Abstract

RepAir's Next-Generation Solution: Electrochemical DAC System for Sustainable Carbon Removal

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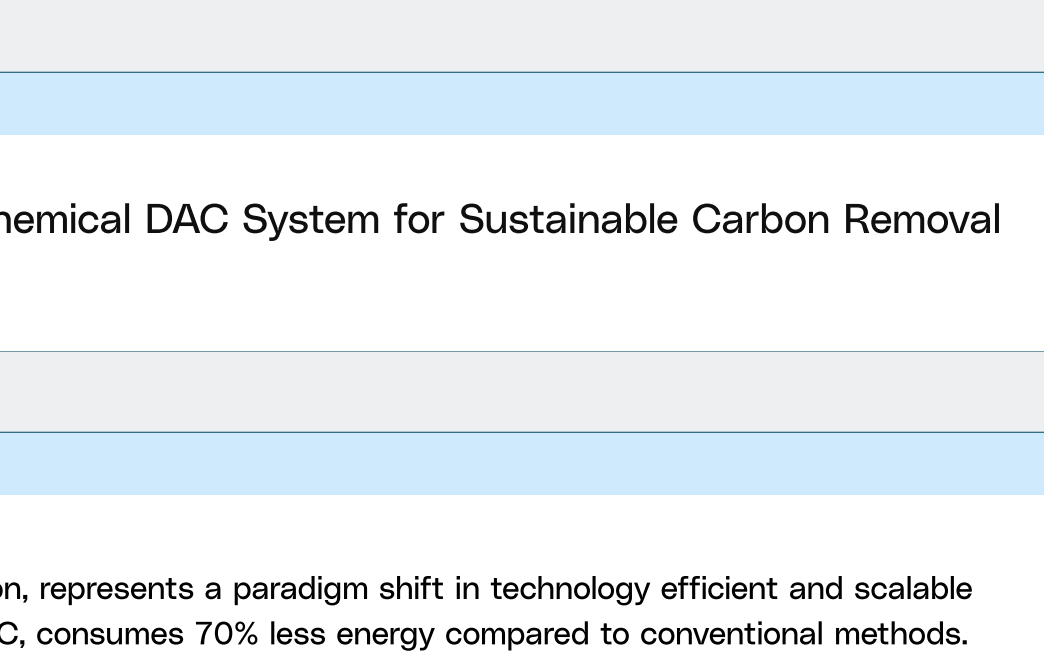
Introduction

RepAir's electrochemical Direct Air Capture (DAC) solution, represents a paradigm shift in technology efficient and scalable carbon removal. The streamlined process of RepAir's DAC, consumes 70% less energy compared to conventional methods. RepAir's DAC system is fully electric and operates without the need for external heat, enabling global deployment in diverse geographical locations and across various storage and utilization facilities. The entire operation is powered by renewable energy sources, ensuring an environmentally friendly and cost-effective solution at scale.

