

ChemE Cube Competition Returns to the Premise of Compact Direct Air Capture

The 2025 ChemE Cube Competition, powered by the RAPID Manufacturing Institute and ExxonMobil, will be held at this year's AIChE Annual Meeting in Boston, MA. This undergraduate student competition challenges teams to design, build, and operate a chemical process within a one-foot cube to meet technical criteria defined in a problem statement. The competition will be a two-day event, with the pitch and poster portions of the competition beginning Sunday, Nov. 2nd, and the final run occurring Monday, Nov. 3rd, with awards being given that afternoon.

Similar to last year's challenge, this year's competition will task teams with creating a modular direct air capture (DAC) mini plant with both adsorption and regeneration functionality that can fit inside the 1-ft³ cube. Carbon dioxide (CO₂) emissions remain the largest source of greenhouse gas emissions globally, increasing the rate of climate change and disrupting ecosystems. Carbon capture and storage (CCS) technologies can be used to capture CO₂ at the point where it is emitted; however, even aggressive emissions reduction efforts may not be enough to keep global temperature rise within safe limits. Addressing this issue may require the deployment of DAC technologies, where CO₂ is removed from the atmosphere and sequestered. The difficulties of developing efficient, robust, and cost-effective DAC systems have slowed the rollout of these technologies; this is the problem students are tasked with solving at this year's competition.

The mini plant must capture CO₂ from the ambient air while sufficiently optimizing process efficiency so that the

CO₂ emissions that come from the energy used to power the mini plant remain low. Teams will have a maximum budget of \$2,500 for their first-of-a-kind prototype, and each design should be marketable as a modular CO₂ capture device. Ultimately, the winning design will demonstrate technological breakthroughs, be able to address a market need, and, finally, benefit humanity. All of this must be effectively shown in the pitch (*i.e.*, the business case for the device), the poster (*i.e.*, the technical case for the device), and the run (*i.e.*, the design implementation).

During the poster and pitch section, teams are given the chance to promote their technology through a one-minute video, poster, and 20-min startup pitch to a panel of mock investors. The competition culminates with the teams testing their cubes in two demonstration rounds to see which team's process best achieves the goals set out by the criteria. This competition is designed to force students to tackle a real-world problem by putting their engineering knowledge to the test. Teams will be challenged to think creatively and work collectively, utilizing each member's skillset to put together a strong effort in every aspect of the competition.

The ChemE Cube Competition was first held at the 2021 AIChE Annual Meeting in Boston, MA. In the first two competitions, the challenge was to design a compact water filtration system capable of producing purified water on demand. Beginning in 2023, the focus turned to DAC technologies. Improving upon the successes of last year's competition, this year's rules include an expanded maximum budget and a revised method for calculating expenses, in addition to the requirement that returning teams display an appreciable change from their previous design.

This year, due to a record number of over 50 qualifying applicants, 23 teams will be competing, compared to 16 in 2024. Attendees of this year's Annual Meeting are invited to stop in, view the posters, hear the pitches, and watch the competition. An overview of the 2025 ChemE Cube competition, a list of the competing teams, and more information on the scope of the challenge can be found at <https://rapid.aiche.org/education-workforce-development/cheme-cube-competition>.

Interested in supporting ChemE Cube? Sponsoring puts your company at the heart of bold ideas, breakthrough technologies, and rising engineering talent. Get in front of future leaders, fuel game-changing solutions, and show the industry you're driving what's next. If you are interested in sponsorship opportunities, contact Tania Babiuk at tanib@aiiche.org.

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▲ The ChemE Cube Competition challenges teams of undergraduate students to build a chemical process in the confines of a one-foot cube, with the 2025 competition's challenge following up on the previous year's goal of creating a modular direct air capture (DAC) mini plant.