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RE: Algae Biomass Organization Comments on the Proposed Clean Power Plan for Existing Power Plants

I. Introduction

In the Clean Power Plan, EPA proposes guidelines for states to follow in developing plans to address greenhouse gas (GHG) emissions from existing fossil fuel-fired electric generating units.[1] The Algae Biomass Organization (ABO) appreciates and supports EPA's efforts to reduce emissions of carbon dioxide (CO_2) from power plants and other industrial sources as a key component to addressing carbon pollution and global climate change, and appreciates the opportunity to comment on this proposal.

ABO is the trade association for the algae industry, representing the leading developers of renewable, sustainable products from algae. Our membership includes pioneering algae technology companies, research institutions, leading academics, utilities, airlines and other end users, and a range of other industry partners throughout the algae supply chain. ABO's membership directory is included as **Appendix A.**

[1] Carbon Pollution Emission Guidelines for Existing Stationary Sources: Electric Utility Generating Units,79 Fed. Reg. 34830 (proposed June 18, 2014).

ABO members are developing a wide range of algae technology platforms to convert CO_2 captured from power generation and other industrial sources into renewable fuels, chemicals, fertilizer, plastics, feed ingredients and other products. Appropriate regulation of CO_2 emissions can mitigate the rise in atmospheric GHG concentrations and address global climate change. Appropriate regulation also represents a tremendous opportunity to foster the growth of carbon capture and utilization (CCU) technologies that will be vital to achieving necessary atmospheric GHG reductions.

ABO has serious concerns, however, that the proposed rule, as written, could have a profound chilling effect on the development of algae and other CO_2 utilization technologies. While the proposed rule offers states flexibility in developing compliance plans, by making no mention of CCU while affirmatively recognizing other compliance options, including carbon capture and sequestration/storage (CCS), the proposed rule risks sending the signal to states – and to investors – that carbon utilization is not a preferred or acceptable mitigation strategy. This would be a profound missed opportunity.

By creating a market for captured carbon, carbon utilization can mitigate, offset, or even negate the cost of carbon capture, providing a CO_2 reduction mechanism that minimizes the cost to ratepayers. In recognizing CCS and not CCU in the proposed rule, EPA risks exposing ratepayers to unnecessary compliance costs. EPA also departs from the waste management hierarchy established in the Pollution Prevention Act by promoting disposal of CO_2 through CCS ahead of recycling.

Algae-based CCU is adequately demonstrated and technically feasible. It can be implemented at reasonable cost, provide meaningful emission reductions, and its inclusion in the Clean Power Plan will serve to promote further development and deployment of a broad set of carbon capture and conversion technologies.

ABO requests EPA include language in the final rule clearly indicating that carbon utilization is an acceptable component in state emissions reduction plans. Such affirmative recognition would provide states and sources of private capital with the confidence to invest in this highly promising CO_2 solution while helping to expand the market for CO_2 that reduces the cost of compliance.

II. Algae-based Carbon Utilization

a. The Algae Platform

The use of CO_2 as a feedstock to produce algae-based fuels and products is among the most promising options for reducing CO_2 emissions from existing and future CO_2-producing power plants. Algae are among nature's most prolific and efficient photosynthetic organisms. Algae's exceptional ability to convert sunlight and CO_2 into oxygen transformed Earth's early atmosphere into the oxygen-rich one we enjoy now, and the lipids and carbohydrates produced by these early algae are the original source of the crude oil that drives our economy.

Photosynthetic algae thrive on concentrated sources of CO_2. To provide the optimal environment for growth, today's algae developers must purchase commercial CO_2 – at great expense – as a feedstock. ABO members would welcome the opportunity to participate in reducing emissions of CO_2 from the power sector by partnering with utilities to utilize captured carbon as a feedstock, transforming CO_2 from an expensive waste disposal issue into a resource that will benefit industry, the environment and ratepayers. ABO members are, in fact, in active negotiations with utilities to do just that. A clear signal from EPA that CCU projects are eligible under the Clean Power Plan would greatly accelerate these negotiations.

b. Technology Demonstration

In the 1970s, the U.S. Department of Energy (DOE) recognized the potential to harness algae for industrial production of transportation fuels and pursued this objective under the Aquatic Species Program from 1978 to 1996.[2] Great strides were made in the science of manipulating the metabolism of algae and the engineering of microalgae production systems over this period. The subsequent advent of modern biotechnology greatly accelerated this development and has made cost-competitive algae-based fuels and other products achievable.

