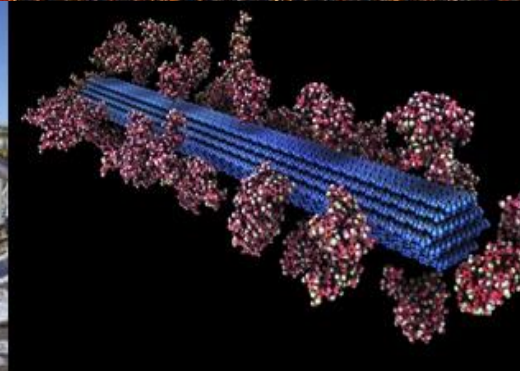




U.S. DEPARTMENT OF
ENERGY

Energy Efficiency &
Renewable Energy



National Energy Technology Laboratory Carbon Utilization Project Review Meeting Panel Discussion on Direct Air Capture (DAC) and Utilization

October 22, 2020

Christy Sterner, Technology Manager
Advanced Algal Systems
Bioenergy Technologies Office

BETO's Advanced Algal Systems Program

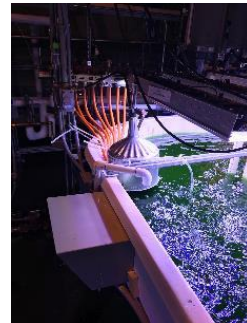
BETO funds R&D to strategically address lowering costs, improving quality, and increasing productivity of algal biomass.

BETO partners are developing sustainable, scalable algae cultivation systems and approaches to:

- maximize reliable annual biomass yield and quality, and
- minimize energy use, water consumption, land use, and nutrient additions.



