

PMC-ND

(1.08.09.13)

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



**RECIPIENT:** Michael Burkart / University of California San Diego

**STATE:** CA

**PROJECT TITLE:** Production of high-performance biodegradable polyurethane products made from algae precursors

<b>Funding Opportunity Announcement Number</b>	<b>Procurement Instrument Number</b>	<b>NEPA Control Number</b>	<b>CID Number</b>
	DE-EE0009295	GFO-0009295-001	GO9295

**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.

**B5.25 Small-scale renewable energy research and development and pilot projects in aquatic environments** Small-scale renewable energy research and development projects and small-scale pilot projects located in aquatic environments. Activities would be in accordance with, where applicable, an approved spill prevention, control, and response plan, and would incorporate appropriate control technologies and best management practices. Covered actions would not occur (1) within areas of hazardous natural bottom conditions or (2) within the boundary of an established marine sanctuary or wildlife refuge, a governmentally proposed marine sanctuary or wildlife refuge, or a governmentally recognized area of high biological sensitivity, unless authorized by the agency responsible for such refuge, sanctuary, or area (or after consultation with the responsible agency, if no authorization is required). If the proposed activities would occur outside such refuge, sanctuary, or area and if the activities would have the potential to cause impacts within such refuge, sanctuary, or area, then the responsible agency shall be consulted in order to determine whether authorization is required and whether such activities would have the potential to cause significant impacts on such refuge, sanctuary, or area. Areas of high biological sensitivity include, but are not limited to, areas of known ecological importance, whale and marine mammal mating and calving/pupping areas, and fish and invertebrate spawning and nursery areas recognized as being limited or unique and vulnerable to perturbation; these areas can occur in bays, estuaries, near shore, and far offshore, and may vary seasonally. No permanent facilities or devices would be constructed or installed. Covered actions do not include drilling of resource exploration or extraction wells, use of large-scale vibratory coring techniques, or seismic activities other than passive techniques.

Rationale for determination:

The U.S. Department of Energy (DOE) is proposing to provide funding to University of California San Diego (UCSD) to develop novel algae-based organic compounds for use in the production of polyurethane (PU) products. These would include algae based diisocyanates and polyols. The compounds would be developed so as to increase the organic content of PUs and enhance PU product performance. Test batches of the compounds would be synthesized, characterized, and assessed for biodegradation performance.

Proposed project activities would consist primarily of laboratory-based research, including laboratory-scale synthesis of organic compounds. Some outdoor testing may also be performed when assessing the biodegradation of PU materials. Specific work activities are described in detail below:

Task 1 – Process and Data Validation: Baseline performance metrics, processing capabilities, and preliminary biodegradation process data would be validated and share with DOE. Task work was completed prior to NEPA review and accordingly, this task cannot be reviewed as part of this NEPA Determination.

Task 2 – Develop Algae-based Diisocyanates: UCSD would develop flow chemistry processes required to synthesize diisocyanates. Compounds would then be synthesized at laboratory scale (>1 g).

Task 3 – Improve Polyols with Algae-based and Branched-chain Monomers: Project partner Algenesis Materials would synthesize polyols from existing algae feedstocks at laboratory scale (~ 500 g).

Task 4 – Produce Performance Enhanced Polyurethane Products with >80% Bio-based Content: Algenesis Materials would synthesize processed PU materials from precursors provided by UCSD. Processed PU materials would be synthesized at laboratory scale (approximately 10 – 20 g samples), including foams, adhesives, coatings, and films. Existing equipment (e.g., mixing systems, molds, etc.) would be utilized for PU product production.

Task 5 – Measure Physical Characteristics of >80% Bio- based Polyurethane Products: PU product materials developed as part of Task 4 would be characterized and tested for performance (e.g., tensile strength, tear strength, etc.). The processed PU materials would also be used in the formulation and testing of prototype finished products (e.g. flip flops fabricated from foams, flip flop adhesives, etc.). Testing would be coordinated between Algenesis Materials and UCSD and performed at laboratory facilities at UCSD's campus in San Diego, CA.