Today, algae biomass research, development and deployment are underway throughout the U.S. A 2013 survey of ABO members identified 148 facilities conducting or supporting algae R&D and commercial deployment [See **Appendix B**].

Research has evolved rapidly, and algae-based carbon utilization is now being demonstrated at scale, including at DOE-funded integrated biorefinery (IBR) projects in Florida, New Mexico and Illinois, and pilot projects in Iowa, Hawaii, Kentucky, and elsewhere.[3,4]

[2] http://www.nrel.gov/biomass/pdfs/24190.pdf (all sites last visited November 28, 2014)
[3] http://energy.gov/eere/bioenergy/related-links-0
[4] http://energy.gov/eere/bioenergy/algal-integrated-biorefineries

ABO's Algae Project Book [**Appendix C**] highlights several leading projects. For example, Sapphire Energy began production of algae-based crude oil at its 100-acre Integrated Algal Biorefinery in Columbus, New Mexico, in August 2012 and has been in continuous operation since. By 2015, the company expects to produce 100 barrels per day of algal crude oil from the facility. In addition to DOE funding, the project was supported by a $54.5 million loan guarantee from the U.S. Department of Agriculture (USDA). In 2013, USDA announced the repayment of the guaranteed loan in full, citing the project as an example of how the Biorefinery Assistance Program can effectively support the development of advanced biofuels.[5] Sapphire has since signed agreements with Tesoro Refining and Marketing Company and Phillips 66 to bring these fuels to market,[6,7] and earlier this year signed a deal through the U.S. State Department's EcoPartnerships Program with Sinopec, China's state petroleum corporation, to deploy Sapphire's technology in China.[8]

Florida-based Algenol is now operating its 36-acre IBR project in southern Florida to convert CO_2 to ethanol and bio-crude oil from algae. Algenol has invested over $250 million to develop and deploy the underlying technology, and has reported production of greater than 8,000 gallons of liquid fuel per acre per year.[9] Algenol is now in negotiations with landholders, CO_2 emitters and others to execute its first commercial project.

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5 http://www.usda.gov/wps/portal/usda/usdahome?contentid=2013/10/0195.xml
6 http://www.sapphireenergy.com/press-article/1557405-sapphire-energy-enters-into-a-commercial
7 http://www.sapphireenergy.com/press-article/1986963-sapphire-energy-and-phillips-66-to
8 https://ecopartnerships.lbl.gov/partnership/sapphire-sinopec-producing-green-algae-crude-oil
9 http://www.algenol.com/sites/default/files/press_releases/Production%20and%20Jobs%20Press%20Release%2003.08.2013.pdf

Since 2012, Duke Energy and the University of Kentucky have been operating a demonstration scale algae CCU unit at Duke's East Bend coal-fired power generating station in Union, KY, converting CO_2 flue gas from a coal-fired power plant into algal biomass at an onsite photobioreactor.[10]

Accelergy Corporation, a leading coal-to-liquids (CTL) technology developer, is currently validating its TerraSync technology for algae-based conversion of CO_2 from CTL fuel production into bio-fertilizer. Algae absorb CO_2 from CTL flue gas and then continue to capture CO_2 and nitrogen from the atmosphere once applied to soil as a fertilizer, greatly enhancing GHG mitigation.[11] Accelergy has signed a deal to deploy the technology at a CTL plant in Mongolia.[12]

BioProcess Algae has leveraged DOE funding to deploy their algae CO_2 utilization platform at a Green Plains Renewable Energy ethanol plant in Shenandoah, Iowa. Phase III of the project has recently been completed, a five acre production facility consisting of greenhouses growing algae with BioProcess Algae's technology.

In addition to projects identified in the Algae Project Book, algae technology developers Cellana and Renewable Algal Energy have recently signed offtake agreements with Neste Oil, a leading oil refiner, for algal oil produced at planned commercial algae production facilities.[13] And in November, Mississippi-based Algix, LLC, opened its first commercial facility for production of algae-based bioplastics.[14]

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[10] http://www.duke-energy.com/environment/carbon-capture-and-storage.asp

[11] http://www.accelergy.com/technology_cbtl.html

[12] http://www.algaeindustrymagazine.com/accelergy-partners-with-yankuang-for-algae-farm-at-coal-to-liquids-plant-in-china/

[13] http://www.nesteoil.com/default.asp?path=1,41,540,17988,7906,24191

[14] http://msbusiness.com/blog/2014/11/14/bioplastics-maker-opens-business-east-mississippi/

Beyond fuels and plastics, several leading algae biomass developers have recently signed deals to market algae-derived ingredients for human and animal nutrition, personal care, cosmetics and other high value markets.[15] This broad suite of commercial developments illustrate that algae-based CO_2 utilization has now clearly advanced to the point where it can and should be available to states to help meet their greenhouse gas goals.

