantial variation across the country. Our analysis includes cases with three leakage rates: 1%, 2.5% and 4%.

Global Warming Potential (GWP) Time Horizon

The GREET model uses 100-year GWPs in the calculations of carbon intensity, which downplays the impact of methane and other greenhouse gases (GHGs) on atmospheric heating. The model also excludes hydrogen as a GHG.

In line with current scientific studies that lay out the higher potent impact methane has on warming in the near term, we use the 20-year GWP values. We also assume a 5% leak rate for hydrogen and include its GWP impact in our carbon intensity calculations.

Emissions From Hydrogen Compression and Leakage

In line with the Clean Hydrogen Production Standard,[9] carbon intensities in GREET are calculated on a well-to-gate basis, meaning emissions only include those related to the facility itself and the production and transport of the fuel and feedstock required. No emissions are included relating to the compression of hydrogen required for offsite transport. Also, no emissions are included related to leaked hydrogen because the GREET model assumes it has no GWP.

We include emissions associated with the compression and leakage of hydrogen if the gas were to be purchased by a buyer offsite. For the 100-year GWP case, we assume this would add 2 kilograms (kg) CO_2e per kg H_2 to the project's impact; for the 20-year GWP case the addition would amount to 3.0 kg CO_2e.

It is unclear whether all the hydrogen produced by the LCEC project would be used onsite for ammonia production, or if some would be compressed and transported to a buyer. For the purposes of this analysis, we assume half the hydrogen will be used for ammonia and will not have any additional emissions related to its production. The other half would be compressed and transported offsite and would incur additional related emissions.

[9] U.S. Department of Energy. Clean Hydrogen Production Standard (CHPS) Guidance. June 2023.

Hydrogen Benefits

Hydrogen can be used in a variety of applications including fuel cells, production of fertilizers and other chemicals and production of secondary fuels. It can also be combusted for power. Each of these potential uses would result in a different carbon intensity if the life cycle envelope included all upstream and downstream emissions. Since we do not know what use will be made of the hydrogen in many projects, including the LCEC, it is difficult to calculate the emissions "benefit" that might be realized by using blue hydrogen in lieu of gray hydrogen (fossil-based hydrogen without carbon capture), fossil fuel combustion, or some other use.

In this study, we used statements from the DOE regarding the net emissions impact of the hydrogen hubs program to determine the net benefit of each metric ton of hydrogen produced. In an October 2023 letter,[10] the White House estimated that the 3 million metric tons of hydrogen produced in the hubs would displace 25 million metric tons of CO_2—a ratio of 8.33 metric tons of CO_2 avoided for each metric ton of hydrogen.

Unfortunately, DOE has not provided any details around the net emissions analysis used to arrive at the figure of 25 million metric tons CO_2 avoided. The figure depends on the uses for the hydrogen and the carbon intensity of the fuels it is replacing. It is also unclear how much of the reduction would be due to blue hydrogen and how much to green (electrolytic) hydrogen. This calculation of metric tons of CO_2 avoided per metric ton of hydrogen is a basic average so it overstates the emissions savings from blue hydrogen. Nevertheless, to be conservative, we have used the 8.33-to-1 ratio described above as an estimate of the downstream CO_2 avoided by the use of hydrogen produced at LCEC.

Results

Air Products states it will produce 750 million standard cubic feet of hydrogen per day,[11] amounting to approximately 585,000 metric tons per year assuming an average 90% capacity factor. Our analysis examines a range of average annual CO_2 capture rates at the LCEC from a high of 94.5% to a low of 60%. The high end is from the DOE's GREET model and is consistent with Air Products' claimed capture rate for the facility. We also examine the impact of a range of upstream methane emissions, ranging from 1% to 4%. The low end of the range is based on the DOE's assumption in the GREET model. The mid-range 2.5% figure is based on current scientific studies. The high end of the range, 4%, assumes upstream emissions would be 1.5 percentage points above the mid-range figure. All calculations included in this section are based on 20-year global warming potentials.