Arizona State University's Algae Field Station



Volatiles detection equipment being used at Sandia National Laboratories



Phenomic's ePBRs being used at CalPoly

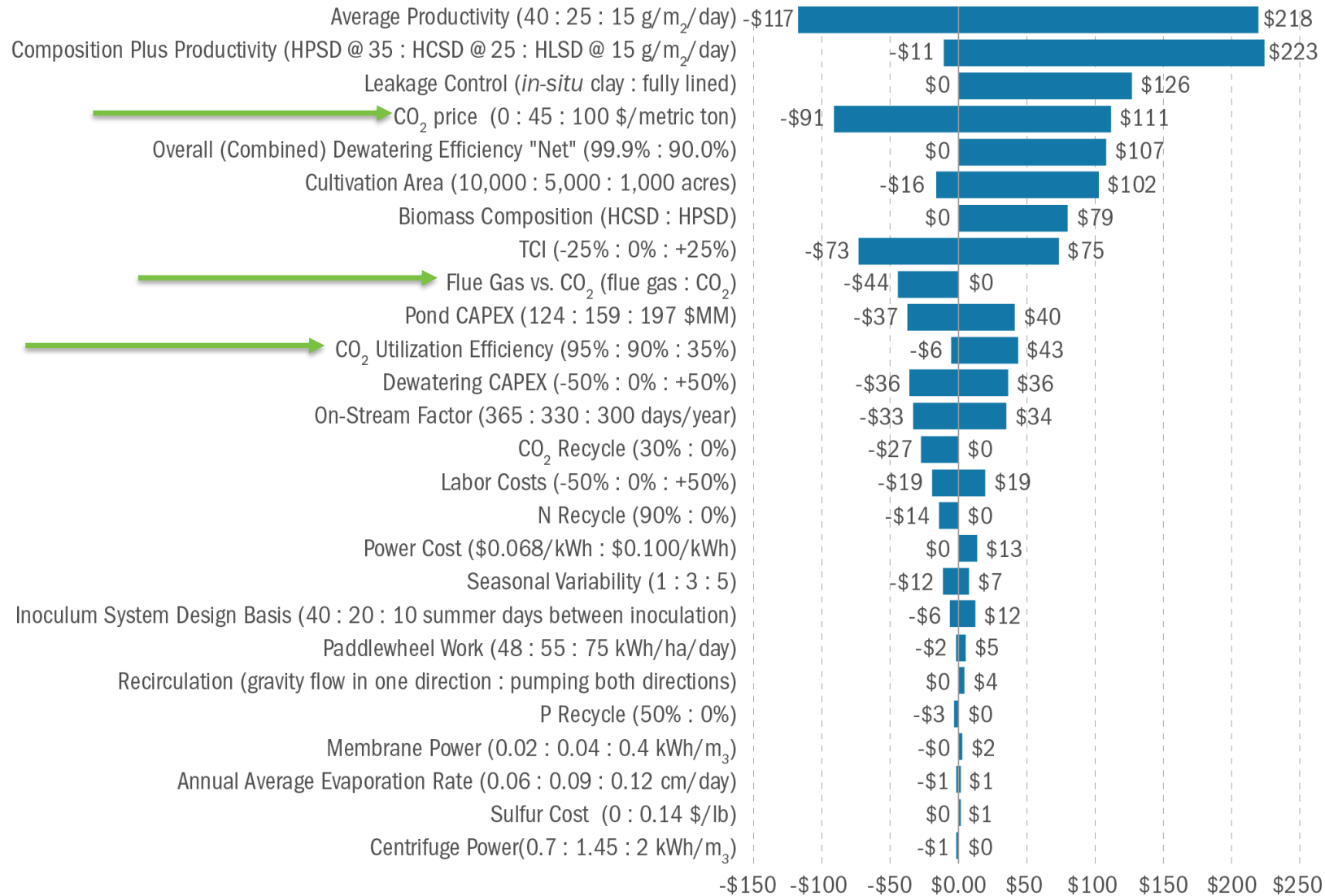


One Water founder Dan Johnson explains the Algae Wheel wastewater treatment reactor



Global Algae Innovations miniponds at the UCSD Algae Field station

Sensitivity Plot for Algae Biomass Cost – Why CO₂ Capture and Utilization?



Change to MBSP from 2030 Baseline (\$/ton ADW)



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Applied R&D at BETO: Photosynthetic CO₂ Utilization

Advanced Algal Systems Program

Like terrestrial plants, algae require CO₂ for growth – a perfect biological, photosynthetic capture and utilization mechanism!

- Initial CO₂-focused projects awarded from Targeted Algal Biofuels and Bioproducts FOA in 2015 (one on CO₂ from flue gas, one on direct air capture)
- Algae Cultivation for Carbon Capture and Utilization Workshop, May 23, 2017 (in coordination with Office of Fossil Energy and Stanton Energy Center)
- Efficient Carbon Utilization in Algal Systems FOA, 2018 two topic areas – CO₂ utilization within cultivation systems and direct air capture)
- Coordination/Information Sharing with the Office of Fossil Energy (most recently coordinated language, metrics, topic areas for both FE's and BETO's FY20 FOAs, including participation on each other's FCBs; sharing project info for synergies and to avoid duplicative efforts)
- FY20 BETO Multi-topic FOA – Topic Area 3, Algal Bioproducts and CO₂ Direct Air Capture Efficiency (all projects include direct air capture technologies and CO₂ utilization metrics/goals)



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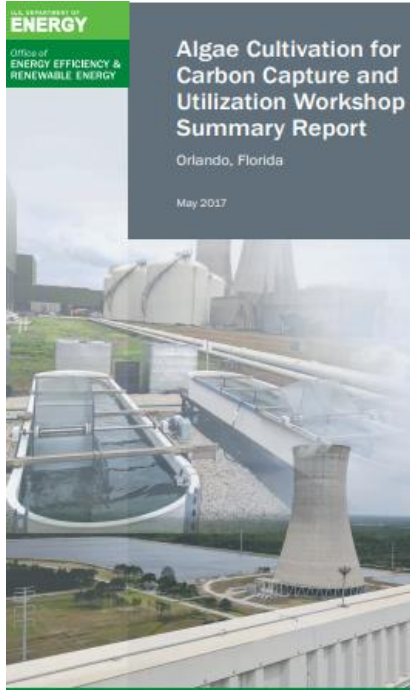
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Advanced Algal Systems investment in CCU and partnership with FE

The algae industry is an early DAC and flue gas capture adopter.