A wide range of other technologies for beneficial use of CO_2 are also under development. DOE has invested over $100 million in innovative concepts for reuse of CO_2, including mineralization, soil remediation, and polymer manufacturing.[16] In October, Skyonic Corporation dedicated its first-of-a-kind CCU facility to capture CO_2 from a cement plant for conversion to byproducts that can be sold profitably to other industries.[17] The broad demonstration and deployment of carbon capture and utilization technologies makes clear that CCU is at least as adequately demonstrated as CCS, and should be available to states to help meet their 111(d) obligations.

c. Sustainability and Scalability

i. Sustainability

As has been observed by DOE, algae-based CO_2 conversion offers a diverse set of economic and environmental benefits.[18] Algae offer high potential yield per acre, the

[15] http://www.biofuelsdigest.com/bdigest/2014/10/01/state-of-the-algae-industry-10-top-level-commercial-leaders-look-at-the-path-to-scale/
[16] http://energy.gov/fe/innovative-concepts-beneficial-reuse-carbon-dioxide-0
[17] http://www.houstonchronicle.com/business/energy/article/Texas-plant-to-debut-new-carbon-capture-technology-5838410.php
[18] http://energy.gov/sites/prod/files/2014/09/f18/algal_biofuels_factsheet.pdf

ability to grow on land not suited for agriculture and in brackish or wastewater, absorption of CO_2, and relative ease of conversion into fuels and products.

Algae's potential for GHG reductions is among its most desirable characteristics. Peer reviewed lifecycle analyses of two of the leading commercial demonstration algae production facilities show CO_2 reductions of 68 to 80 percent on a full lifecycle basis versus petroleum-based alternatives. [19,20] Algae-based renewable diesel is approved by EPA under the Renewable Fuel Standard as a qualified advanced biofuel with lifecycle GHG emissions reductions of greater than 50 percent verses petroleum-based diesel.[21] Several additional algae-based fuel pathways are expected to receive approval.[22]

In addition to substituting for petroleum in fuels and chemicals markets, algae oils offer a sustainable alternative to palm oil in a wide range of markets such as laundry surfactants.[23] Widespread deployment of algae carbon capture could therefore have the added benefit of reducing CO_2 emissions from deforestation for palm oil production.

ii. Scalability

Algae production has the potential to scale to very significant levels of commercial production. The DOE has said the production of algae-based fuel represents a significant opportunity to impact the U.S. energy supply for transportation fuels.[24] A comprehensive 2013 analysis by Pacific Northwest National Labs (PNNL)[25]

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[19] http://www.sciencedirect.com/science/article/pii/S0960852413013631
[20] http://pubs.acs.org/doi/abs/10.1021/es1007577
[21] http://www.epa.gov/otaq/fuels/renewablefuels/new-pathways/approved-pathways.htm
[22] http://www.epa.gov/otaq/fuels/renewablefuels/new-pathways/rfs2-pathways-review.htm
[23] http://www.theguardian.com/environment/2014/apr/02/ecover-algae-laundry-liquid-palm-oil
[24] U.S. DOE 2010. National Algal Biofuels Technology Roadmap. U.S. Department of Energy, Office of Energy Efficiency and Renewable Energy, Biomass Program.
[25] http://pubs.acs.org/doi/abs/10.1021/es304135b

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 – more than ten times the yield from palm oil – and over 100 gallons of biofuel per ton of CO_2.[26] A 10,000 acre commercial algae production unit would therefore absorb nearly 1 million tons of CO_2 annually – nearly 1/4 of the CO_2 emitted by a typical 600MW coal power plant[27] and more than half the CO_2 from a similar size natural gas unit – all while producing over 80 million gallons of renewable fuel to substitute for fossil petroleum.

