

## Modular Carbon Capture and The Inflation Reduction Act

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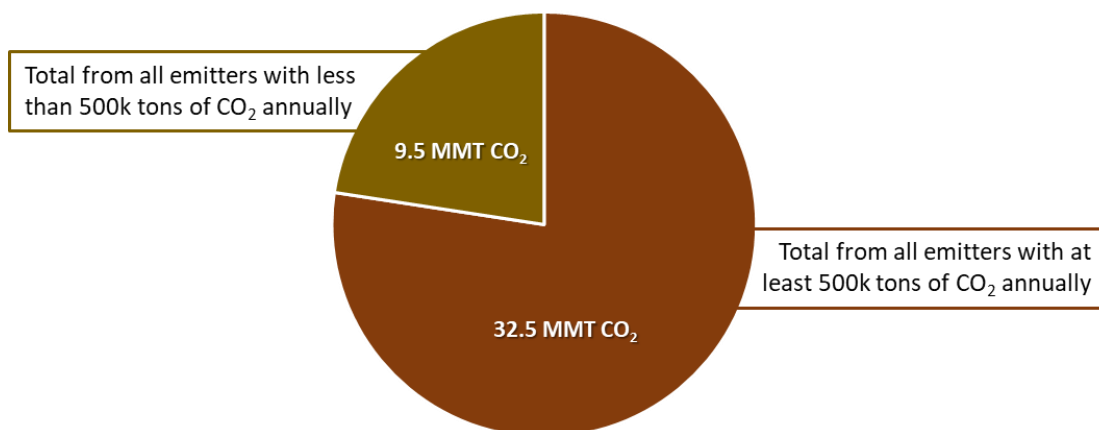
As the field of carbon capture, utilization, and storage (CCUS) continues to evolve, the importance of modular carbon capture technologies has become increasingly apparent. August of 2023 marked the one-year anniversary of the Inflation Reduction Act ([IRA](#)) being signed into law, and its potential to incentivize smaller-scale capture systems is manifesting in modular capture innovation.

### **IRA: Emission Thresholds**

Since its inception, the IRA's amplification of the [45Q tax credit](#) for CO<sub>2</sub> capture and storage has created a flurry of activity. Though, increasing the per ton value of CO<sub>2</sub> is not the only way that the new law influences the CCUS industry in reducing greenhouse gas emissions. Thresholds for what facilities can qualify for credits were also expanded. Under the previous guidelines, operators qualifying for the credit were required to capture 500,000 metric tons of CO<sub>2</sub> per year. Smaller CO<sub>2</sub> emission sources lacked economic appeal without the assistance of tax credits. As a result, in the US attention has primarily been directed towards major emitters where custom capture systems are tailored to on-site specifications. Despite the high costs and extended construction timelines associated with these retrofits, they stood as the best option to initiate profitable projects, qualifying for the 45Q tax credit.

The updated language has significantly lowered this qualification threshold to 12,500 metric tons of CO<sub>2</sub> per year. This dramatic change stands to benefit a significant number of greenhouse gas mitigation efforts nationwide. As an example of the impact this could make: the [EPA's](#) Facility Level Information on GreenHouse Gases Tool ([FLIGHT](#)), lists 194 emitters in the state of Colorado. The database includes annual emissions data on 118 of these. Of those 118, only 15 emitters statewide qualified under the previous threshold of 500,000 metric tons per year. While these 15 largest emitters represent the lion share of statewide point emissions, it still leaves a large gap in addressing GHG emissions:

## Colorado: Annual CO<sub>2</sub> Emissions (2021 data from the EPA FLIGHT database)



\*The U.S. Energy Information Administration ([EIA](#)) lists Colorado's annual emissions in the year 2021 (the most recent data publicly available) at 85.4 Mt of CO<sub>2</sub>. The FLIGHT tool values do not encompass total emissions, (which would also include emissions from vehicles)

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Opening the playing field and drastically increasing the number of emitters eligible for credits will enable capture tech developers to be involved in small and less capitially intensive demonstration projects. The 103 smaller emitters still represent a significant volume of total emissions in Colorado (and nationwide). And while incentivizing rather than disqualifying almost one fourth of the states' emitters to mitigate CO<sub>2</sub> is a positive policy change, the benefit of this new regulation could also be important in incentivizing modular capture technology development, testing, and deployment. This could benefit emission reduction efforts in harder to reach, less urban/industrial areas.

### What is Modular Capture?

Modular capture refers to systems that are prefabricated, and transported to capture sites for installation rather than custom retrofits of emitters that are site-specific, and often involve long lead times and high cost. Modular carbon capture technology has been called an out-of-the-box solution, promising more efficient and adaptable systems for mitigating emissions. The ability to scale these solutions up or down is potentially their greatest strength and can reach emitters that would otherwise be excluded.

Just recently, Carbon Clean and Samsung Engineering [announced](#) a joint venture that will focus on adapting modular capture technologies for use onboard ships. The announcement highlights the importance of modular systems' significantly smaller footprint, and ability to operate in the confined spaces of the marine sector. Companies like Mitsubishi are developing modular capture technologies for smaller scale applications, dubbed 'bite sized carbon capture' in a recent [article](#) from Bloomberg. These units can capture up to 95% of CO<sub>2</sub> emitted from smaller emitters like municipal waste incinerators and other small-scale industrial processes.

Modular systems will need to address the same issues of parasitic load (the energy demand) that has troubled the larger capture systems and challenges may still exist in deployment of economic projects. An ominous roadblock to all CCUS projects, and likewise to modular capture, is the challenge in transporting the CO<sub>2</sub> itself. Even large projects find that pipeline infrastructure is one of the biggest capital burdens, and challenges with landowners and right-of-way agreements have made linear project development a project execution risk. Lower volumes of CO<sub>2</sub> from smaller capture operations would likely not support the expense of large infrastructure buildouts and may demand other transportation solutions. Individual project margins

vary significantly, but given the increase in research and development, the flexibility to apply technologies to small and medium scale emitters and still qualify for the tax credit is certainly a step in the right direction.

### **What's Next?**

The lower volumetric thresholds for the 45Q tax credit, will ideally allow for more flexibility in the application of capture technologies, reach emitters that would have been previously excluded, and most importantly encourage rapid technological advances by funding demonstrations of smaller scale projects. Despite facing some challenges, the benefits of modular carbon capture are undeniable. Their flexible nature allows for incremental deployment, reducing upfront investment risks, and promoting wider adoption and enhancing our ability to mitigate emissions rapidly and comprehensively.

However, to fully harness the potential of modular carbon capture, demonstration projects are imperative. These projects serve as crucial testing grounds, allowing operators to validate the technology's efficiency, cost-effectiveness, and environmental impact. Continued investment in these demonstration initiatives will be pivotal in establishing modular carbon capture as an adaptable solution for a broad spectrum of CO<sub>2</sub> emitters, facilitating a more comprehensive emission reduction landscape.

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Anna Littlefield is the Program Manager for Carbon Capture Utilization and Sequestration for the Payne Institute at the Colorado School of Mines. As a current PhD student in the Mines geology department, her research focuses on the geochemical impacts of injecting CO<sub>2</sub> into the subsurface as well as the overlap of geotechnical considerations with policy-making. Anna joins the Payne Institute with 8 years' experience in the oil and gas industry, where she worked development, appraisal, exploration, new ventures, and carbon sequestration projects. Her academic background is in hydrogeology with an M.S. in geology from Texas A&M University, and a B.S. in geology from Appalachian State University. Anna is passionate about addressing both the societal and technical challenges of the energy transition and applying her experience to advance this effort.

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