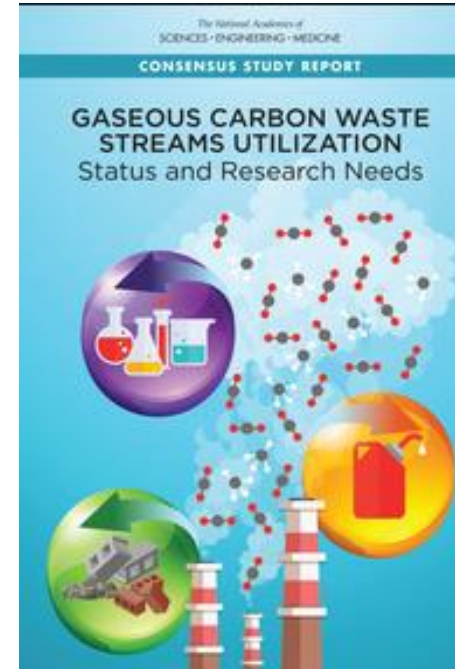
BETO has **partnered with FE on carbon utilization** algae efforts to investigate both flue gas capture and direct air capture (DAC) to reduce delivered CO₂ costs and provide added value.

Selection of FOA awards that include carbon utilization from a point source and direct air capture



ECUAS
Topic
language
developed
with input
from FE

45Q includes
algae as a CCU
technology



ABCDE
Scoping on FOA discussed with FE
FE reviewer
FE Federal Consensus Board

The IRS released a new set of regulations for the Section 45Q tax code that can award a federal investment tax credit of up to \$35 per ton for carbon utilization with algae.