Scientific Principle

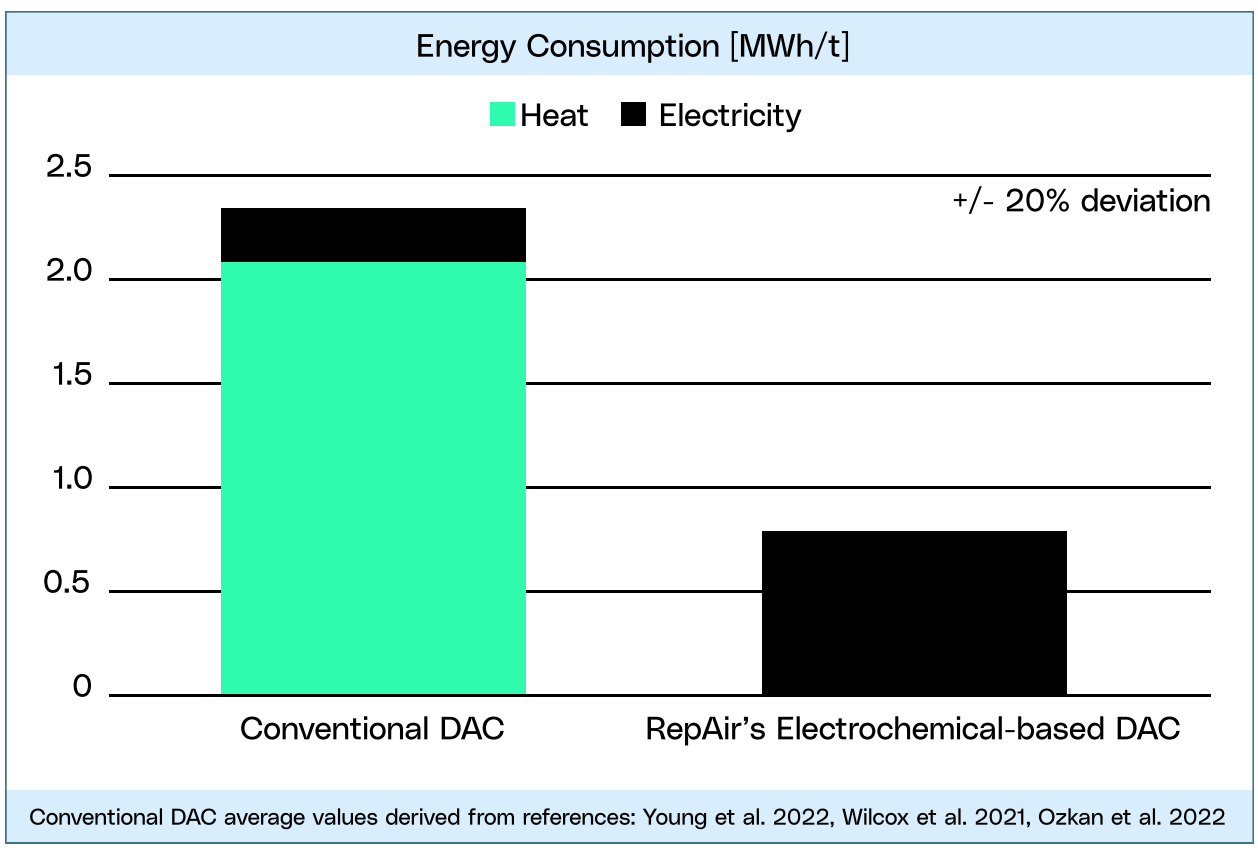
The technology behind RepAir's DAC system involves a series of electrochemical principles. Like a battery cell, the process employs two electrodes separated by a selective separator. Cells can be 'stacked' to multiply carbon removal capacity and atmospheric air is drawn into the cathode, where an electrical current generates hydroxide ions that bind to CO_2 molecules, forming carbonate and bicarbonate ions. Only these ions cross the membrane into the anode, wherein the binding process is undone, the hydroxides are consumed, and pure CO_2 gas is drawn out. Achieving a continuous process is realized by systematically switching cell polarity approximately every few hours.



Principles of Operation

1 Generate OH^- → 2 Scrub CO_2 as HCO_3^- / CO_3^{-2} → 3 Transport CO_3^{-2} → 4 Consume OH^- → 5 Release CO_2

Outcomes



Conventional DAC average values derived from references: Young et al. 2022, Wilcox et al. 2021, Ozkan et al. 2022

The core units exhibit low energy consumption of less than 0.6 MWh per ton CO_2, including regeneration, resulting in a total energy consumption of less than 1 MWh/tCO_2. Moreover, the carbon footprint is below 5% - less than 50kg of CO_2 are emitted for every ton of CO_2 removed. The system is estimated to have a compact footprint of ~15 tCO_2/m^3, further highlighting its efficiency and scalability.

Conclusions

The continuous nature of RepAir's carbon removal process maximizes productivity while minimizing downtime, setting it apart from batch separation or fixation methods. The system ensures optimal energy utilization, with power management through simple on-off switches. RepAir's solution emerges as a promising avenue for sustainable carbon removal, offering a clean and economically viable alternative to conventional DAC.