

**FINANCIAL ASSISTANCE
REQUEST FOR INFORMATION**



**U.S. Department of Energy
Golden Field Office**

Enhanced Algal Biofuel Intermediate Yields (EABIY)

Request For Information: DE-FOA-0000745

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Responses Submitted to: eabiy@go.doe.gov

**Enhanced Algal Biofuel Intermediate Yields (EABIY)
Request for Information (RFI)
DE-FOA-0000745**

Program Manager / Area: Valerie Reed, Acting Program Manager, Office of Biomass Program (OBP), Energy Efficiency and Renewable Energy (EERE), U.S. Department of Energy (DOE)

Information Requested On: Development of algae production and downstream processing technology to enhance the yield of algal biofuel intermediate products.

Background: Advanced biofuels play an increasingly important role in meeting the volumetric mandates of the Renewable Fuels Standard (RFS2) of the Energy Independence and Security Act of 2007 (EISA), reaching at least 21 billion gallons per year (BGY) in 2022. Fuels derived from algal biomass qualify as advanced biofuels and have the potential to contribute significantly to the pool of advanced biofuels, alongside fuels derived from terrestrial biomass. While algal biofuels have tremendous potential, no commercial entity today can yet produce algal biofuels at a cost that is competitive with other advanced biofuels.

The Office of the Biomass Program (OBP) considers “biofuel intermediates” to be biomass-based products that can be treated as commodities and passed from a producer to a refiner through the supply chain, being finished as a biofuel. In the case of algae, an intermediate would be the end result of cultivation, concentration, and pre-processing of the algal biomass into a feedstock for the refining process. In the 2012 integrated algae baseline¹, low intermediate biomass yields are identified as a key driver of the high cost of algal biofuels because of the high capital investment projected as necessary to achieve commercial-scale volumes of biofuel. Increased yields would both decrease the total amount of capital needed, and better utilize capital investment. To address the technical barriers associated with algal biofuel’s high capital costs, OBP will propose technical targets in its Multi-Year Program Plan that, if achieved, would help overcome the barriers. The technical targets are intended to support meeting milestones for algae productivity in commercially relevant outdoor production environments, and for reductions in processing costs from the 2012 baseline.

Purpose and Need for Information: The purpose of this request for information (RFI) is solely to solicit input for DOE consideration in the development of future algal biofuels research, development, and deployment (RD&D) programs. Information obtained in response to this RFI will be used by DOE on a non-attribution basis. Although DOE may determine as the result of this RFI to issue a formal Funding Opportunity Announcement (FOA), there is no guarantee that future funding opportunities or other activities will be undertaken as a result of this RFI.

This RFI provides algae stakeholders with an opportunity to contribute their views to help inform the development of OBP’s strategic plans, requirements, and metrics for a potential research and development (R&D) program focused on enhancing the yield of algal biofuel intermediates. DOE is interested in stakeholders’ input regarding multiple types of algae, including microalgae,

¹ <http://www.nrel.gov/docs/fy12osti/55431.pdf>

cyanobacteria, and macroalgae. Specifically, the OBP requests information from algal biofuel developers to help establish appropriate scope, scale, and metrics for consideration in developing two topics: 1.) Reductions in Downstream Processing Costs; and 2.) Improved Algal Biomass Productivity.

RFI Guidelines: DOE will not pay for information provided under this RFI and DOE will not provide reimbursement for costs incurred in responding to this RFI. This RFI **DOES NOT** constitute a solicitation for proposals, **IS NOT** a FOA, and DOE **IS NOT** accepting applications for financial assistance or financial incentives under this RFI. Responses to the RFI will be treated as informational only and will not be viewed as a binding commitment for the respondent to develop or pursue the project or ideas discussed. DOE **MAY** decide at a later date to issue a FOA based on consideration of the input received from this RFI, but there is no guarantee that future funding opportunities or other activities will be undertaken as a result of this RFI.

Because information received in response to this RFI may be used to structure future FOAs and/or otherwise be made available to the public, respondents are strongly advised to **NOT** include any information in their responses that might be considered business sensitive, proprietary, or otherwise confidential. If, however, a respondent chooses to submit business sensitive, proprietary, or otherwise confidential information, it must be clearly and conspicuously marked as such in the response.

In order to avoid any possible conflict with future funding opportunities, DOE will not respond to any respondent questions or contacts received after the closure of the submission period for this RFI. DOE thanks you for your assistance and input.

RFI Response Instructions:

Response to this RFI should be submitted in Microsoft Word or PDF format to ecbiy@go.doe.gov by **8:00 PM Eastern Standard Time on August 1, 2012.**

DOE prefers that responses to this RFI be **no more than 5 pages**, with 1 inch margins and 12 point font. Please indicate the question being addressed (e.g., A.1. or B.2.). Questions regarding the content of this RFI must be submitted to the email address provided above.

