

## Chapter 6: Policy and Regulation

### Characterization of Industry Standards

*Convener: Lieve Laurens*

#### Discussion:

In framing this discussion, it is important to answer:

- What are the components that are the most important to measure?
- What are the terminology differences?
- Can there be one central place to explore published methods?
- How do we get researchers to accept these standard measurements?
- What standards already exist, and which are applicable to this field?

Characterization research needs:

- Fuel perspective carbon/mass balance, where does the carbon go?
- Temporal yields
- Inorganic elements
- Biopolymer profiling
- Standardizing extraction components/reference standards
  - For biomass
  - For oils
  - The National Institute of Standards and Technology (NIST) is not involved in this area yet
- Co-product processing, identification, profiling
  - Value-added products
- Spectroscopy
- Lipids
  - What do we need to know about lipids?
  - How do we characterize lipids?
  - How do we measure extraction efficiency?
  - Efficiency and reliability
  - In-situ characterization
  - Primary characterization of an extract
  - Characterization of an oil product using American Oil Chemists' Society (AOCS) standards
  - Transition to product yield
- Applicability of existing methods – gap analysis
  - Industries might be more willing to share this information at a workshop.
  - Dry-weight measurements. Researchers may all be measuring dry weight differently. Measuring biomass can even be difficult, especially in salt water when there are different methods for washing away organic salts.

- Development of method standardization and validation. The DOE conducted a round-robin experiment where one sample was sent to different labs for analysis, and the methods for extraction varied.
- Pathway specific characterization needs/methods
  - Common basis for datasets on different unit operations – issues with IP could hold back industry, but investors would appreciate a standard method.
  - Different methods will require different analyses (could be in the form of a matrix of fuel production process specific biomass specification needs).
  - Broad-based methods and specific methods.

### **Guiding Questions:**

1. What is the time horizon for this topic or issue; will this impact algal biofuel production in the near, mid, or long term?
  - Near term, < 5 years
2. Has this topic been included in the National Algal Biofuel Technology Roadmap; and if not, should it be?
  - This issue is not mentioned in the Algae Roadmap, and it should be.
3. What is the BETO Algae Program role in furthering this topic or addressing this issue?
  - Support the creation of a central location where people can find the locations of these methods – maybe a website with links to standardized methods.
  - Determine the impacts of measurement uncertainty and propagation of error.
  - Support consensus building. DOE could require certain methods be used by their funded research through FOAs and contract vehicles. This would not necessarily exclude other methods, just require minimum methods.
  - Conduct a round-robin research approach; sending one sample to different labs for characterization and analysis.
  - Identify reference standards, coordinate with NIST (NIST standards are already used to test some instruments, prior to biomass testing) and possibly AOCS, as proactive facilitator.
  - Provide regulators with data-sets.
  - DOE can communicate product quality certification/validation and require it in their funded products.

**Poster:**

Research Needs:

1. Standard methods for product/biomass characterization
  - Trade
  - Upgrading
  - Near-term (<5 years)
  - Not in Roadmap
2. Gap analysis and workshop
3. Reference standards
  - Oil
  - Biomass
  - Industry
4. Pathway-specific
5. Co-products
  - Protein (feed)
  - Carbohydrates
  - High value (W-3, pigments)
  - Biopolymers
6. Carbon balance to products

## CO<sub>2</sub> Issues and Opportunities in Algal Biomass

Convener: Albert Vitale

### Discussion:

There were a number of topics to cover based on the initial workshop agenda setting session:

- CO<sub>2</sub> transport and resource potential
- Optimizing CO<sub>2</sub> delivery and eliminating wasted CO<sub>2</sub>
- CO<sub>2</sub> economic optimization
  - Delivery of CO<sub>2</sub> into systems
- CO<sub>2</sub> cost and availability at full scale
- Co-location of production with CO<sub>2</sub> sources
- Carbon capture and sequestration (CCS)/ Carbon capture and use (CCU)
  - Capture, sourcing, and reuse
- Alternative forms of inorganic carbon
  - Specify: Not discussing CO<sub>2</sub> so much as dissolved inorganic carbon
- Discuss role of EERE and National Energy Technology Laboratory (NETL) in the algae concepts
  - Get NETL involved in future in this discussion because they are involved in CO<sub>2</sub> sequestration

