Climate Change

Solutions that will have an impact on local policy and greenhouse gas emissions

Carbon Sequestration with Algae

Some types of algae can take carbon from the atmosphere.

96-Acre Algae Farm at Keahole Point, Kona, Hawaii

The Impact

While we should strive for reducing our emissions in every way we can, it will be nearly impossible to have a completely carbon-neutral lifestyle by just reducing our carbon output. Thus, sequestering carbon from the atmosphere can be an impactful supplement to existing emission reduction programs. Some strands of algae have been shown to be 10 to 50 times more powerful in taking carbon out of the atmosphere than other vascular plants (i.e., most terrestrial plants).

Where It's Been Implemented

Qualitas, a company in New Mexico, operates a 97-acre Nannochloropsis (a strain of algae) farm for nutritional and fuel purposes.The carbon dioxide injected into the algae plants to stimulate growth transforms the algae into a natural carbon sink. Currently, to produce 1 kilogram of algae, the team at Qualitas uses 2.7 kg of CO_2. Other companies have capitalized on this effect. For instance, Brilliant Planet is a company boasting a 30,000-square-meter production facility in the coastal desert of Morocco. It chooses to operate in coastal deserts in order to harness the productivity of vast areas of unused land. For each new production center, the company searches through thousands of strains of local algae to maximize sequestration effectiveness.

Description

The most common form of carbon sequestration through algae is done in raceway ponds. In essence, large shallow oval lakes (see image above) are filled with saltwater or freshwater, depending on the strand of algae that is then treated to prevent disease. As algae grow in these ponds, they sequester carbon as the bloom expands. Eventually, the algae in the ponds can be harvested and used for the production of bioplastics, biopharmaceuticals or biofuels.

Microalgae are able to survive and thrive where other crop plants cannot, in saline-alkaline water and in wastewater. Thus, growing algae for sequestration purposes does not necessarily take away from freshwater shortages in California. Microalgae also can grow from other waste gasses aside from CO_2, such as NO_x, SO_x, flue gas, inorganic and organic carbon, nitrogen, phosphorus and pollutants from agricultural, industrial and sewage wastewater.

Key Drivers

Climate change is the greatest issue facing future generations. In 2020, humans pumped 37 billion tons of carbon dioxide into the atmosphere, perpetuating sea level rise and global warming. In response, the United Nations has advocated for global carbon neutrality by 2050. In order to reach these goals, ambitious steps need to be taken by both reducing our emissions and sequestering more CO_2 out of the atmosphere.

Key Factors for Success

Algae sequestering is still far from becoming a mainstream way to offset carbon emissions. For algae to have any measurable impact on emissions, producers must find ways to maximize carbon intake efficiency from targeted strains. In order to sell algae sequestering at reasonable consumer prices, incentives must be provided to lower costs and find a cheap supply of CO_2.

Additionally, as mentioned, carbon sequestration through algae is still relatively new commercially and will require further education and introduction into the mainstream psyche before it can be adopted as a viable solution to a carbon neutral future.

References and Resources

MDPI Journal, March 2022. "Industrial CO2 Capture by Algae: A Review and Recent Advances"

MDPI Journal, November 2021. "Role of Microalgae in Global CO2 Sequestration: Physiological Mechanism, Recent Development, Challenges, and Future Prospective"

Brilliant Planet (based in U.K.)

IEEE Spectrum, May 2018. "New Tech Could Turn Algae into the Climate's Slimy Savior"

Frontiers, February 2019. "Overview of Carbon Capture Technology: Microalgal Biorefinery Concept and State-of-the-Art"

Youth Climate Ambassadors Program

Year-long program trains high school students to take climate action into their own hands

The Impact

The Youth Climate Ambassadors program in San Mateo County (Calif.) is a hands-on learning and action program for students who want to address climate change. Through education, collaboration and solution-based leadership, students are given the tools to change their community for the better. Empowered by the program's resources and activist spirit, students have hosted sustainable art contests, built gardens at their schools and restored a site with native vegetation, to name a few of their projects.

The program seeks to train the next generation of socially and environmentally conscious leaders. Studies show that civic engagement and joining membership organizations while young play a key role in developing voting habits later in life. By learning how to take action and offer support for sustainability measures, students are able to make a tangible difference in their community that will inspire them in adulthood. In the short term, they learn about environmental action and implement real projects. And in the long term, cities may see improved voter turnout, civic engagement and local action as a result of the program's graduates.