2015

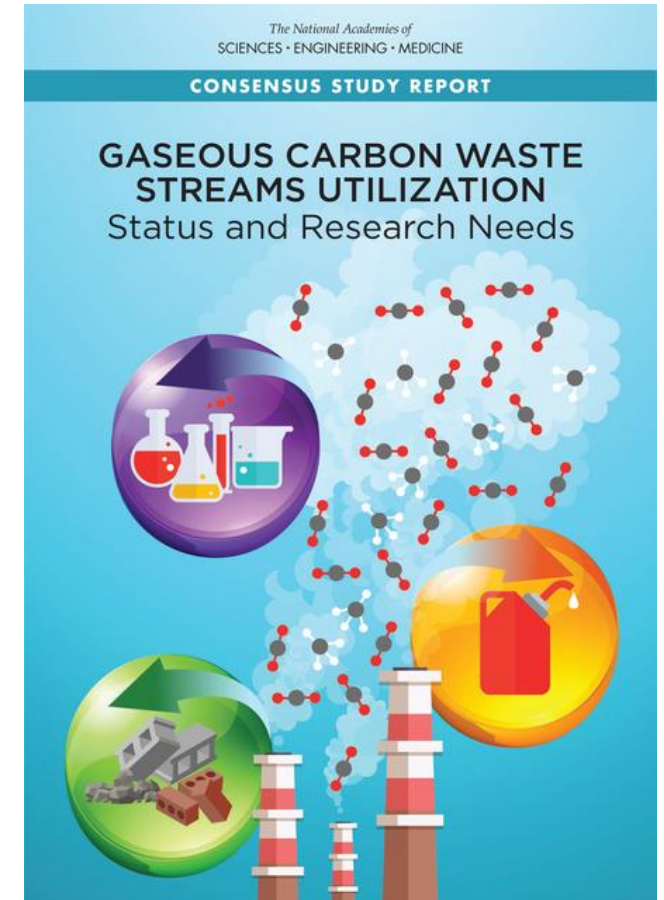
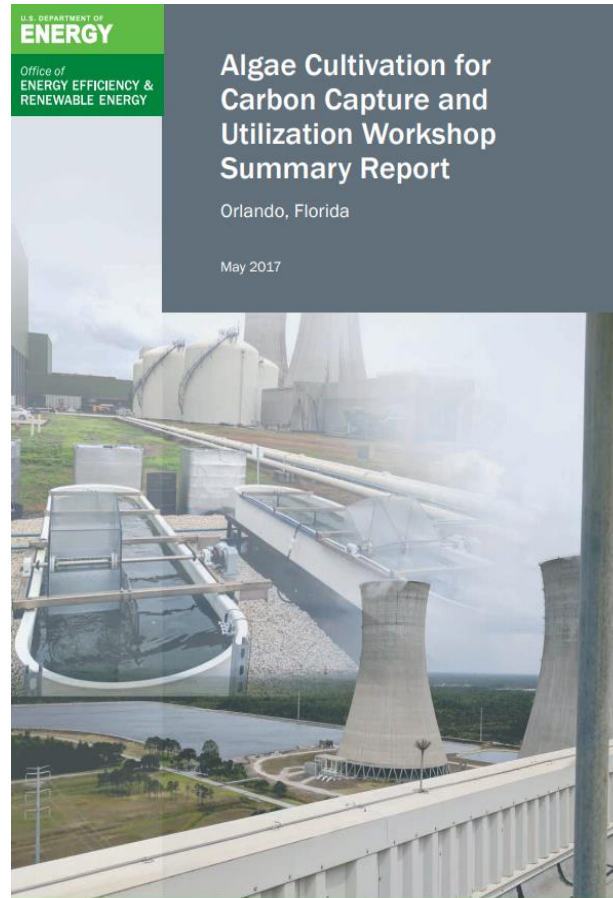
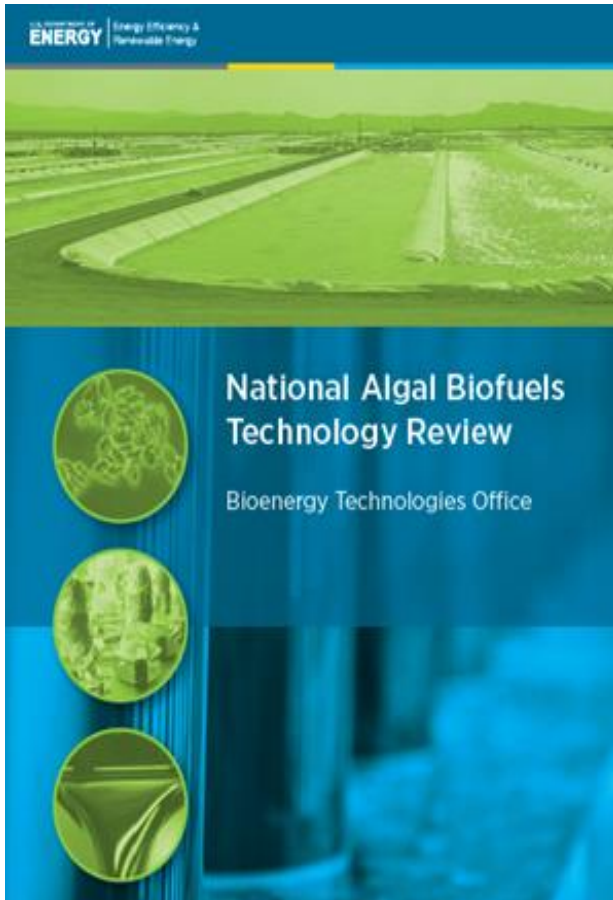
2017

2018

2017-2019

2020

Support for AAS Carbon Capture and Utilization R&D



Engineering and **biological** solutions are needed to increase the efficiencies of **CO₂ delivery** and **uptake** by the algae, and it is important to show that algae can **thrive** on these emissions while **reducing costs** of production.

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