### Topics:

- CO<sub>2</sub> transport resource potential, CO<sub>2</sub> cost and availability at fuel scale, co-location production with CO<sub>2</sub> sources.
  - The industry needs to refine their understanding of the cost of transporting CO<sub>2</sub>.
    - For an algae production facility to be co-located with a CO<sub>2</sub> source, they must be within 3 miles of each other according to current understanding.
    - CO<sub>2</sub> distribution networks are needed.
  - Joint enhanced oil recovery/algae opportunities could expand the pipeline network supported by DOE.
    - DOE can support pipeline siting.
    - DOE must determine who is going to use it and who is going to benefit.
      - CO<sub>2</sub> producers and algae producers will benefit, pending EPA rulemaking.
    - Incorporation of enhanced oil recovery in the algae pitch to the EPA tarnishes the algae pitch.
- CO<sub>2</sub> quality
  - Heavy metals need to be cleaned from reused CO<sub>2</sub> sources, but this will make recovered CO<sub>2</sub> more expensive.
  - What can be put into pipelines is regulated.
  - Flue gases are less expensive; the industry needs to learn how to use them.
- The industry should keep electric fuels representatives at the table when making decisions to help the process.
- Transport of CO<sub>2</sub> needs to be included in the LCA.

## Guiding Questions:

1. What is the time horizon for this topic or issue; will this impact algal biofuel production in the near, mid, or long term?
  - Near, medium, and distant. There needs to be an immediate response to the EPA rulemaking on carbon sequestration, which excludes reuse, and therefore, could hinder the algal biofuels commercial viability.
2. Has this topic been included in the National Algal Biofuel Technology Roadmap; and if not, should it be?
  - CO<sub>2</sub> is not sufficiently included in the Algae Roadmap, and needs to be.
3. What is the BETO Algae Program role in furthering this topic or addressing this issue?
  - BETO needs to draw in NETL to iron out the CCS issues.
    - Establish lab/cross-lab research on CCS.
    - There should be a DOE Roadmap on carbon, not just a BETO Roadmap.
    - DOE needs to address the current EPA rulemaking regarding new and existing performance standards in regards to what is acceptable as CCS. Displacement of fossil fuels should be counted as sequestration. However, the Clean Air Act does not clarify. EPA may not understand this, and the issue needs to be clarified to them. BETO should create the metrics so that the EPA policy makes sense. GREET can be used to influence the policy so it accounts for something like fossil displacement as part of carbon accounting.
    - DOE needs to go to EPA to make clear the value of algae as a CO<sub>2</sub> mitigation strategy, and methods of beneficial carbon reuse as a pathway for GHG compliance and an addition to CCS.
      - Near-term action: The EPA Notice of Proposed Rule Making is out, 60 days are left.
      - The EPA does not want to list an alternative to CCS.
      - Technical memo from DOE to communicate to EPA the impact and inform of the impact/benefit of algae as a GHG mitigation tool is necessary.
        - Based on the quick turnaround time, the memo should reference Algenol and Sapphire LCAs rather than create a new LCA.
        - The memo needs to emphasize that the process is technically and economically feasible for EPA to consider the information, and that this technology will occur in a reasonable time horizon (immediate-term).
        - The DOE should “Work with industry to produce technical memos to communicate to EPA and inform them of the impact/benefit of algae as a GHG mitigation tool that is both technically and economically feasible in the immediate term.”

## Poster:

### Main Topics

- CO<sub>2</sub> Collection, transport, delivery, and economics
- Optimizing CO<sub>2</sub> delivery and economics at a national scale (inside battery limits /outside battery limits)
- Capture, reuse, and sequestration with DOE and EPA coordination/input
- Identifying alternative inorganic sources
- Immediate need to engage all critical stakeholders within the Federal system

Work with industry to produce technical memos to communicate to EPA the impact/benefit of algae as a GHG mitigation tool that is both technically and economically feasible in the immediate-term.

## Opportunities for Industry and Academia Collaboration

*Convener: Bill Henley*

### **Discussion:**

Where is the funding for ideas for research that are not quite at the pilot scale, but are wanting to get beyond bench scale? These ideas are often too applied for National Science Foundation grants; algae has not been considered a crop yet so can't easily get USDA funding; and not scaled up enough for DOE; so where is the place for this research? NETL unsolicited proposals are too much work to apply for when the rate of award is so low. This type of research was the most productive working under the NAABB consortium.

DOE needs to provide more funding for basic research that impacts the field by increasing awards to academia rather than only the National Labs. Academia has the added benefit of providing young people to the field for the future of the industry.

DOE must select funding recipients in support of its mission, so is it an effective strategy to encourage collaboration in FOAs to further basic research, or does it need separate allocation? The FOA process is too complicated to make small awards focused on only basic research, even though these lower-cost projects may have significant impacts.

How can DOE facilitate connecting basic academic R&D work with industries? Having a private company partner with a University, like LightWorks, can help. These partnerships are largely funded at the state level.