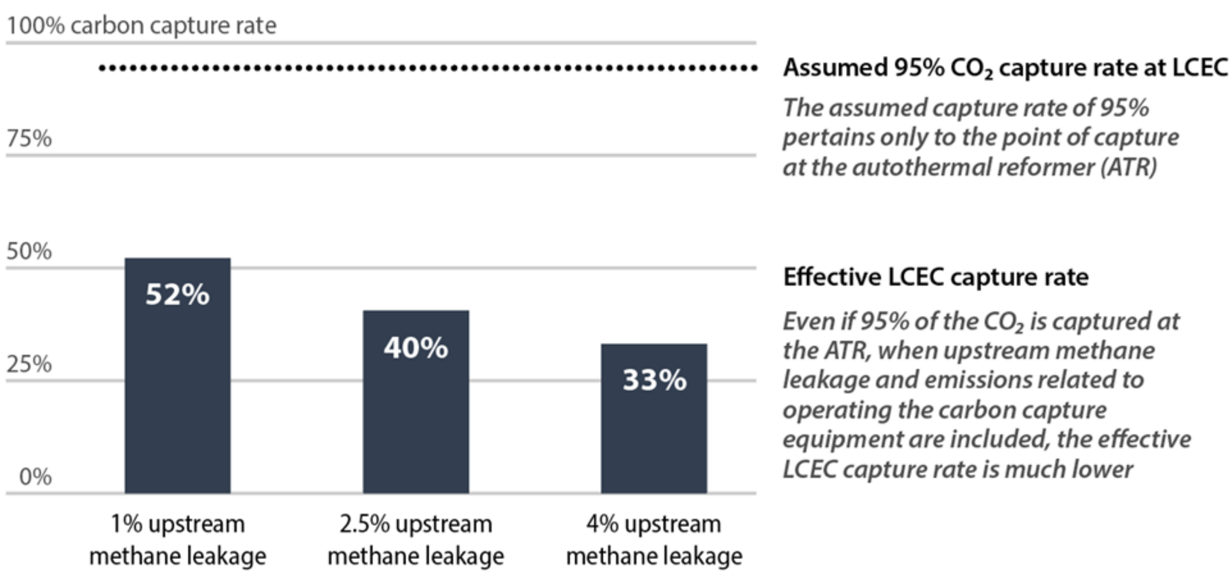
[10] The White House. Biden-Harris Administration Announces Regional Clean Hydrogen Hubs to Drive Clean Manufacturing and Jobs. October 13, 2023.
[11] Air Products. Louisiana Clean Energy. Accessed March 19, 2025.

Overall, we have considered 12 scenarios combining different capture rates and upstream methane emissions rates. The carbon intensities used in these scenarios are based on the results of a September 2023 IEEFA blue hydrogen study.[12]

Capture Rates Will Be Well Below 95%

Air Products' claimed 95% capture rate applies only to the autothermal reformer itself and does not reflect a well-to-gate life cycle envelope. When emissions related to upstream methane leakage and running the carbon capture equipment are included, the effective carbon capture rate for the LCEC falls dramatically. Upstream methane leakage has a substantial impact on the project's effective capture rate.

Figure 1: Effective Carbon Capture Rates Fall Well Below 95% Claim



Source: IEEFA analysis

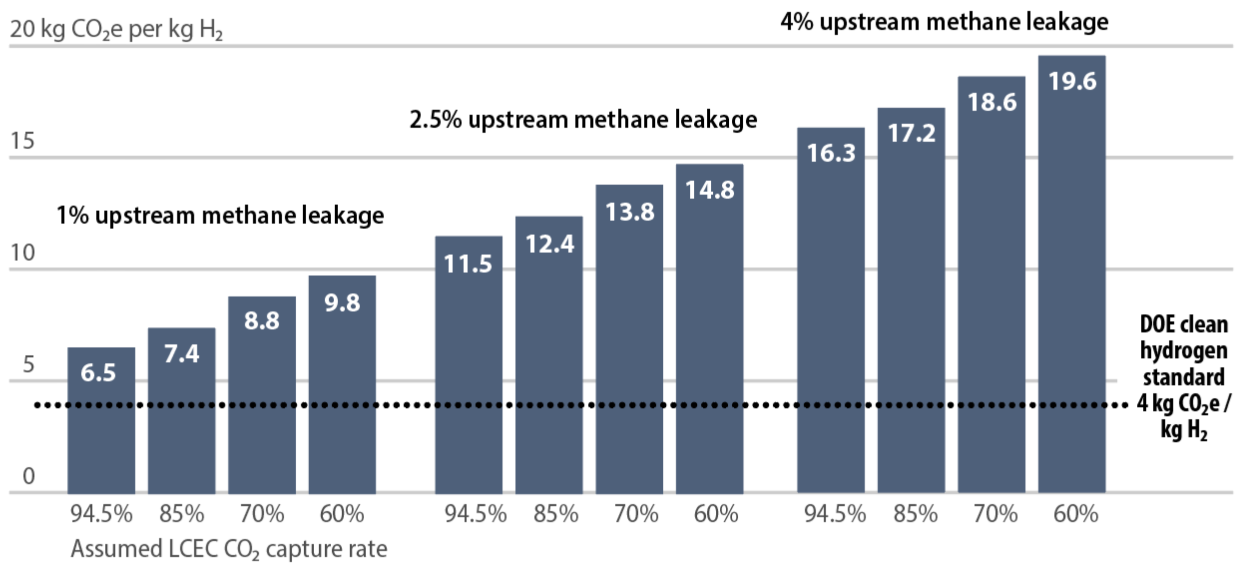
Well-to-Gate Carbon Intensity Likely To Be Much Higher Than U.S. Clean Hydrogen Standard