Some critics have suggested that algae and other CCU platforms could not be deployed at sufficient scale to significantly mitigate CO_2 emissions from the power sector. But DNV, the respected Norwegian classification and risk management society, found in a recent analysis that conversion of CO_2 into fuel, utilization of CO_2 as a feedstock for chemicals, and non-conversion use of CO_2 together have the potential to reduce CO_2 emissions by at least 3.7 gigatons per year (Gt/y) – approximately 10 percent of total current annual global CO_2 emissions – both directly and by reducing use of fossil fuels, and that much greater reductions are possible through wider adoption of these technologies.[28]

Other CCU critics have argued that CO_2 conversion requires high levels of process energy. These critics should be reminded that photosynthesis has been efficiently converting CO_2 to valuable products for millennia using only sunlight. Other

[26] www.algenol.com
[27] http://www.ucsusa.org/clean_energy/coalvswind/c02c.html#.VFz-JfnF-aI
[28] http://www.dnv.com/binaries/dnv-position_paper_co2_utilization_tcm4-445820.pdf

biological conversion pathways, such as are found in chemoautotrophs, also do not require energy inputs, since they create their own chemical reactions within the cell.

d. Cost

Perhaps the greatest concern about carbon regulation is the cost of compliance. Absent technologies that can reuse waste carbon, compliance is a sunk cost. Cost has been the leading obstacle to deployment of CCS technologies, for example.[29]

Algae-based CCU is clearly cost advantaged over CCS. For example, Accelergy, in a November 2014 presentation to the National Rural Electric Cooperative Association (NRECA), estimated the cost of its algae bio-fertilizer CCU platform at $4 to $11 per ton of CO_2 captured, with up to 60 additional tons of CO_2 reduction realized for every ton of CO_2 captured through reduced application of nitrogen-based fertilizer and ongoing carbon and nitrogen uptake by the algae once applied to the soil [see **Appendix D**]. This represents a cost reduction of up to 95 percent versus CCS.

Many of today's algae producers must buy CO_2 from commercial sources. Carbon dioxide procurement is one of the leading operational costs of algae biomass projects. Given these costs, algae project developers are hungry for new sources of CO_2. At over 100 gallons of biofuel produced per ton of CO_2, *the value of biofuel produced from algae-based CCU is likely to exceed $300 per ton of CO_2*.[30] Algae project developers are therefore well positioned to mitigate, offset, or even negate the cost of carbon capture, providing a CO_2 reduction mechanism that minimizes the cost to ratepayers. For example, Algenol Biofuels estimated in its November presentation to

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[29] http://www.cbo.gov/sites/default/files/cbofiles/attachments/43357-06-28CarbonCapture.pdf
[30] www.algenol.com

NRECA that its CCU to biofuels platform could offer up to $25 per ton in revenue to power generating partners, offering CO_2 solution that benefits ratepayers [see **Appendix E**].

Algae-based CCU also does not require the added expense and parasitic load of CO_2 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 CO_2 that minimizes cost to the ratepayer by turning CO_2 from a waste into a commercial resource.

DOE is supporting a range of projects to offset the cost of compliance through use of CO_2 for enhanced oil recovery (EOR).[31] While EOR improves the economics of CCS, it has the perverse effect of increasing fossil carbon extraction. In contrast, algae CCU offers a way to offset the cost of compliance while reducing the use of petroleum. We urge EPA to ensure the final rule provides states a clear signal that the agency supports and encourages implementation of this economically and environmentally advantageous mitigation strategy.

III. Accounting and Verification of Emissions Reductions

CCU produces real, quantifiable and permanent reductions in CO_2 emissions. Many CCU applications, such as algae conversion to chemical intermediates and plastics, directly sequester CO_2 in enduring products.[32] Other applications, such as

[31] http://energy.gov/fe/science-innovation/oil-gas-research/enhanced-oil-recovery
[32] e.g. www.algix.com

production of algae-based soil amendments and bio-fertilizer, can produce ongoing reductions in atmospheric CO_2 well beyond the life of individual organisms.[33,34]

Even when subsequently combusted as a transportation fuel, CO_2 utilization produces ton-for-ton 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, CO_2 remains permanently stored underground as petroleum [**Fig. 1**].