If the issue with using a FOA mechanism is the size of the grant, the DOE could consider a \$5M proposal call once a year focused on supporting academic and small business groups in basic research. This would add stability to the research field. Awardees could potentially assemble teams to find paths for implementation rather than operating independently. This coordination could also include National Laboratories, rather than just industry. The academic system could provide highly educated personnel with very specialized skill sets to labs. The number of phycologists in the country is dwindling because they are having difficulty getting academic funding.

An issue with coordinating academic relationships with corporations (such as via internships/post-docs) is the closely-guarded proprietary information. However, the larger private algae companies have inquired about possible basic biology assistance and are unsure how to procure this talent. An idea for facilitating this collaboration is a networking website to connect partnerships; this may be a function for an industry group, such as the Algae Biomass Organization, rather than the DOE, however.

Another difficulty in competitive DOE awards for basic research is that the project management requirements include hard metrics and milestones for accomplishments, but these are difficult to apply to basic R&D.

DOE could do more workshops to increase networking, as well as include higher travel budgets within awards for this purpose.

### **Guiding Questions:**

1. What is the time horizon for this topic or issue; will this impact algal biofuel production in the near, mid, or long term?
  - This is an immediate need or else there will be a dearth of specialists in this field due to lack of academic funding.
2. Has this topic been included in the National Algal Biofuel Technology Roadmap; and if not, should it be?
  - This is not explicitly in the Roadmap, but it may not need to be covered in the R&D strategy.
3. What is the BETO Algae Program role in furthering this topic or addressing this issue?
  - The DOE should make an effort to better foster relationships among academia and industry/national labs and should attempt to dedicate some basic R&D funding to academia rather than solely to national labs.

### **Poster:**

The DOE should make an effort to better foster relationships among academia and industry/national labs and should attempt to dedicate some basic R&D funding to academia rather than solely to national labs.

Core National Laboratory – academic partnership mechanism (supplemental funds?)

Satellite Workshops at conferences

Personnel training

## DOE Regulation, Policy, Financing

*Convener: Jacques Beaudry-Losique*

### **Discussion:**

This discussion hopes to define DOE's role in regulation, policy, and financing. With the DOE algae budget stuck under \$50M per year and stakeholders growing towards commercialization, what should be the new DOE role? Should the DOE be doing more for commercialization?

It appears that grant funds are not going to be as common, so what are potential funding options other than grant funding? There does not seem to be a good way for researchers (i.e. labs, academics) to line up an industrial partner to procure a cost share. Researchers need a way to easily partner with industry.

Regulatory barriers to advanced biofuels are difficult for stakeholders to overcome; how can DOE help stakeholders navigate the process? DOE can provide a template that helps with standardization for all relationships among industry, academia, and labs.

What are the DOE's priorities? The DOE should be more proactive in policy conversations. The EPA said that no other government agencies participated in recent rulemaking on carbon emissions.

Algae stakeholders want equal funding in line with cellulosic feedstocks funding and believe they can provide a product today, especially when looking at algae from a carbon component. The DOE does not make this focus a priority. The DOE should support the classification of algae as a crop with USDA so that it will be eligible for crop insurance. In addition, the DOE should increase engagement with DOD. From an outside perspective, people do not have a clear understanding of why DOE is not participating in the DOD program.

There is currently an inherent market risk due to there being only six years left in the Renewable Fuel Standard (RFS) requirements. Lowering the RFS requirements or extending the date will be vital, otherwise the industry will reset at that time. Stakeholders do not feel that DOE is supporting algae. The changeover in management was a reoccurring discussion.

### **Guiding Questions:**

1. What is the time horizon for this topic or issue; will this impact algal biofuel production in the near, mid, or long term?
  - Algae funding parity has a mid to long-term impact, but DOE needs near-term funding to have a mid-term impact. Stakeholders would like a sustained level of funding for research and demonstration to support algae.
2. What is the BETO Algae Program role in furthering this topic or addressing this issue?
  - Stakeholders would like an opportunity to communicate the current state of technology and the improved economics, even if it is not part of an award scope. Technology is changing so quickly and these changes are not getting captured.

DOE might benefit from a quarterly meeting to discuss state of the art while maintaining confidence that IP won't be exposed, incorporating closed-section reviews with non-disclosure agreements. Stakeholders want to share their techno economic models.

- Standardized approaches to partnerships/agreements will help improve partnerships.
- DOE could help to inform standard regulation, such as basing policy at the fuel molecule rather than feedstock (functional equivalence). Aviation fuel is not an attractive option because the minimal margin and investment in certification. Diesel presents a more reliable market and better margin. It would be advantageous for industry to agree on a process for fuel certification so certification occurs once.
- Industry would like an opportunity for engagement with cross-agency steering committees. DOE could improve the effectiveness of cross-agency steering committees.
- DOE should be using the PNNL geospatial/resource analysis to communicate and put the old arguments to rest. DOE could be educating non-governmental organizations (NGOs) about the state of art in the algae industry.

