

PMC-ND

(1.08.09.13)

**U.S. DEPARTMENT OF ENERGY  
OFFICE OF ENERGY EFFICIENCY AND RENEWABLE ENERGY  
NEPA DETERMINATION**



RECIPIENT: Arizona State University

STATE: AZ

**PROJECT TITLE:** ASU's DAC Polymer-enhanced Cyanobacterial Bioproductivity (AUDACity)

<b>Funding Opportunity Announcement Number</b>	<b>Procurement Instrument Number</b>	<b>NEPA Control Number</b>	<b>CID Number</b>
DE-FOA-0002203	DE-EE0009274	GFO-0009274-002	G09274

Based on my review of the information concerning the proposed action, as NEPA Compliance Officer (authorized under DOE Policy 451.1), I have made the following determination:

**CX, EA, EIS APPENDIX AND NUMBER:**

Description:

**A9 Information gathering, analysis, and dissemination** Information gathering (including, but not limited to, literature surveys, inventories, site visits, and audits), data analysis (including, but not limited to, computer modeling), document preparation (including, but not limited to, conceptual design, feasibility studies, and analytical energy supply and demand studies), and information dissemination (including, but not limited to, document publication and distribution, and classroom training and informational programs), but not including site characterization or environmental monitoring. (See also B3.1 of appendix B to this subpart.)

**B3.6 Small-scale research and development, laboratory operations, and pilot projects** Siting, construction, modification, operation, and decommissioning of facilities for smallscale research and development projects; conventional laboratory operations (such as preparation of chemical standards and sample analysis); and small-scale pilot projects (generally less than 2 years) frequently conducted to verify a concept before demonstration actions, provided that construction or modification would be within or contiguous to a previously disturbed or developed area (where active utilities and currently used roads are readily accessible). Not included in this category are demonstration actions, meaning actions that are undertaken at a scale to show whether a technology would be viable on a larger scale and suitable for commercial deployment.

**B5.15 Small-scale renewable energy research and development and pilot projects** Small-scale renewable energy research and development projects and small-scale pilot projects, provided that the projects are located within a previously disturbed or developed area. Covered actions would be in accordance with applicable requirements (such as local land use and zoning requirements) in the proposed project area and would incorporate appropriate control technologies and best management practices.

Rationale for determination:

The U.S. Department of Energy (DOE) is proposing to provide federal funding to Arizona State University (ASU) to develop a novel system, called AUDACity, for the cultivation of cyanobacteria for biofuel production applications. The AUDACity system would capture and deliver CO<sub>2</sub> from the air to cyanobacterial strains that would in turn produce inputs for biofuel production.

The project would be divided into three Budget Periods (BPs). BP1 activities, consisting solely of process and data validation, were previously reviewed in November 2020 (GFO-0009274-001; CX A9). At that time, BP2 and BP3 activities were restricted, as the task work was still being negotiated and was not then fully defined. Since that time, the structure of these tasks has been finalized and submitted to DOE for review. This NEPA determination will apply to all BP2 and BP3 activities.

Project work would consist of the development of prototype AUDACity systems and testing their ability to delivery CO<sub>2</sub> to cyanobacteria. Tasks to be performed would include the following:

**Task 1 – Polymer design and synthesis:** ASU would iteratively develop and synthesize polymer sorbents at its laboratory facilities in Tempe, AZ. Polymers would be synthesized in small batches measuring approximately 10 - 20 g. ASU would characterize the polymers produced and further optimize polymer performance based on the results of material characterization. ASU would then process the polymers for use as a coating material for belts to be integrated into the prototype AUDACity systems. ASU would assemble various belts with the coating materials developed.

**Task 2 – Polymer biocompatibility and lab-scale DAC cultivation of Synechocystis:** ASU would cultivate Synechocystis cyanobacteria at its laboratory facilities in Tempe, AZ. Polymers would be tested for biocompatibility with the

cyanobacteria. Based on experimental characterization, cyanobacteria strains would also be engineered to improve biofuel production efficiency.

**Task 3 – Design, develop and evaluate AUDACity systems:** ASU would test components of the AUDACity system in a laboratory environment, before assembling prototype systems for outdoor cultivation trials to be performed.

Laboratory testing would include polymer screening, wind tunnel testing, and laboratory-scale cultivation. Polymer screening would consist of rapid, iterated exposure of polymer samples to a simulated growth medium. Wind tunnel testing would be performed to measure CO<sub>2</sub> uptake, drying, and delivery rates into a growth medium. An existing, indoor wind tunnel would be used for testing. The wind tunnel is a closed-loop system installed on a laboratory test bench (measuring approximately 10 ft across and 4 ft in height). A section of the wind tunnel would be modified to incorporate moving belts and a liquid tray. Finally, two laboratory-scale (~1 g CO<sub>2</sub>/day with dimensions small enough to be tested within a laminar flow hood cabinet) cultivation systems would be developed and assembled for testing. One would be used indoors for laboratory testing and one would be tested outdoors, utilizing existing pools (small-scale testing - 2,000 L liquid medium). All laboratory testing activities and small-outdoor testing would be performed at laboratory facilities at ASU's campus in Tempe, AZ

As part of Task 3, AUDACity system prototypes would be assembled and installed for outdoor testing to be performed as part of Task 4. Installation would occur at ASU's AzCATI testing facility in Mesa, AZ. The AUDACity systems would consist of a series of belts that would be partially submerged in the cultivation medium (i.e., water containing various nutrients and the cyanobacterial strains). The belts would be held in place by a metal frame attached to existing mini-raceway ponds (4.2 m<sup>2</sup> surface area; ~800 L at 20 cm depth). Each belt would be coated in a polymer which would be used to deliver CO<sub>2</sub> to the cultivation medium. A motor would turn the belts and expose the coated polymer areas to air and the cultivation medium, successively. The structures housing the belts and auxiliary equipment for each system would have an approximate height of 1-2 m and width of 0.5 – 1 m. Each system would be powered via an existing 110 V AC power source. Three AUDACity system prototypes would be installed, each with a production capacity of 100 g CO<sub>2</sub>/day.