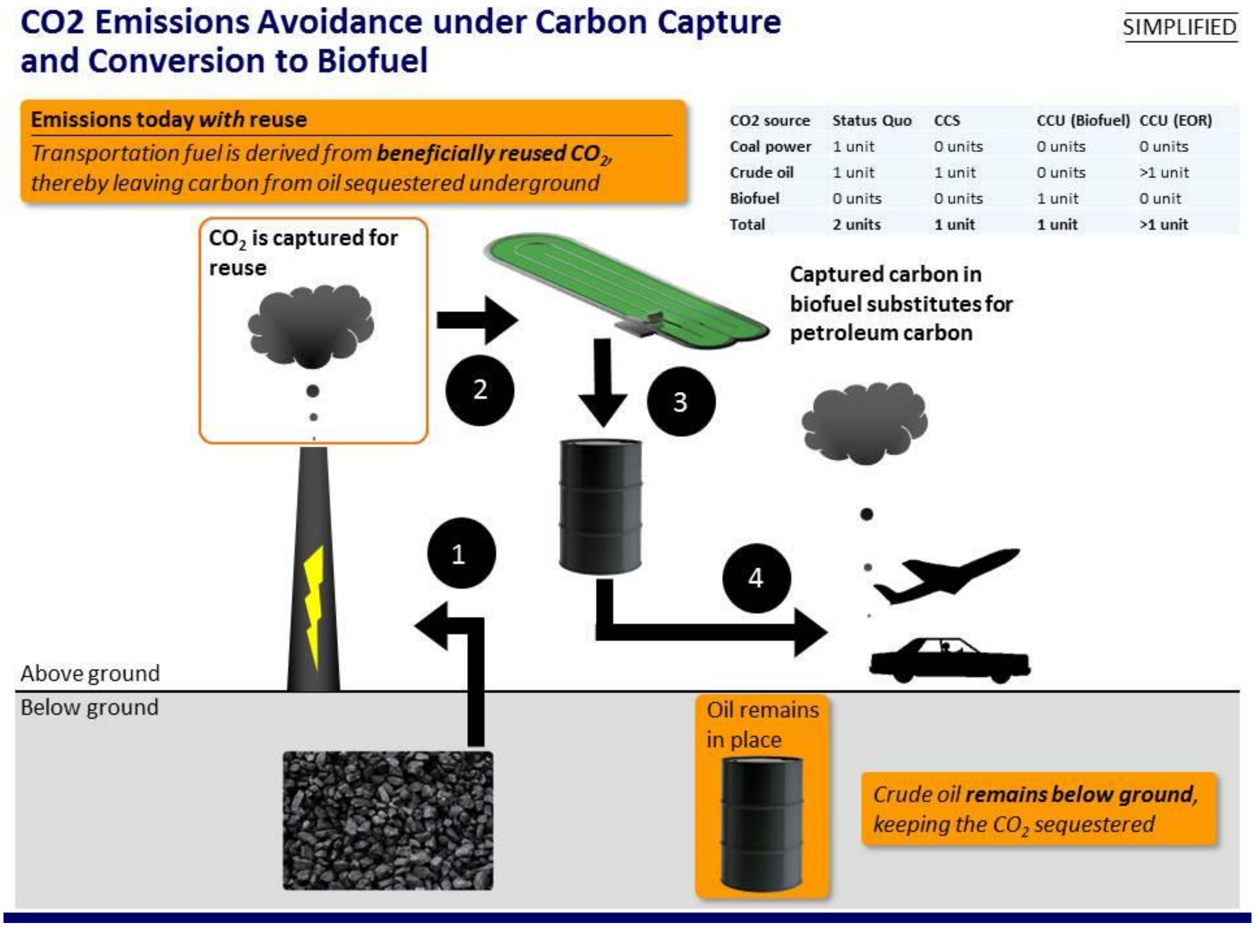

Figure 1 - Schematic of CO_2 reductions from carbon capture and conversion to biofuel [Adapted from Sapphire Energy]

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33 http://www.accelergy.com/technology_cbtl.html

34 e.g. http://www.slideshare.net/asku92/production-of-biofertilizeranabaena-and-nostoc-using-co2

In this way, carbon capture and conversion to biofuel achieves CO_2 emissions reductions comparable to CCS and is a preferred option to reuse for EOR, which by definition increases fossil carbon extraction and subsequent combustion.

A peer reviewed analysis published this year by scientists at the Georgia Institute of Technology provides the first direct comparison of CO_2 reductions achieved using algae-based CCU versus application of CCS for the same power generation facility.[35] The study is attached as **Appendix F**. The analysis found that algae-based CCU results in a greatly advantaged carbon footprint relative to business as usual, and emissions similar to CCS, even when subsequent biofuel combustion is included. *For biofuels produced with lifecycle emissions reductions greater than 75 percent relative to petroleum, CCU is advantaged with respect to CCS.*

a. Permanence

Because carbon in CCU systems is recycled and returned to the economy, quantification and verification of CO_2 reductions under CCU can be complex. EPA correctly points out in subsection VII(L)(3)(b) of its proposed New Source Performance Standard for New Power Plants ("Alternatives to Geologic Sequestration")[36] that understanding the ultimate fate of the captured CO_2 is essential to consideration of how CCU projects contribute to meeting the performance standard. EPA also correctly notes that the degree to which the method permanently isolates CO_2 from the atmosphere is an appropriate measure by which to demonstrate reductions.