Respondents are requested to include the following information in their responses to this RFI: Company/institutional name; individual contact (mailing address, phone number, e-mail address); facility location(s) (zip code); and area of expertise/interest.

OBP recognizes that all listed questions may not be applicable to all respondents, and respondents may provide responses to all or a portion of the RFI questions. OBP requests that respondents focus only on the questions for which they can provide concise, quantifiable information. OBP is interested in responses that address one or more of the following topics:

A. Reductions in Downstream Processing Costs: The overall goal of this topic is to achieve a target of 40% reduction in the modeled CAPEX and OPEX costs for downstream processes for harvesting and extraction from the 2012 baseline. Conceptually, OBP uses the term downstream processes here to refer to unit operations outside but co-located with the cultivation system that

may serve to harvest, concentrate, and process algae in preparation for conversion to biofuel. OBP is interested to hear from stakeholders on what work is needed to support meeting this goal. Specifically, the OBP seeks information (data, metrics, and processes) on algal biofuel technologies, and input on the role of DOE in increasing algal biofuel yields.

1. If this is not the most relevant goal for overall downstream processing, what is?
2. While processing algae for biofuel, what information on unit performance and integration do you gather? How well does it inform modeled and scaled-up CAPEX and OPEX costs? What type and scale of research is needed to meet the target?
 - a. Do you think that a downstream technology provider needs to cultivate their own feedstock or are there effective and adequate mechanisms to partner with algae producers?
 - b. Does research need to be integrated with cultivation and conversion to be valuable?
 - c. If research is not integrated, how can it be informative?
3. How long is your suggested period of performance to achieve the goal?
4. Are novel downstream unit operations (dewatering, harvesting, extraction) needed to make significant cost reductions in CAPEX and OPEX or can existing technologies be improved and scaled up?
5. What volumes of feedstock need to be processed and for what durations to yield meaningful data?
6. How tolerant is your process to heterogeneous feedstocks?
7. How robust are the pieces of equipment that you use? How far are current lifespans from what is needed?
8. What are the barriers to effective downstream processing? What are the showstoppers?
9. How do co-products and recycle streams fit in your overall process?
10. What metrics should DOE use to inform progress towards meeting the overall goal? (e.g. parasitic energy loss; operating costs; capital costs; input feedstock characteristics; volumetric throughput; online time; feedstock to fuel efficiency).
11. What role can the recently established DOE funded algae test beds (to be funded from the ASAP DE-FOA-0000615) play in meeting the goal?
12. What are we not asking but should be?

B. Improved Algal Biomass Productivity: The overall goal of this topic is to support development of algae strains and cultivation techniques that allow for the achievement of a target annual average algal biomass productivity of 35 grams per meter squared per day of ash free dry weight ($35 \text{ g m}^{-2} \text{ d}^{-1}$ AFDW) in outdoor cultivation environments relevant to commercial scales. OBP is interested to hear from stakeholders on what work is needed to support meeting this goal and when, if at all, this goal may be met. Specifically, OBP seeks information (data, metrics, and processes) on several questions related to algal biofuel technologies and input on the role of DOE in increasing algal biofuel yields.

1. If this is not the most relevant goal for algal productivity, what is?
2. While cultivating algae for biofuel, what productivities have you achieved? At what scale, duration, and reliability? What types of research do you see as needed to increase productivity?

3. How long is your suggested period of performance to achieve the productivity goal?
4. Lab-scale work is ongoing nationwide to improve algal biology for increased biofuel yields:
 - a. How do you think continued lab-scale work can support meeting the DOE target productivity? What is specifically needed (e.g. strain screening, mutagenesis, directed evolution/breeding, genetic modifications, etc.)? What specifically is not needed?
 - b. In your experience, how do lab successes translate to outdoor production environments?
 - c. How reproducible are your results?
5. What scale of outdoor cultivation work do you need to perform to advance your algal biofuel technology along the commercialization pathway?
 - a. If you are working at scale already, are your results predictable and or reproducible?
 - b. How big of a barrier is contamination to achieving predictable, scalable results?
 - c. What role does seasonality play?
 - d. How do well do current biophysical models predict productivity in outdoor cultivation environments?
6. What do you see as a path forward for genetically modified algae in outdoor production?
 - a. What are the barriers? What are the showstoppers?
 - b. Does your business plan (s) identify strategies to overcome GM algae barriers?
 - c. What role, if any, do you envision the DOE and the Biomass Program having in addressing the barriers?
7. What metrics should DOE use to help inform progress towards meeting the overall target? (e.g. productivity in AFDW; intermediate yield; culture and/or cell characteristics; nutrient and CO₂ utilization; culture resilience; carbon to fuel efficiency).
8. What role will the DOE funded algae test (to be funded from the ASAP DE-FOA-0000615) beds play in meeting the target?
9. What are we not asking but should be?