#### **Poster:**

1. Algae Parity Funding
  - Sustainable level of funding commensurate with roadmap requirements
  - Independent status in quad review
  - Provide industry closed sessions with reviewers
2. Facilitate Industry Research Partnerships
  - Commercialization focus
  - Standardized approach to lab collaborations
3. DOE Role in helping cost fuel certification process
  - a. Replicate CAAFI for land based fuels
  - b. Fund CAAFI
  - c. Provide input to streamline ASTM certification process
4. DOE engagement with EPA/DOD/USDA
  - a. Improve effectiveness of cross-agency steering mechanisms
  - b. Industry engagement
  - c. Revive Biomass R&D board
  - d. Have 2 algae participants on the Technical Advisory Committee
5. DOE funding its share of 510M DOD Fuels Program
6. DOE to engage NGOs with accurate, face-based, analytical prospecting

## DOE Funding & Algae Portfolio Optimization

Conveners: Rachel Levinson; Jacques Beaudry-Losique

### Discussion:

This topic was convened because a number of participants did not understand the issues and nuances associated with how DOE funding decisions are made or affected. To ensure the participants in this session received the information on the budget process and an understanding of the competitive pressures that exist within EERE, Office of Management and Budget, House and Senate appropriations, and other federal agencies, a DOE Program Staff member was brought in at the beginning of the session to answer questions from the group. Then the participants redirected the topic discussions to identifying and addressing the key issues and realizations noted below.

Key issues and realizations:

- There appears to be a fundamental lack of support for algae in DOE Management (above the Program Level).
- Modest funding has accomplished significant results, but those results have not been appropriately packaged and communicated to the general public and critical decision makers.
- While topically relevant, the existing roadmap was produced roughly 5 years ago and is somewhat outdated. Furthermore, it does not provide a clear vision for the future of the DOE algal biofuels efforts; it does not establish concise rally points that will guide stakeholders and decision makers into the future.
- To ensure robust future funding for Algae activities, Program advocates and champions need to be identified, engaged, and educated on the importance of the algae value chain and the near-, mid-, and long-term opportunities to contribute to the national effort to increase biofuel production, reduce greenhouse gases, spur domestic job creation, and ensure increased economic activity.

Next steps:

- DOE must initiate an effort to gather, communicate, and highlight up the DOE management chain, the successes achieved in the Algae Program (and affiliated industry, laboratory, and academia participants) to ensure that decision makers see the value, and risk/reward potential of the activities in the BETO portfolio.
- Algae industry CEOs and allied trade organizations need to organize and secure meetings with key decision makers to advocate for their interests.
- DOE should work with industry to develop a clear vision for the future of the DOE algal biofuels efforts. The development of a cascading Vision, Mission, Goals, Targets, Objectives, and Milestones could provide a comprehensive path forward; critical aspects that are not part of the BETO Multiyear Program Plan (MYPP)<sup>8</sup> planning effort could

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<sup>8</sup> *Bioenergy Technologies Office Multi-Year Program Plan*. DOE/EE-0915. Washington, DC: U.S. Department of Energy, 2013. [bioenergy.energy.gov/pdfs/mypp\\_may\\_2013.pdf](http://bioenergy.energy.gov/pdfs/mypp_may_2013.pdf)

perhaps be added, or captured as part of a higher-level document that is updated less regularly than the MYPP (perhaps on a 3-4 year cycle).

- DOE should develop a funding strategy that crosswalks research, development, and deployment needs in Algae pathways and ensures that portfolio funding is commensurate with the vision and appropriately balanced with other BETO critical funding needs.

### **Guiding Questions:**

1. What is the time horizon for this topic or issue; will this impact algal biofuel production in the near, mid, or long term?
  - The timeline for initiating these “next step” activities are in the immediate near term. Most of the aspects of this topic, the key realizations, and next steps, need to be included in cyclic management processes, they are not “one and done” activities.
2. Has this topic been included in the National Algal Biofuel Technology Roadmap; and if not, should it be?
  - It was the opinion of this group that the current Roadmap document is outdated and insufficient to communicate a clear path forward for broad scale algae biofuel commercialization.
3. What is the BETO Algae Program role in furthering this topic or addressing this issue?
  - The Algae Program could look to incorporate “Pond to Pump” or “Pond to Tank” demonstration projects requiring vertically integrated collaborative teams that would bring together algal crop production, upstream and downstream processing, end-use vehicle fleets to ensure that all Pond to Pump/Tank system issues can be resolved and lessons learned applied to next generation integrated systems.