[35] http://onlinelibrary.wiley.com/doi/10.1002/bbb.1505/references
[36] Standards of Performance for Greenhouse Gas Emissions From New Stantionary Sources: Electric Utility Generating Units, 79 Fed. Reg. 1430 (proposed Jan. 8, 2014)

However, EPA seems to assert that emissions reductions from CCU may only be achieved to the extent that captured CO_2 is permanently stored or isolated from the atmosphere. This interpretation of permanence is impermissibly narrow and at odds with EPA's definition of best system of emission reduction (BSER) under the proposed rule for existing sources, which does not require individual utilities to capture CO_2 emissions, but instead allows states to use a variety of controls so long as the statewide CO_2 target is achieved.

The appropriate measure of permanence is whether the constellation of actions anywhere within the electric generation and distribution system results in permanent reductions in CO_2 emissions to the atmosphere. This is the measure by which the four "building blocks" of the proposed BSER for existing sources are evaluated. Dispatching lower-emitting and zero-emitting energy sources or implementing end use energy efficiency does not permanently store or isolate emitted CO_2 from the atmosphere, but these systems do result in permanent reductions in CO_2 to the atmosphere.

Likewise, CCU systems producing biofuels achieve the stack standard by avoiding emissions of CO_2 through substitution for extraction and combustion of petroleum. These systems permanently isolate CO_2 from the atmosphere by ensuring petroleum-based carbon remains sequestered underground. This conclusion is fully supported by the recent peer-reviewed analysis in Appendix F.

In contrast, use of captured CO_2 for EOR, which is supported in the proposed rule, actually serves to increase extraction and subsequent combustion of fossil carbon. The proposed rule's explicit support of EOR without at least equal recognition of algae-based CCU places technologies with the greatest potential for CO_2 reduction at a distinct disadvantage. EPA must remedy this outcome in the final rule.

To assure compliance for CCU projects, EPA need only impose appropriate monitoring and reporting requirements, as is required of CCS projects. This approach also appropriately constrains section 111 regulation to electric generating units. Section 111 does not authorize EPA to regulate mobile sources, and it would therefore be inappropriate to attribute emissions from the combustion of CCU-derived biofuels in mobile sources to the EGU as suggested in the New Source proposal. Such attribution of emissions would be unprecedented and impermissible under Section111. Moreover, CO_2 emissions and reductions would be double-counted if CO_2 emitted by mobile sources were attributed to an affected EGU in this way, and would compromise the GHG Reporting Program[37] by double-counting CO_2 emissions and reductions.

For the wide spectrum of products other than biofuels produced through CCU, the diversity of product lifespans, alternative substitution scenarios, and end-of-life options further complicates accounting for lifecycle reductions in CO_2 emissions, but significant work has been done in this area to establish accounting standards.

The Biotechnology Industry Organization has established industry Principles for the Accounting of Biogenic Carbon in Product Carbon Footprint (PCF) Standards,[38] which are applicable to products derived from biological conversion of captured CO_2. The USDA BioPreferred Program established under the 2002 Farm Bill, has required lifecycle assessments of participating bioabsed products for more than a decade.[39] The

[37] 74 FR 56260 (published October 30, 2009)
[38] https://www.bio.org/sites/default/files/Position_Carbon_Footprint_PCF.pdf
[39] http://www.biopreferred.gov/BioPreferred/

program earlier this year released a comprehensive evaluation of the impact of biobased products on the economy and the environment.[40] The report cites a recent meta analysis of 44 lifecycle assessment studies of biobased products, which found that one metric ton of biobased materials saves, relative to conventional materials, 3 ± 1 ton of CO_2 equivalent in greenhouse gases.[41]

The USDA report also notes that several leading industry sustainability initiatives, including The Sustainability Consortium, the Sustainable Apparel Coalition, and the Bioplastic Feedstock Alliance, have employed lifecycle analysis to assess GHG reductions from substitution of biobased materials. Coca-Cola's use of PlantBottle™ packaging, for example, eliminated almost 30,000 metric tons of CO_2 in its limited roll out of the new biobased material in 2010.[42]

While the lifecycle methodology for biobased products continues to evolve, it is clear that sufficient evidence of CO_2 reductions exists now to justify inclusion of materials produced through biological conversion of captured CO_2 under the proposed rule, alongside biofuels. Clear guidance should be provided to states that use of carbon captured from regulated facilities for production of biofuels and other bio-derived products is an approved mitigation strategy.

