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Notice of Funding Opportunity

Title: FY21 Bioenergy Technologies Office (BETO) Feedstock Technologies and Algae FOA
Website: https://www.grants.gov/web/grants/view-opportunity.html?oppId=330306
Funding: Total: $35,000,000. Maximum awards: $2M-$3.5M, depending on topic.
Dates: Concept Paper Deadline: February 1, 2021
Application Submission Deadline: April 5, 2021

Summary: The U.S. Department of Energy's (DOE's) Bioenergy Technologies Office (BETO) develops technologies that convert domestic biomass and other waste resources into fuels, products, and power to enable affordable energy, economic growth, and innovation in renewable energy and chemicals production – the bioeconomy. This Funding Opportunity Announcement (FOA) will support high-impact technology research and development (R&D) to enable growth and innovation to accelerate the bioeconomy by requesting applications across BETO's mission space in Feedstock Technologies and Advanced Algal Systems. BETO focuses on applied R&D to bolster the body of scientific and engineering knowledge that can enable industry to demonstrate and deploy high-performing drop-in biofuels and renewable chemicals at $2.50 per gallon gasoline equivalent (GGE) by 2030.

Project Topic Areas:

Topic Area 1: Characterization of Municipal Solid Waste to Enable Production of Conversion-Ready Feedstocks

Municipal Solid Waste (MSW) represents a potential low-cost, abundant feedstock for producing fuels and products. The heterogeneity of MSW characteristics including chemical composition, and physical and biological properties, presents a significant challenge for utilization. The importance of any particular MSW characteristic is defined by the conversion technology specifications.

Subtopic 1a: Measurement of variability of key MSW characteristics within and across unique MSW streams

Examples of anticipated technology approaches/ innovation used to meet the goals of this subtopic include, but are not limited to: Creation of MSW resource-shed maps covering the range of values of each key characteristic and capturing geographic and/or seasonal variability; For mixed streams, characterization of the percentage of each organic fraction (e.g., paper, cardboard, wood, textiles, plastic); Characterization of the spatial and/or temporal range of MSW using: Standard approaches for chemical, biological, and physical analysis; Rheology measurement equipment; and Technology to detect, identify, and evaluate key properties (and their forms if applicable) at macro, micro, and/or molecular scales.

Subtopic 1b: Development of novel methods for rapid/real-time measurements

Examples of anticipated technology approaches/ innovation used to meet the goals of this subtopic include, but are not limited to: Novel use, adaptation, and/or integration of rapid/real-time sensor(s) including gas sensors, colorimetric sensors, and/or spectroscopy (e.g., near infrared (NIR), Raman, nuclear magnetic resonance (NMR), Fourier-transform infrared spectroscopy (FTIR)); The incorporation of artificial intelligence or other data handling/interpretation approaches/strategies/process controls; Development of novel, rapid approaches for chemical, biological, and physical analysis; Development of rapid technologies to detect and identify key properties at macro, micro, and/or molecular scales.

Topic Area 2: Algae Productivity Exceeding Expectations (APEX)

Algae are photosynthetic, carbon sequestering organisms that have the ability to grow in fresh to saturated saline water, at a broad range of pH, and in many growth configurations including open unlined ponds, enclosed photobioreactors, attached growth systems, and in the open ocean. Due to their ability to use sunlight to convert carbon dioxide (CO2) into biomass with advantageous biochemical compositions, at high areal yield, using marginal land, and with waste resources, algae are a desirable renewable

feedstock for the production of biofuels and bioproducts. However, increases in productivity per cultivation area (areal productivity) are necessary to accelerate the commercialization of algae technologies. This Topic Area seeks to support research to develop and test strain and cultivation technologies that advance the state-of-the-art for algal areal productivity, and biomass quality achievable in industrially relevant cultivation systems.

Subtopic 2a: Improvements in productivity with traditional CO2 supply
Applications to Subtopic 2a must propose improvements in productivity through strain improvements and/or cultivation improvements while utilizing traditional methods of delivering CO2 as necessary to support growth. Potential approaches to meet the goal of this subtopic include, but are not limited to, strain and cultivation improvements such as: For Strain Improvement: Directed evolution experiments that improve stress tolerance of industrially relevant strains; Strain improvement approaches such as genetic engineering to achieve target biochemical composition while maintaining high productivity to reduce overall costs of downstream processing; Breeding strategies to increase productivity of algae. For Cultivation Improvement: Physical, mechanical, chemical and biotechnological approaches to crop protection; Identification and introduction of novel bacteria or complimentary algae that confer greater stress tolerance and/or predator and pest resistance; Alteration of cultivation operations, like culturing at high salinity, to reduce contamination from pests and competition from non-production algae strains.

