Carbon capture surface: CO2 removal technology

openaccessgovernment.org/article/carbon-capture-surface-co2-removal-technology/186422

13 December 2024

Inoculation of microalgae on a porous substrate being deployed within a module

Beth McDaniel, JD, Partner President from Reactive Surfaces Ltd. LLP, introduces us to Carbon Capture Surfaces, a CO_2 removal technology that checks all the boxes

In the urgent race to combat climate change, innovation in carbon dioxide removal (CDR) technologies is critical. Among the many solutions under development, Carbon Capture Surfaces (CCS) stands out as a cutting-edge approach that offers cost-efficient, scalable, and measurable CDR in what is called a Passive DAC (Direct Air Capture) system, being one that leverages biological processes and materials, and natural and sustainable energy sources.

This article explores how CCS captures and sequesters CO_2 and checks all the boxes for desired attributes that leading carbon credit registries such as Gold Standard, Verra, and the Climate Action Reserve seek in High-Value CDR offset credits.

Utilizing microalgae for CO_2 reduction is one of the best tools we have in the fight against climate change. Microalgae are fantastic at photosynthesis; about 50-70% of the oxygen you breathe is the result of photosynthesizing microalgae.

CCS are special porous sheets coated with proprietary bio-based functional coatings, inoculated with microalgae, and contained in a system of 1m3 stackable modules. The microalgae photosynthesize as they multiply, building up algal biomass on the sheets that

contain the captured CO_2. Each of these 1m3 modules holds up to 20m2 of substrate (sheet) surface area; the more surface area, the more surface area to do the work of photosynthesis, capturing CO_2 in the form of algal biomass.

Each module is constantly monitored for its CO_2 uptake (and other relevant conditions). At the appropriate time, the resulting algal biomass containing the captured CO_2 is harvested from the sheets and dried. The resulting algal powder can then be durably sequestered in a closed-loop carbon sequestration system designed for zero leakage. Or, if desired, the algal biomass can be pyrolyzed and converted to biochar, a valuable carbon feedstock used for soil amendment in agriculture.

This DAC system, which can be run on solar energy alone, utilizes recycled and readily-available materials in a system that is practically deployable around the world in fields, farms, industrial facilities and even schools and backyards to contribute meaningfully to the effort to solve climate change. Until now, there has never been a CO_2 personal offset device, but now there is.

The efficiency of Carbon Capture Surfaces

To put all this into perspective, a 1-acre CCS “farm” containing 1,000 modular units (each 1m3 in size) will remove approximately 100 tons of atmospheric CO_2 per year. In comparison, a 1-acre forest of trees will only capture between 1.5 and 6 tons of CO_2 per year. And as a High-Quality CDR, each ton of CO_2 removed by CCS could be expected to fetch upwards of $500/ton in the Voluntary Carbon Market. Together with available tax credits, low startup cost, and the potential for the sale of valuable byproducts of the CCS process, the deployment of CCS “farms” offers compelling financial incentives for farmers, businesses, and governments.

Small CCS farm

Checking all the boxes

High-value carbon credits are in demand by companies and governments aiming to meet their net-zero goals. The primary standards for meeting the definition of a High-Quality Carbon credit are: Additionality, Quantification, Permanence, Verification, Transparency and Reporting, and Co-Benefits.

1. Additionality: the principle that the carbon reductions would not have occurred without the project.
    CCS farms are purpose-built to remove atmospheric CO_2, and would not have otherwise occurred. CCS would not exist without the financial support of the carbon credit market.

2. Quantification of carbon sequestration: Precise, verifiable quantification of carbon removal ensures that each carbon credit represents one ton of CO_2 removed from the atmosphere.
    CCS technology uses state-of-the-art sensors and data logging, continuously monitoring CO_2 capture rates in the individual modules, ensuring accuracy and transparency in reporting.
3. Permanence: refers to the need for carbon to remain sequestered for long periods (typically 100+ years) to ensure the climate benefit is not reversed.
    Captured CO_2 from the CCS farm is dried to a powder and then either contained in a closed-loop system to prevent re-emissions or converted into stable carbon-based products, which are not expected to re-emit for hundreds of years.
4. Verification: Independent, third-party verification is essential to maintain trust and credibility in carbon markets.
    CCS projects will undergo regular audits by accredited verifiers who can readily assess capture performance, energy use, and storage integrity, due to the contained nature of the captured CO_2 and its onsite monitoring routine.
5. Transparency and reporting: High-value carbon credits require complete transparency to prevent double-counting and ensure accountability.
    - All CCS offset credits will be sold on the blockchain and/or registered with public registries, where credit issuance, retirement, and sale can be tracked.
    - Comprehensive reporting will include project methodologies, carbon capture metrics, and third-party verification results, all accessible to stakeholders.
6. Environmental co-benefits: Many registries, such as Gold Standard, prioritize projects with environmental and social co-benefits beyond carbon removal.
    The modular design allows farmers and landowners to repurpose fallow land, generating economic opportunities in rural areas while enhancing soil conservation and biodiversity.

The future of Carbon Capture Surfaces

CCS represent the next generation of carbon removal technologies.

For governments, CCS presents an opportunity to achieve ambitious climate targets while promoting local economic development. For investors, the premium price of high-value carbon credits offers a lucrative and relatively rapid pathway to sustainable returns. For scientists and academics, CCS opens a new frontier for research into innovative, low-impact carbon removal technologies and carbon sequestration potential.

In checking all the boxes of a High-Value Carbon Offset Credit, CCS are poised to become a cornerstone of the global carbon removal effort.

Carbon Capture Surfaces, by Reactive Surfaces.

- Article Categories
- Environmental Sciences

- Article Tags
- North America Analysis

- Publication Tags
- OAG 045 - January 2025

- Stakeholder Tags
- SH - Reactive Surfaces Ltd