ABO strongly opposes the assertion in the proposed rule for New Sources that "alternatives to geologic sequestration could not be used until the EPA finalizes a mechanism to demonstrate that a non-CCS technology would result in permanent

[40] http://www.biopreferred.gov/BPResources/files/WhyBiobased.pdf
[41] http://onlinelibrary.wiley.com/doi/10.1111/j.1530-9290.2012.00468.x/abstract
[42] http://www.coca-colacompany.com/stories/plantbottle-benefits

storage of CO_2."[43] EPA can and should make clear in both the New Source and Existing Source rules that CCU is an approved compliance option. Clear articulation of monitoring and reporting requirements for such projects will ensure that the standard achieves its objectives.

b. Monitoring and Reporting

To ensure compliance with the proposed standard and public confidence in CCU as a GHG mitigation strategy, EPA should include in the final rule adequate monitoring and reporting requirements for CCU projects. Section 111, together with Section 504(b), 42 U.S.C. § 7661c(b), authorize EPA to adopt the monitoring and reporting requirements necessary to ensure compliance with existing source performance standards. For example, EPA could set general criteria and require affected EGUs to submit a Monitoring, Reporting and Verification Plan (MRV Plan) for EPA's approval on a case-by-case basis, similar to MRV Plans prepared by entities undertaking geologic sequestration pursuant to 40 C.F.R. § 98.448 subpart RR. This approach would ensure that affected EGUs remain fully responsible for achieving emissions reductions.

c. Regulation of Downstream Recipients

As appropriately recognized in EPA's proposed new source rule,[44] EPA should restrict its regulation under the proposed existing source rule to fossil-fired EGUs. Nothing in the rule should involve regulation of any downstream recipients of captured CO_2. Appropriate monitoring and reporting requirements as proposed in the preceding

[43] 79 FR 1430 at subsection VII(L)(3)(b)
[44] 79 FR 1430 at subsection VII(L)(3)(a)

section will ensure that affected EGUs remain responsible for the proper disposition of CO_2 after it is captured, and EPA has ample authority to establish such monitoring requirements under Section 111.

d. Additionality

Some observers have correctly observed that there exists a risk that carbon reductions from CCU projects could be double counted if both the EGU and downstream recipients of captured CO_2 claim reductions. ABO agrees that accounting of CO_2 reductions for CCU projects must be done in a manner that avoids double counting of reductions resulting from CO_2 uptake and ensures additionality. However, there currently exist no federal programs under which downstream recipients of captured CO_2 may claim specific reductions. The federal Renewable Fuel Standard (RFS) does include standards for lifecycle GHG reductions of qualifying fuels, but only for the purposes of generation of Renewable Identification Numbers (RIN) and subsequent demonstration of compliance with renewable fuel blending requirements.[45] Renewable fuels produced from captured CO_2 that meet RFS requirements for RIN generation rightly qualify for the program, but do not receive specific credit under the program for CO_2 reductions. Thus, there is currently no threat that reductions credited under the proposed rule will receive duplicate credit under another Clean Air Act program.

Under economy-wide CO_2 regulations, such as those proposed in 2009 under H.R. 2454, the *American Clean Energy and Security Act of 2009*, appropriate measures

[45] 42 U.S.C. § 7545(o)

would be required to prevent double counting. Industry and the environmental community worked together to include language in H.R. 2454 to establish a simple methodology to prevent double counting.[46] A similar approach could be adopted administratively by EPA should downstream CO_2 recipients be subsequently regulated under future EPA action, such as under a federal Low Carbon Fuel Standard.

IV. Level Playing Field and Pollution Prevention Hierarchy

We understand that the proposed rule does not mandate any single method for meeting the CO_2 reduction targets. It does, however, include a discussion of CCS as a method that states can use to meet its target. "*The implementation of partial CCS may be a viable GHG mitigation option at some facilities, and as a result, emission reductions achieved through use of the technology could be used to help meet the emission performance level required under a state plan*."[47] The preamble also specifically asks for the public to comment on the application of CCS for existing utilities but makes no mention of utilization, and Chapter 7 of the Greenhouse Gas Abatement Measures Technical Support Document provides extensive consideration of available CCS technologies, but no such similar analysis for CCU.

We are concerned and believe that EPA is missing an important opportunity by failing to recognize CO_2 utilization as a method that states can use to meet their targets. We are concerned the proposed rule's silence on CO_2 utilization will effectively discourage states from including utilization in their state plans, thereby slowing progress

[46] H.R. 2454, Section 722(b)(9)
[47] 79 FR at 34876

in development of a technology platform with great potential for monetizing CO_2 and reducing atmospheric CO_2 in a productive way.