Subtopic 2b: Improvements in productivity with Direct Air Capture (DAC) of CO2 from ambient air
Utilizing DAC strategies while achieving high productivities poses unique challenges, such as the need to maintain alkaline culture media to drive CO2 into solution. This subtopic is intended for applicants seeking to meet the FOA objectives of improved areal productivity and biomass quality while also seeking to decouple algae growth from point or purchased sources of CO2. Potential approaches to this subtopic include, but are not limited to, strain and cultivation improvements such as: For Strain Improvement: Generate genetic engineering tools that increase the number of CO2 transporters on the cell surface; Evaluate conserved and divergent genetic and structural components of pyrenoids and using synthetic biology tools to integrate CO2 fixation improvements. Tuning the expression of central carbon metabolism enzymes to increase overall photosynthetic efficiency; Model metabolic flux under light and dark conditions to identify pathways that increase net daytime carbon assimilation and at night reduce CO2 release due to dark respiration. For Cultivation Improvement: Cultivate highly productive strains under alkaline conditions; Employ biological mechanisms or crop protection strategies to retain high levels of dissolved inorganic carbon in the culture media; Reduce loss of dissolved organic carbon by engineering algae and bacteria consortia; Model at organism and systems level, energy loss of the culture at night and changing culture operations to mitigate losses.

Funding:
EERE expects to make a total of approximately $35,000,000 of federal funding available for new awards under this FOA, subject to the availability of appropriated funds. EERE anticipates making approximately 11 to 15 awards under this FOA. EERE may issue one, multiple, or no awards. Individual awards may vary between $2,000,000 and $3,500,000. The cost share must be at least 20% of the total allowable costs for research and development projects and must come from non-federal sources unless otherwise allowed by law.

Topic Area Number	Topic Area Title	Anticipated Number of Awards	Anticipated Minimum Award Size for Any One Individual Award (Fed Share)	Anticipated Maximum Award Size for Any One Individual Award (Fed Share)	Approximate Total Federal Funding Available for All Awards	Anticipated Period of Performance (months)
1	Characterization of Municipal Solid Waste to Enable Production of Conversion-Ready Feedstocks	5-7	$2,000,000	$3,500,000	$15,000,000	24-48
2	Algae Productivity Exceeding Expectations (APEX)	6-8	$2,500,000	$3,200,000	$20,000,000	36-48

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Project Requirements:

Subtopic 1a Specific Requirements:

The following requirements must be addressed in the application and the strength of the applicant's discussion will be evaluated by the independent technical review panel for scientific merit: Specify whether the application is submitted in response to Subtopic 1a or Subtopic 1b. A single application should not be in response to both subtopics.

Topic Area 2 Specific Requirements:

The following requirements apply to both subtopics and must be addressed in the application to meet the responsiveness requirement of the FOA. The applicant is required to: specify the subtopic and improvement emphasis of the application; establish baselines on FOA targets; create a strain or cultivation improvement toolkit and shared learning; ensure cultivation-readiness; propose an R&D plan that use techno-economic analysis and a sustainability assessment; and provide verification requirements.

Subtopic 2b Specific requirements:

The following requirements apply to Subtopic 2b and must be addressed in the application to meet the responsiveness requirement of the FOA. The applicant is required to: Either (1) develop new DAC technology that is part of the algae cultivation system or the algae itself or (2) integrate existing DAC technology with the algae system and develop strategies to overcome integrated performance challenges; Include an outdoor cultivation campaign with CO2 supplied from the ambient air or a direct air capture unit.

Eligible Applicants:

The following are eligible to apply for funding as a prime recipient or subrecipient: U.S. citizens and lawful permanent residents; For-profit entities, educational institutions, and nonprofits that are incorporated (or otherwise formed) under the laws of a particular state or territory of the United States and have a physical location for business operations in the United States; State, local, and tribal government entities; and Incorporated and Unincorporated consortia, which may include domestic and/or foreign entities. Unincorporated Consortia must designate one member of the consortium to serve as the prime recipient/consortium representative and must be incorporated (or otherwise formed) under the laws of a state or territory of the United States. Foreign entities, whether for-profit or otherwise, are eligible to apply for funding under this FOA. If a foreign entity applies for funding as a prime recipient, it must designate in the Full Application a subsidiary or affiliate incorporated (or otherwise formed) under the laws of a state or territory of the United States to be the prime recipient. The Full Application must state the nature of the corporate relationship between the foreign entity and domestic subsidiary or affiliate. A foreign entity may receive funding as a subrecipient. The following are eligible to apply for funding as a subrecipient but are not eligible to apply as a prime recipient: DOE/NNSA FFRDCs; Non-DOE/NNSA FFRDCs; and Federal agencies and instrumentalities (other than DOE). Nonprofit organizations described in section 501(c)(4) of the Internal Revenue Code of 1986 that engaged in lobbying activities after December 31, 1995 are not eligible to apply for funding.