On a life cycle basis, the blue hydrogen produced at LCEC will not be clean or low-carbon. None of the scenarios we evaluated resulted in hydrogen that meets or exceeds the U.S. DOE clean hydrogen standard of 4 kg CO_2e / kg H_2 on a well-to-gate basis. Even using the most optimistic model parameters in GREET, the project exceeds that standard.

[12] IEEFA. Blue hydrogen: Not clean, not low carbon, not a solution. September 12, 2023.

Applying realistic assumptions, we find double-digit carbon intensities that are multiple times higher than the clean standard. Note that the carbon intensities shown below do not include any downstream emissions to be consistent with the well-to-gate limitation of the life cycle definition in the U.S. clean hydrogen standard.

Figure 2: Well-to-Gate Carbon Intensity Will Exceed DOE Clean Hydrogen Standard



Source: IEEFA analysis

The U.S. sets a "clean" hydrogen standard of 4 kg CO_2e / kg H_2 produced, but it does not have a "low carbon" hydrogen standard. Air Products could market hydrogen or ammonia domestically as "low carbon" regardless of its carbon intensity. This is not the case, however, for all international markets. The EU's low-carbon hydrogen standard, for example, is 3.38 kg CO_2e / kg H_2 on a full life cycle basis using 100-yr GWP for methane.[13] Asian markets may be no better, in terms of providing a market for hydrogen that is not sufficiently low carbon. Japan's low-carbon standard of 3.4 kg CO_2e / kg H_2 (well-to-gate, 100-yr GWP for methane)[14] is out of reach for the LCEC project, even assuming best-case scenarios for carbon capture effectiveness and low upstream methane leakage. Even with a 100-yr GWP time horizon for methane, 1% upstream methane leakage, and 94.5% carbon capture, the LCEC project has a carbon intensity of 4.4 kg CO_2e / kg H_2 on a well-to-gate basis.

[13] Agora Energiewende. Low-carbon hydrogen in the EU. September 2024.
[14] GR Japan. Japan's Hydrogen and Ammonia Policies. March 2024.

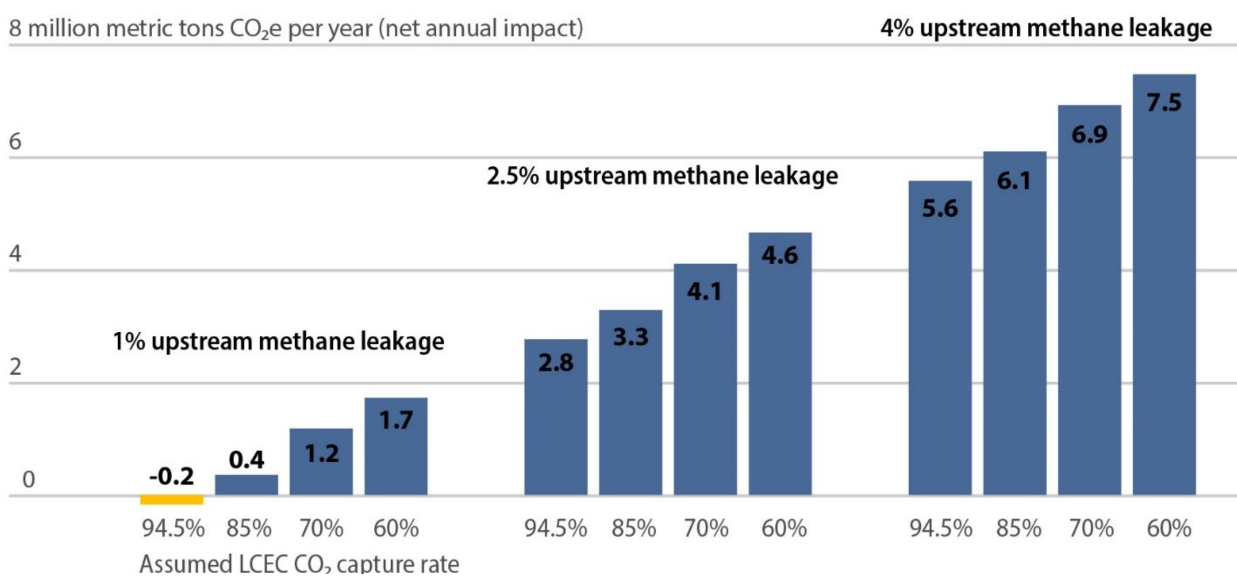
Net Emissions Are Likely to Be Significant