By referencing CCS and not CCU the proposal also adopts a preference for the disposal of CO_2 over its reuse. This violates the well established waste management hierarchy set forth in the Pollution Prevention Act (P2 Act),[48] which prioritizes prevention, reduction and recycling of waste over treatment or disposal. In light of the technical feasibility and commercial availability of carbon utilization technologies, the proposed rule should encourage the utilization of CO_2 as a preferred alternative to sequestration.

V. Promotion of Technology

In its proposal, EPA correctly observes that standards of performance should "encourage technological development that is important to achieving further emission reductions."[49] ABO agrees the promotion of technology is an important criterion in the process EPA is directed to use in establishing performance standards under Section 111 of the CAA. Unfortunately, the proposed rule as written risks diminishing investment in, and development of, algae-based and other CCU technologies with the greatest potential to reduce emissions from existing fossil-powered EGUs.

Carbon capture and utilization is critically important not only in the U.S., but is vital to reducing the impact of the rapid deployment of fossil-powered EGUs in China and other developing nations. Without strong options for conversion and use of CO_2 from these facilities, global GHG emissions will continue to increase unabated.

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[48] 42 U.S.C. § 13101.
[49] 79 Fed. Reg. at 34852

Carbon capture and utilization is also essential to realizing further emissions reductions in the future. To begin drawing down atmospheric carbon stocks will require advances in both carbon capture and carbon utilization technologies. Only through a combination of zero-carbon energy generation and application of CCU to other point sources – as well as capture and conversion of ambient CO_2 – can the planet's governments hope to stabilize global climate. EPA should ensure that the proposed rule provides the greatest possible encouragement for these vital technologies.

VI. Job Creation and Stakeholder Support

In addition to benefitting ratepayers directly by offsetting the cost of compliance for fossil-fired EGUs, broad deployment of CCU has the potential to provide substantial additional benefits to the economy through job creation. Currently the algae sector employs, directly and indirectly, more than 10,000 workers at approximately 100 companies, as well as at academic and government research projects around the country, and many suppliers of specialized equipment and services.[50] This number will grow exponentially as the industry successfully moves from research and development to deployment.

ABO estimates that once algae fuel production reaches full commercial scale the industry could support approximately 100,000 direct jobs. This figure does not include indirect job-creation, such as those positions related to infrastructure construction, transportation and shipping, marketing, and other key positions along the value chain. If one includes these ancillary jobs, the industry is expected to create over 200,000 jobs

[50] http://allaboutalgae.com/jobs/

that will be steady and high-paying, requiring workers spanning across a wide variety of educational backgrounds and skills.[51] The ABO Algae Project Book [Appendix C] outlines current and projected jobs associated with several of the leading algae projects.

The potential for economic benefits from algae-based CCU is reflected by the strong public support already shown for inclusion of CCU in the final rule. ABO's "We the People" White House petition garnered 348 signatures from CCU supporters across 45 states and in 215 cities. A list of petition signatories is attached as **Appendix G**. On October 24, House Algae Caucus chairman Rep. Scott Peters (D-CA52) also wrote to the EPA Administrator, requesting EPA clarify inclusion of CCU in the Clean Power Plan [see **Appendix H**]. ABO understands that more than 100 other letters have been submitted to EPA in support of inclusion of CCU from a broad spectrum of stakeholders, including algae industry employees, local communities that stand to benefit from CCU projects, and other partners in the value chain. Given this broad support, we urge EPA to explicitly include CCU in its final rule.

VII. Conclusion

In these comments, we have demonstrated that algae-based CCU is adequately demonstrated and technically feasible. It can be implemented at reasonable cost, provide meaningful emission reductions, and its inclusion in the Clean Power Plan will serve to promote further development and deployment of a broad set of carbon capture and conversion technologies. We have shown that, by creating a market for captured carbon, CCU can mitigate, offset, or negate the cost of carbon capture, providing a CO2

[51] ibid

reduction mechanism that minimizes the cost to ratepayers. We have outlined the opportunity, sustainability and scalability of CCU technologies, and detailed that emissions reductions from CCU projects are verifiable, quantifiable, permanent and additional, and that EPA has the authority and necessary monitoring and reporting analogs to ensure the standard's emissions objectives are met. And we have shown the outstanding jobs potential and broad stakeholder support for CCU.

ABO therefore respectfully requests that EPA include clear language in the final rule indicating that carbon capture and utilization is an acceptable component in state emissions reduction plans. Such affirmative recognition would provide states and sources of private capital with the confidence to invest in this highly promising CO_2 solution while helping to create a market for CO_2 that reduces the cost of compliance and benefits the U.S. economy. Thank you for your consideration of these remarks.