**Task 4 – AUDACity outdoor cultivation trials at AzCATI:** Once the AUDACity prototype systems have been installed at AzCATI, as described in the previous Task, the systems would be used for outdoor cultivation. Biofuels would be produced through outdoor cultivation (100 g CO<sub>2</sub>/day). Two outdoor cultivation trials would be performed, each lasting for approximately 4 weeks.

**Task 5 – Techno-Economic and Life Cycle Analyses (TEA/LCA):** Project partner Sustainability Science (Fort Collins, CO) would develop engineering process models based on data obtained from the project.

ASU would coordinate and perform all laboratory-based experimentation and biofuel production. Polymer synthesis/testing, laboratory-based bacterial cultivation, biofuels production, and AUDACity system development would be performed at laboratory facilities at its campus in Tempe, AZ. Small-scale prototype AUDACity systems would be installed and tested outdoors at the Tempe, AZ campus. Approximately 2,000 L of liquid medium would be used for small-scale outdoor testing. Larger-scale (40,000 L) outdoor cultivation trials would be performed at the AzCATI research facility at ASU's campus in Mesa, AZ. Sustainability Science would perform computer-based research at its office facilities in Fort Collins, CO. No physical modifications to existing facilities, ground disturbance, or changes to the use, mission, or operations of existing facilities would be required. No additional permits or authorizations would be required.

Project work would involve the use and handling of industrial solvents, chemicals, compressed gases, and mechanical equipment with moving parts. All such handling would be performed in purpose-built laboratory and outdoor testing environments. To mitigate potential hazards, ASU would adhere to established institutional health and safety policies and procedures. Protocols would include personnel training, the use of personal protective equipment, monitoring, and engineering controls. Equipment used would meet applicable industry safety standards. All waste materials produced by the project would be disposed of according to established institutional policies and procedures. Biomass would be bleached prior to disposal. No significant health and safety risks are anticipated for work to be performed by Sustainability Science, as these tasks would consist solely of computer-based research. ASU and Sustainability Science would observe all applicable Federal, state, and local health, safety, and environmental regulations.

Genetically modified organisms (GMOs) would be used in cultivation experiments at ASU. GMOs would consist of cyanobacteria with introduced genes from plants and bacteria. Personnel handling recombinant GMOs would be trained in applicable National Institute of Health (NIH) guidelines. GMOs used for the project would be limited to organisms requiring Biosafety Level 1 (BSL-1) containment requirements per NIH guidelines. All laboratory spaces in which GMOs would be handled meet BSL-1 health and safety requirements. All material containing recombinant DNA would be autoclaved or neutralized with bleach prior to disposal.

## NEPA PROVISION

DOE has made a final NEPA determination.

Notes:

Bioenergy Technologies Office  
This NEPA determination does not require a tailored NEPA provision.  
Review completed by Jonathan Hartman, 02/18/2021

**FOR CATEGORICAL EXCLUSION DETERMINATIONS**

The proposed action (or the part of the proposal defined in the Rationale above) fits within a class of actions that is listed in Appendix A or B to 10 CFR Part 1021, Subpart D. To fit within the classes of actions listed in 10 CFR Part 1021, Subpart D, Appendix B, a proposal must be one that would not: (1) threaten a violation of applicable statutory, regulatory, or permit requirements for environment, safety, and health, or similar requirements of DOE or Executive Orders; (2) require siting and construction or major expansion of waste storage, disposal, recovery, or treatment facilities (including incinerators), but the proposal may include categorically excluded waste storage, disposal, recovery, or treatment actions or facilities; (3) disturb hazardous substances, pollutants, contaminants, or CERCLA-excluded petroleum and natural gas products that preexist in the environment such that there would be uncontrolled or unpermitted releases; (4) have the potential to cause significant impacts on environmentally sensitive resources, including, but not limited to, those listed in paragraph B(4) of 10 CFR Part 1021, Subpart D, Appendix B; (5) involve genetically engineered organisms, synthetic biology, governmentally designated noxious weeds, or invasive species, unless the proposed activity would be contained or confined in a manner designed and operated to prevent unauthorized release into the environment and conducted in accordance with applicable requirements, such as those listed in paragraph B(5) of 10 CFR Part 1021, Subpart D, Appendix B.

There are no extraordinary circumstances related to the proposed action that may affect the significance of the environmental effects of the proposal.

The proposed action has not been segmented to meet the definition of a categorical exclusion. This proposal is not connected to other actions with potentially significant impacts (40 CFR 1508.25(a)(1)), is not related to other actions with individually insignificant but cumulatively significant impacts (40 CFR 1508.27(b)(7)), and is not precluded by 40 CFR 1506.1 or 10 CFR 1021.211 concerning limitations on actions during preparation of an environmental impact statement.

The proposed action is categorically excluded from further NEPA review.

**SIGNATURE OF THIS MEMORANDUM CONSTITUTES A RECORD OF THIS DECISION.**

NEPA Compliance Officer Signature: \_\_\_\_\_

 Electronically Signed By: **Roak Parker**  
NEPA Compliance Officer

Date: 2/18/2021

**FIELD OFFICE MANAGER DETERMINATION**

- Field Office Manager review not required
- Field Office Manager review required

**BASED ON MY REVIEW I CONCUR WITH THE DETERMINATION OF THE NCO :**

Field Office Manager's Signature: \_\_\_\_\_

Field Office Manager

Date: \_\_\_\_\_