

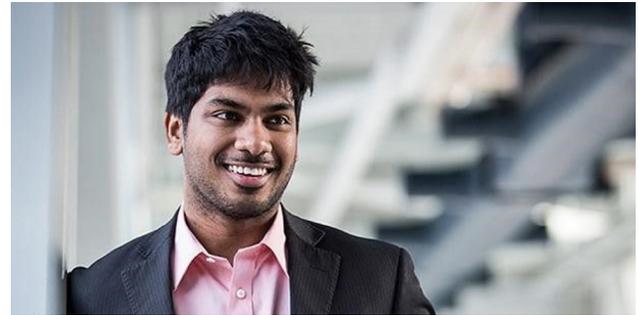
A Customer Success Story
CMC RESEARCH - ACCELERATING INNOVATION

CARBON UPCYCLING CHOOSES CMC RESEARCH TO ACCELERATE THEIR RATE OF TECHNOLOGY VALIDATION AND SCALE-UP



Carbon Upcycling is developing and commercializing an integrated CO2 capture and utilization process, and has relied on CMC Research for third party testing and validation of their unique polymer membrane and CO2 separation technologies.

Apoorv Sinha, CEO
CARBON UPCYCLING TECHNOLOGIES



Carbon Upcycling Technologies is a finalist in the \$20 million **NRG COSIA Carbon XPRIZE** and is focused on creating carbon-based materials. The company, which started in 2014, is developing technology that chemically absorbs CO2 emissions into inorganic solids, creating a portfolio of fine

nanoparticles such as graphitic nanoplatelets and graphene quantum dots. The company has found a range of different applications for these products and is commercializing a concrete coating and polymer additive in Canada and the U.S.

CHALLENGE

Although proven on a small scale, Carbon Upcycling was lacking third party validation that their carbon conversion technology could be viable in real-life conditions.

They needed a research partner to work with them to enable a shorter pathway to commercialization.

SOLUTION

Carbon Upcycling turned to CMC Research as their research partner to test the efficacy of a polymer membrane for CO2 capture.

CMC Research, with their plug-and-play facility, had the instrumentation, equipment and expertise to conduct a credible analysis of the technology using real flue gas within the tight project deadlines.

RESULTS

The project resulted in a solid and credible research report with supporting data that proved the viability and scalability of the polymer membrane for CO2 capture in real-life conditions.

Carbon Upcycling used these research results to engage with clients and investors. They were able to commercialize their technology more rapidly because of the expert support provided by CMC Research.

Carbon Upcycling, operating in the heart of Canada's energy sector, is commercializing a suite of technologies that is poised to change what we believe about carbon. At Carbon Upcycling, they believe that carbon is a resource, not a problem.

CMC Research Institutes provides facilities to field test, develop and demonstrate early-stage technologies.

The Carbon Capture and Conversion Institute in Richmond, B.C. provides facilities and experts to help innovators de-risk, test and scale-up technologies aimed at reducing industrial greenhouse gas emissions.

- Field test, develop and demonstrate early stage technologies.
- Take your technology from the lab bench to pre-pilot operation.
- Solve design and process challenges during startup and commercialization.
- Validate your technology so you can take it to market quicker.
- Provide equipment, instrumentation and research know-how to simulate real world conditions.

CANADA'S CARBON FUTURE

CMC Research Institute plays a vital role in ensuring Canada's greenhouse gas reduction goals are met:

- In 2017, the International Energy Agency (IEA) estimated that 14% of greenhouse gas reductions by 2060 will have to come from CCUS in order to meet a 2°C pathway.
- Canada is a signatory to the Paris Agreement, with a target to cut GHGs by 30% below 2005 emission levels by 2030.



RAPID SCALE-UP & VALIDATION RESEARCH

When Carbon Upcycling began working with CMC Research, they were in the process of developing an integrated CO₂ capture and utilization process based on a unique polymer membrane licensed from Ohio State University that could eliminate the traditional two-step process of CO₂ separation technologies. "At the time of licensing, the technology was proven at 1,000 hours with simulated flue gas in a lab set up," said Aproveo Sinha, CEO of Carbon Upcycling. "We wanted a plug-and-play set up testing with real flue gas."

RESULTS

CMC Research was a key technology partner with Carbon Upcycling in the testing and validation of their membrane technology. "They have a lot of experience, not just in terms of the technology of carbon capture, but also in business. They were agile, able to cope with aggressive timelines and had the exact equipment, facility and expertise we required" said Sinha.

Carbon Upcycling Technologies focus on the carbon conversion and utilization piece which can only be tested with the customers. They needed a technology partner that could help them validate their carbon capture technologies in a way that simulated real-world conditions, to de-risk a full pilot plant. The flexibility of being able to use real-time results to rapidly respond to and adjust test protocols 'on the fly' gave them the speed and agility they needed to complete the research project within tight timelines.

Conducting their research with the support of the facility and team at CMC Research gave them what they needed, and enabled them to move to the next stage of their business and technology development: "We got a really solid report, data we were able to share with both end users and investors. It moved our company forward" said Sinha.

THE BIGGER PICTURE

Carbon Upcycling is on a mission to be part of creating a carbon negative world, and they understand the importance of rapidly deploying carbon negative solutions to achieve that goal at scale.

The circular economy, where waste from industrial processes is recycled or repurposed into new products in a carbon neutral (or carbon negative) manner is coming. But Sinha believes that the timelines to achieving this are too long. "They are talking 10, 20, 30 years out. I believe we could and should validate and scale technologies much quicker - in the 5 year range."

The carbon negative world envisioned by Carbon Upcycling requires that the rate of technology validation and scale up in Canada be accelerated considerably.

Tangible change must happen quickly, and partnerships between innovators and companies such as CMC Research are a vital part of the solution. Our future depends on it.