Where It's Been Implemented

The San Mateo County Youth Climate Ambassadors program began in 2020 and has been growing ever since. It is sponsored by the county's Office of Sustainability, Office of Education, Peninsula Clean Energy and a local nonprofit called the Citizens Environmental Council. As of fall 2022, more than 180 students have participated, learning about climate change, producing community impact projects to tackle climate change and graduating with a better understanding of climate action.

A similar pilot program launched in Houston during the summer of 2021. It is a collaboration between the nonprofit ecoRise, the facilitator group Hire Houston Youth and Houston's Office of

Sustainability. Houston's Youth Climate Ambassadors are specifically tasked with advancing key goals of the Houston Climate Action Plan, raising awareness about impacts of climate change and better incorporating historically underserved community voices into the plan, primarily through outreach.

Description

The Youth Climate Ambassadors program is a broad learning experience that brings a diverse group of students together around climate action. At a time when students are anxious about how climate change will hurt their communities, this program provides opportunities to get engaged and instigate positive change.

Through a collaboration between public and private organizations, students generally begin by learning about climate change directly from seasoned activists and local climate leaders. Aided by peer mentors and community building, they are empowered to explore how they can help fight climate change. The training culminates in a final Community Impact Project where students showcase what they have learned about climate change and implement a program or plan in the community to address it.

Key Drivers

Today's young people absorb information at a rate never seen before because of technology and social media. They are constantly bombarded with news about current events and the next big threat. They are often highly motivated to do something, but it's hard for them to figure out how to influence political issues when they can't even vote. Their response is often to tune out the information and become desensitized to very real issues.

The YCA program teaches young people how to engage with local government and climate action so that they can be the change. With the tools they learn to use, students are motivated and supported to implement real programs that address their climate anxiety.

Key Factors for Success

Strong support from local governments, such as an Office of Sustainability or Office of Education, is essential to encourage partnerships with other organizations and easily access local, federal and state funding incentives. California offers grants specifically for environmental literacy and environmental education.

Support from local organizations (especially climate-focused ones) will allow for increased opportunities for hands-on learning and more connections to future engagement. These organizations can also help bear some of the administrative burden of creating curriculum and managing students so that no one organization is overwhelmed.

Key Obstacles

San Mateo County's Youth Climate Ambassadors (YCA) program has no funding issues, thanks to generous support from multiple public and private partnerships. Peninsula Clean Energy (PCE), the county's community choice aggregation energy provider, funds all student stipends. As of September 2022, the PCE-YCA contract fully funds 80 student stipends and 20 supplemental travel and food stipends.

Equity and inclusion are currently the biggest obstacles for San Mateo's YCA. Making sure the program isn't just filled with Advanced Placement Environmental Science (APES) students, presidents of school green clubs and upper-middle class students has been a challenge. Increased socioeconomic diversity increases the diversity of perspectives, and with each new perspective comes new solutions to

issues. The scope of projects will increase and so will impact on their community. The program's goal is to connect as many of these student perspectives as possible to build a cleaner future.

To broaden diversity, the YCAs use local and national equity assessment tools such as the Government Alliance on Race and Equity (GARE) toolkit to assess equity, finding very specific regions of San Mateo County that have been overrepresented by YCA participants. Then YCA has partnered with specialized environmental organizations and local APES/Biology teachers in underrepresented regions to utilize their more direct connection to students. Ultimately, it was able to increase applications from these regions. Finally, it set diversity targets of at least 50 percent BIPOC students to promote and protect diversity.

Return on Investment

The Houston Youth Climate Ambassadors have interacted with more than 400 Houston residents by passing out flyers and attending over 10 outreach events. The San Mateo County Youth Climate Ambassadors program has produced hundreds of community impact projects that address a wide range of environmental issues.

References and Resources

Kamille Lang, Youth Climate Ambassadors lead, San Mateo County Office of Sustainability, klang1@smcgov.org, 408-832-0388

Andra Yeghoian, Chief Innovations Officer at TenStrands, ayeghoian@tenstrands.org, 925-348-5337. She started the YCA program in San Mateo County.

Julie Hilborn, Coordinator, San Mateo County Office of Education Environmental Literacy and Sustainability Initiative, jhilborn@smcoe.org

Social Science Quarterly, July 23, 2004, "Participation in Voluntary Youth-Serving Associations and Early Adult Voting Behavior"

Government Alliance and Racial Equity (GARE) toolkit

San Mateo County's Youth Climate Ambassadors program

Projects by students in San Mateo County's Youth Climate Ambassadors program

Houston's Youth Climate Ambassadors program

Presentation on Houston's Youth Climate Ambassadors program

California Department of Education. Environmental education and environmental literacy resources and grant opportunities