A key rationale for the stimulation of hydrogen production is that it will bring about net emissions reductions. Even assuming all the hydrogen produced by Air Products will either replace fossil fuels or unabated gray hydrogen, there is very little avoidance of emissions on a net life cycle basis. Our calculations of net life cycle emissions include the downstream benefits of hydrogen as well as emissions related to hydrogen compression and leakage.

The only scenario with any emissions savings is the case with the lowest assumed upstream methane leakage (1%) and the highest possible CO_2 capture rate (94.5%). Even in this scenario, the emissions savings are minimal – about 200,000 metric tons CO_2e per year. This is roughly equivalent to just 5% of the annual emissions from a typical coal-fired power plant in the U.S.[15]

Applying lower carbon capture rates that reflect real-world performance of the technology coupled with higher upstream methane leakage rates based on current scientific studies, we find about 4 million metric tons CO_2e in new emissions would be generated per year as the result of running the LCEC.

Figure 3: Net Life Cycle Annual Emissions



Source: IEEFA analysis

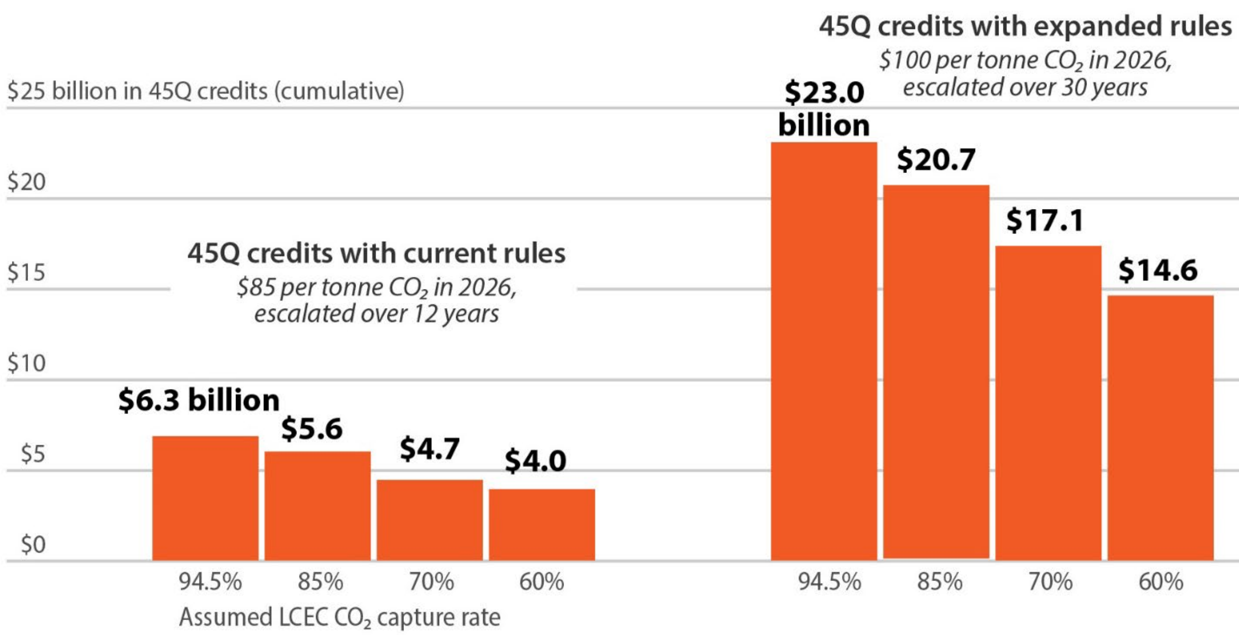
[15] EPA. Greenhouse Gas Equivalencies Calculator. Accessed January 21, 2025.