Task 6 – Determine the Biodegradation of >80% Bio-based Polyurethanes: UCSD would perform biodegradation tests on PU foams synthesized as part of previous task work. Both shredded and intact foams would be used. PU foams would be subjected to chemical degradation testing, using acid and basic compounds, enzymatic degradation testing, using a suite of enzymes, and biodegradation testing, using soil, compost, and ocean water. All testing would be performed in laboratory facilities.

Biodegradation studies may also include in-ocean testing of PU foams, to assess biodegradation efficiency in a natural environment. Testing would be conducted at the Ella Brown Scripps Memorial Pier (Scripps Pier), San Diego, CA. The Scripps Pier is operated by the Scripps Institution of Oceanography (SIO) and is routinely used for marine research, including in water research such as that proposed in this project. UCSD has submitted the in-ocean testing proposal to SIO for review and would obtain authorization prior to performing any testing. All testing would be consistent with regularly conducted in-ocean testing at the Scripps Pier.

In-ocean testing would consist of foam samples, each measuring approximately 6 sq. in., being placed into a sealed nylon mesh bag and placed into a small (approximately 1ft X 1ft x 2 ft.) steel cage. The cage would then be lowered directly off the Ella Brown Scripps Memorial Pier, San Diego, CA. The cage would be lowered and recovered via a single rope (e.g., performed in a manner similar to that of deploying a lobster pot). The cage would contain a weight to ensure the cage sinks and lowers straight down into the water. Deployment would occur over an approximately 8 - 12 week period. The cage would be retrieved weekly, for analysis of the foams.

Previous research has been performed on the chemical breakdown of the PU foams which shows that no toxic compounds would be released during biodegradation. The mesh bag would contain any loose pieces of foam that break down during biodegradation processes. All testing would remain within the footprint of the research pier. Considering all of the above, DOE has determined that the project would not impact protected resources.

Task 7 – Scale Chemical Production of Advanced Bio-based Polyols and Isocyanates with Enhanced PU Performance Characteristics: UCSD and Algenesis Materials would scale up PU synthesis, incorporating results from previous task activities. Production would be scaled to > 0.25 kg. Synthesized PU would then be used to create at least 1 finished PU product (e.g., foam flip flops).

Task 8 – TEA/LCA Analysis: Project partner University of California Davis (UC Davis) would utilize data generated from the previous tasks to develop Technoeconomic and life-cycle analysis models.

UCSD would coordinate all project activities and perform compound synthesis and material characterization at Kendall Laboratory. Biodegradation studies would be performed using formulated PUs at UCSD's Mayfield Laboratory, and Scripps continuous ocean water flow laboratory. All laboratory facilities are located at or near UCSD's campus in San Diego, CA. Compound synthesis, material characterization, and prototype development would be performed by Algenesis Materials at its laboratory facility located within an incubator space at UCSD's campus in San Diego, CA. Computer modeling would be performed UC Davis at computer research facilities at its campus in Davis, CA. No modifications to existing facilities, ground disturbance, or changes to the use, mission, or operation of existing facilities would be required. No additional permits or authorizations would be required.

Project work would involve the use and handling of industrial chemicals and solvents. All such handling would occur in controlled, laboratory environments. Chemistry would be performed under fume hoods and in accordance with established institutional health and safety policies and procedures. Protocols would include employee training, the use of personal protective equipment, engineering controls, monitoring, and internal assessments. All waste materials

would be disposed of properly, in accordance with established institutional policies. UCSD and its project partners would observe all applicable Federal, state, and local health, safety, and environmental regulations.

**NEPA PROVISION**

DOE has made a final NEPA determination.

DOE has made a conditional NEPA determination.

The NEPA Determination applies to the following Topic Areas, Budget Periods, and/or tasks:

Tasks 2 - 8

The NEPA Determination does not apply to the following Topic Area, Budget Periods, and/or tasks:

Task 1

Notes:

Bioenergy Technologies Office  
This NEPA determination does not require a tailored NEPA provision.  
Review completed by Jonathan Hartman, 02/24/2021

**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.

A portion of the proposed action is categorically excluded from further NEPA review. The NEPA Provision identifies Topic Areas, Budget Periods, tasks, and/or subtasks that are subject to additional 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: 2/24/2021

**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: \_\_\_\_\_

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

