

PMC-ND

(1.08.09.13)

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

**RECIPIENT:** University of California, Berkeley**STATE:** CA

**PROJECT TITLE:** Accelerating polyketide synthase engineering for high TRY production of biofuels and bioproducts

Funding Opportunity Announcement Number	Procurement Instrument Number	NEPA Control Number	CID Number
DE-FOA-0002029	DE-EE0008926	GFO-0008926-001	

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.

Rationale for determination:

The U.S. Department of Energy (DOE) is proposing to provide federal funding to University of California, Berkeley (UCB) to develop a Design-Build-Test-Learn (DBTL) cycle to produce polyketide synthases (PKSs). PKSs are enzyme complexes that are used to turn sugars into a variety of compounds. UCB would seek to demonstrate the utility of using PKSs for the production of one commodity chemical (caprolactam) and two novel materials precursors (2-allylcaprolactam and 2- benzylcaprolactam).

The DBTL cycle to be developed by UCB would incorporate a previously developed software tool, ClusterCAD. This software would be used to design DNA sequences for the production of PKSs. PKSs based on the software design work would then be produced in-lab using a host bacteria. The PKSs would be used to produce the targeted compounds (i.e. caprolactam and the novel materials precursors). Machine learning algorithms would be applied to the whole process and lessons learned would be applied to process optimization efforts.

Proposed project activities would primarily center on four broad areas of focus: 1) software/algorithm development, 2) genetic engineering, 3) bioreactor analysis/experiments, and 4) material characterization.

Software/algorithm development would consist of the further development of the ClusterCAD software tool. Machine learning algorithms would be developed to augment the PKS design capabilities of the software. A number of other tools would also be integrated into the ClusterCAD software to further enhance its capabilities (e.g. automation of gene construction/editing design). UCB (Berkeley, CA), Argonne National Laboratory ('ANL' – Lemont, IL), and Lawrence Berkeley National Laboratory ('LBNL' – Berkeley, CA) would all be involved in these activities.

Genetic engineering would be performed in order to develop a bacteria to serve as a host for enzyme expression (e.g. to express PKS). Bacterial strains would be designed, grown, and tested for their ability to serve as a PKS host. UCB, LBNL, and the National Renewable Energy Laboratory ('NREL' – Golden, CO) would contribute to the completion of these activities.

Bioreactor experiments would consist of the production of caprolactam and the materials precursors of interest using bioreactors. Genetically engineered bacterial strains would be used to produce these compounds. Production would take place at different scales, but in all cases, the bioreactors would have a maximum production capacity of less than 10 L. Bioreactor experiments would be performed by UCB, LBNL, and NREL. Bioreactor experiments would be performed using existing bioreactors.

Material characterization activities would consist of enzyme and metabolite characterization of previously engineered strains. Strains would be physically characterized using laboratory equipment (e.g. chromatography, spectroscopy). Pacific Northwest National Laboratory ('PNNL' – Richland, WA) would perform material characterization work at its laboratory facility.

All project work would be coordinated by UCB and performed by UCB and its project partners at existing, purpose-built laboratory facilities. No physical modifications to existing facilities, construction of new facilities, ground disturbing activities, or changes to the use, mission, or operation of existing facilities would be required. Likewise, no additional permits or authorizations would be needed for the completion of project activities.

Project work would involve the use and handling of laboratory equipment and industrial chemicals/solvents. All such handling would be performed in controlled laboratory environments. Potential risks associated with the performance of project activities would be mitigated through adherence to established health and safety policies and procedures. Protocols would include employee training, the use of personal protective equipment, engineering controls, monitoring, and internal assessments. Any hazardous waste produced would be handled, stored, and disposed of in accordance with established corporate policies. UCB and its project partners would observe all applicable Federal, state, and local health, safety, and environmental regulations.

Genetic engineering would be performed on organisms requiring Biological Safety Level 1 (BSL-1) biocontainment measures, per Centers for Disease Control and Prevention (CDC) regulations. All facilities performing genetic engineering would be equipped for BSL-1 work. Strains would be stored and handled properly. This would include autoclaving strains prior to disposal, when applicable.

Any work proposed to be conducted at a federal facility may be subject to additional NEPA review by the cognizant federal official and must meet the applicable health and safety requirements of the facility.

## 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, 04/09/2020

## 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:  \_\_\_\_\_ Date: 4/9/2020  
NEPA Compliance Officer

**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: \_\_\_\_\_ Date: \_\_\_\_\_  
Field Office Manager