CARBON CAPTURE AND UTILIZATION
MYTHS AND FACTS

Myth	Fact
CO2 reuse has not been adequately demonstrated	• Technologies for algae utilization of CO2 are being demonstrated throughout the nation. Since 2010, the Department of Energy has funded a dozen algae CO2 utilization projects.[1,2] Algae carbon utilization is being demonstrated at projects in Florida, New Mexico, Iowa, Arizona, California, Hawaii, and Kentucky[3], and is ready for commercial deployment. • Since 2012, Duke Energy and the University of Kentucky have been operating a demonstration scale algae carbon capture and utilization (CCU) unit at Duke's East Bend Station in Union, KY, converting CO2 flue gas from a coal-fired power plant into algal biomass.[4] • ABO members are in negotiations with partners in China and several other nations to deploy algae CCU technology.[5,6] • A wide range of other beneficial uses of CO2 are also under development. DOE has invested over $100 million in innovative concepts for reuse of CO2, including mineralization, soil remediation, and polymer manufacturing.[7] • CO2 utilization is at least as adequately demonstrated as carbon capture and sequestration (CCS), and should be available to states to help meet their greenhouse gas goals.
Algae CO2 utilization is not scalable	• The industry has developed algae CO2 utilization systems that can be adapted to a broad range of geographies and CO2 sources. Algae systems are being demonstrated in every region of the mainland U.S. and Hawaii. • A comprehensive 2013 analysis by Pacific Northwest National Labs (PNNL)[8] found the nation's land and water resources could support 25 billion gallons of algae-based fuel a year in the United States. • Algae have been demonstrated to produce over 8,000 gallons of biofuel per acre and over 100 gallons of biofuel per ton of CO2.[9] A 10,000 acre commercial algae production unit would absorb nearly 1 million tons of CO2 annually – nearly 1/4 of the CO2 emitted by a typical 600MW coal power plant[10] and more than half the CO2 from a similar size natural gas unit – all while producing over 80 million gallons of renewable fuel to substitute for fossil petroleum.

1 http://energy.gov/eere/bioenergy/related-links-0
2 http://energy.gov/eere/bioenergy/algal-integrated-biorefineries
3 http://www.algaebiomass.org/wp-content/uploads/2010/06/ABO_project_book_lo-res_July2013.pdf
4 http://www.duke-energy.com/environment/carbon-capture-and-storage.asp
5 http://www.algaeindustrymagazine.com/accelergy-partners-with-yankuang-for-algae-farm-at-coal-to-liquids-plant-in-china/
6 http://www.biofuelsdigest.com/bdigest/2014/07/10/u-s-china-ecopartnerships-program-picks-sinopec-sapphire-energy-project/
7 http://energy.gov/fe/innovative-concepts-beneficial-reuse-carbon-dioxide-0
8 http://pubs.acs.org/doi/abs/10.1021/es304135b
9 www.algenol.com
10 http://www.ucsusa.org/clean_energy/coalvswind/c02c.html#.VFz-JfnF-aI

CO2 reuse is not cost effective	• CCU is clearly cost advantaged over CCS. CCU does not require the added expense and parasitic load of CO2 compression and underground injection associated with CCS. Furthermore, with CCS, the entire cost of capture, purification, compression and underground injection is borne by the ratepayer. CCU offers a market-based alternative for CO2 that minimizes cost to the ratepayer by turning CO2 from a waste into a commercial resource. • Today's algae producers must buy CO2 from commercial sources, making CO2 one of the leading operational costs of algae biomass projects. Given these costs, algae project developers are hungry for new sources of CO2. At over 100 gallons of biofuel produced per ton of CO2, the value of biofuel produced from CCU is likely to exceed $400 per ton of CO2. Algae project developers are therefore well positioned to compete with other potential CO2 markets, such as enhanced oil recovery (EOR).
CO2 reuse does not permanently capture and dispose of the CO2	• CCU produces real, quantifiable and permanent reductions in CO emissions. Many CCU applications, such as algae conversion to chemical intermediates and plastics, directly sequester CO2 in enduring products.[11] Other applications, such as production of algae-based soil amendments and bio-fertilizer, can produce ongoing reductions in atmospheric CO2 well beyond the life of individual organisms.[12,13] • Even when subsequently combusted as a transportation fuel, algae CO2 utilization produces meaningful and lasting emissions reductions by displacing additional fossil fuel combustion. Every barrel of algae biofuel produced through carbon capture replaces a barrel of petroleum that would otherwise have been extracted and combusted. Through this substitution, CO2 remains permanently stored underground as petroleum. • Peer reviewed lifecycle analyses of two of the leading commercial demonstration algae production facilities show CO2 reductions of 68 to 80 percent[14,15] on a full lifecycle basis versus petroleum-based alternatives. • A recent peer reviewed analysis[16] found that algae CCU results in a greatly advantaged carbon footprint relative to status quo, and similar or superior total emissions relative to CCS, even when subsequent biofuel combustion is included.
CO2 accounting for CCU is too complicated and/or risks double counting	• Carbon accounting for CCU, especially for projects involving biofuel production, is certainly more complex than for CCS, but can certainly be done, as demonstrated in recent peer-reviewed work.[17] • The algae industry agrees that CO2 accounting for CCU with subsequent biofuel combustion must be done in a manner that avoids double counting reductions resulting from CO2 uptake. In 2009, industry and the environmental community worked together with Reps. Waxman and Markey to include language in H.R. 2454, the *American Clean Energy and Security Act of 2009* to ensure this would be properly accounted for by EPA.[18]

[11] e.g. www.algix.com
[12] http://www.accelergy.com/technology_cbtl.html
[13] e.g. http://www.slideshare.net/asku92/production-of-biofertilizeranabaena-and-nostoc-using-co2
[14] http://www.sciencedirect.com/science/article/pii/S0960852413013631
[15] http://pubs.acs.org/doi/abs/10.1021/es1007577
[16] http://onlinelibrary.wiley.com/doi/10.1002/bbb.1505/references
[17] Ibid.
[18] H.R. 2454, Section 722(b)(9)