Air Products Will Receive Billions of Dollars In Carbon Capture Credits Even If Net Emissions Rise

The 45Q tax credit for carbon sequestration is based only on the carbon oxides that are captured at the facility and stored. It is not connected to net project emissions. If the LCEC captures and stores 5 million metric tons CO_2 per year as claimed, Air Products will receive $6 billion under current 45Q credit rules over 12 years, regardless of the project's impact on net emissions.[16]

Even if capture rates at the facility average 60% per year rather than 94.5%, the company will still bank more than $4 billion over 12 years. If the 45Q credit rules are changed to extend the term of eligibility from 12 to 30 years, Air Products could reap between $14 billion and $23 billion depending on the actual rate of carbon capture by the ATR system.

Figure 4: 45Q Credits Under Current, Extended Program Terms



Source: IEEFA analysis

[16] Federal Reserve Bank of Cleveland. Inflation Expectations. Data as of January 12, 2023. Calculations assume an average annual inflation rate of 2.3%, based on the 10-yr average.

Cost of Avoided Emissions Via Hydrogen Production Is Exorbitant

Hydrogen proponents point to the anticipated emissions avoided as an argument that the expense of subsidizing hydrogen production is worthwhile. But when the investment is assessed on the basis of cost per metric ton CO_2 avoided, the figures are astronomical for the LCEC.

If the facility captures and sequesters CO_2 at the maximum projected rate of 94.5%, it will qualify for $440 million in 45Q credits (in 2025 dollars). This scenario only yields a net annual emissions reduction of about 200,000 metric tons CO_2e—meaning taxpayers would pay roughly $2,600 per metric ton of CO_2 avoided. Air Products would receive the same generous 45Q credits for capturing and storing CO_2 even if there is no net CO_2e avoided.

Proponents of CCS want to see the 45Q subsidies rise. They claim the $85 per metric ton for storage is not enough to offset the costs of capture, transport, and storage of carbon and argue that the figure should be increased to $100 per metric ton. Also, they would like the term over which credits are granted to extend from 12 to 30 years.[17]

If those changes are implemented, for the same minimal net emissions reduction, Air Products could earn $517 million per year (in 2025 dollars). This amounts to a cost of $3,100 per metric ton of CO_2e avoided. Over 30 years, taxpayers would shell out a total of $23 billion (adjusted for inflation) for this one facility.

Table 1: Potential 45Q Credits at LCEC

	94.5% carbon capture	85% carbon capture	70% carbon capture	60% carbon capture
Gross amount of CO_2 stored annually (millions of metric tons)	5.2	4.7	3.8	3.3
Credits under current rules ($85 per metric ton stored and 12-year term)				
Annual (millions)	$440	$396	$326	$279
Cumulative (millions)	$6,278	$5,647	$4,650	$3,986
Credits under potential rule expansion ($100 per metric ton stored and 30-year term)				
Annual (millions)	$517	$465	$383	$329
Cumulative (millions)	$23,028	$20,713	$17,058	$14,621

Source: IEEFA analysis

Note: Cumulative totals include adjustment for inflation

[17] ExxonMobil. Carbon Capture and Storage. Accessed January 13, 2023

Conclusion

Air Products' LCEC facility is unlikely to result in meaningful reductions in greenhouse gas emissions. Rather, our analysis shows the project could contribute millions of metric tons of CO_2e to the atmosphere annually in the form of new emissions. Although an unlikely possibility exists that the project could result in a small reduction in net emissions, this would require near perfect performance of unproven carbon capture technology on autothermal reforming (ATR) systems. And even that unlikely emissions benefit would come at an enormous cost to taxpayers – $2,600 for every metric ton of avoided greenhouse gas emissions under current 45Q credit values.

Regardless of the project's net impact on emissions, Air Products almost certainly will be able claim billions of dollars in credits under the 45Q program—all funded by U.S. taxpayers. As currently structured, the 45Q credit can best be described as a carbon dioxide production credit, encouraging companies to produce and then capture/store CO_2. The regulations have no requirement that the project reduce net emissions and set no penalty if the project actually results in net increases in emissions. There is a substantial risk that private companies will benefit from this taxpayer-funded subsidy without providing any meaningful environmental return on the investment. The LCEC project highlights the problems inherent in the 45Q credit system as well as the false promise of blue hydrogen as a climate solution.

Spending billions of dollars on untested carbon capture technology in applications with no net climate benefit is a waste of taxpayer money. Building out renewable power infrastructure, improving energy efficiency, and reducing methane leakage from the natural gas system are more cost-effective and proven approaches to a clean energy transition.

About IEEFA

The Institute for Energy Economics and Financial Analysis (IEEFA) examines issues related to energy markets, trends and policies. The Institute's mission is to accelerate the transition to a diverse, sustainable and profitable energy economy. www.ieefa.org

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