

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



**RECIPIENT:** Quino Energy, Inc.

**STATE:** CA

**PROJECT TITLE :** Continuous Flow Synthesis of Low-Cost, Long Lifetime Aqueous Organic Flow Battery Reactants

<b>Funding Opportunity Announcement Number</b>	<b>Procurement Instrument Number</b>	<b>NEPA Control Number</b>	<b>CID Number</b>
DE-FOA-0002453	DE-EE0009795	GFO-0009795-001	G09795

**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 funding to Quino Energy, Inc to develop and execute a scalable, cost-effective, continuous process for producing high-performance negolyte (i.e., negative electrolyte) materials for use in an aqueous organic redox flow battery (RFB). The project would be completed over two Budget Periods (BPs) with a Go/No-Go decision point between each BP. This NEPA determination is applicable to both BPs.

Items that would be designed and fabricated during the course of this project include negolyte material, continuous flow reactor prototypes to synthesize the material, stacks, and continuous flow electrosynthesis hardware.

Small amounts of 6-10 different redox-organic negolyte target molecules would be synthesized and characterized. Through a series of down-select processes, at least one negolyte would be synthesized on a 10-gram scale and evaluated for different criteria including physical and chemical properties, cost of manufacture, and cell-level performance. Synthetic routes would be optimized based on cost of manufacture. In parallel, electrosynthetic reactors would be constructed and tested, the most promising would be scaled-up to the kilogram scale then to pilot-scale. This would include the electrochemical cell and components. Four intermediate-size RFB stacks rated at 200 W would be designed and fabricated. Testing would start on single-cell flow batteries at 10 W/10-40 kWh which would be used to evaluate performance and effectiveness of recovery strategies.

A full-scale electrosynthetic reactor and stacks would be constructed and operated to produce approximately 500 kg of the down-selected negolyte target molecule. The 200 W cell previously developed would be expanded by adding more bipolar plates to provide the required 3 kW discharge power. The most likely configuration would be four 750 W stacks. Components for two full size 3 kW systems would be shipped to the reactant production contractor site for integration into full-scale synthetic process and testing with negolyte materials. Tests would be conducted with the full-sized 3 kW systems to demonstrate performance. The system would contain two 300-gallon tanks (approximately 10 ft x 4 ft x 4ft). Stacks would be hydraulically checked and electrochemically characterized for quality control. They would be subject to accelerated lifetime testing at elevated temperatures and long idle times at high state of charge with and without capacity recovery strategies. The operating temperature range would be determined. The project would culminate in test systems (including negolyte and posolyte reactants) being shipped to a federal laboratory (either Pacific Northwest National Lab, Sandia National Lab, or Oak Ridge National Lab) for external validation, which is outside the scope of this project. Techno-economic analyses would be run throughout.

Proposed project activities by location are listed below:

#### Quino Energy – San Leandro, CA

- Use lab-scale electrosynthesis equipment to produce redox flow battery (RFB) reactants up to the 1-kilogram scale and develop an initial process for the electrosynthesis. Negolyte reactants for the RFBs will be produced locally by Quino or shipped from either ESC or MATRIC. Posolyte reactants will be purchased from domestic vendors.
- Operate and test RFB systems at three different sizes: 10 W, 200 W, and 3 kW of rated power.

#### Harvard University – Cambridge, MA

- Identify suitable reactants for redox flow batteries (RFBs), develop cheap synthetic routes for the reactants, and define a production specification.
- Electrochemical characterization of molecules.

#### The Electrosynthesis Company (ESC) – Lancaster, NY

- Design, modify, build, and test RFB stacks and systems at intermediate and full scales, as well as equipment for continuous electrochemical synthesis of the reactant at lab, pilot, and full-scale sizes. Testing would include hydraulic testing and performing charge/discharge cycles on the flow battery.
- Use the pilot scale electrosynthesis equipment to produce one kind of RFB reactant at pilot-scale.
- Ship full-scale equipment to MATRIC.

#### Mid-Atlantic Technology, Research & Innovation Center (MATRIC) – South Charleston, WV

- Produce at least 500 kg of the reactant with instructions and supervision from chemists from Quino and ESC.
- Laboratory and pilot plant demonstration of (electro)synthetic routes to organic flow battery materials.

No changes in the use, mission, or operation of existing facilities would be required as part of this project. If the type of wastes generated are not covered under ESC's current sewer permit, they will submit a request to modify their permit to cover this stream. Aside from this possible adjustment, no additional permits would be required in order to conduct any of the work activities.

Project activities would involve the use and handling of hazardous materials including acids, bases, oxidizers, possible carcinogens, organic chemicals, and industrial solvents. Any risks associated with the handling of these materials would be mitigated through adherence to established health and safety policies and procedures. Protocols would include personnel training, the use of personal protective equipment, monitoring, engineering controls, and internal assessments. Additionally, a third-party company would be hired to provide consultation and make suggestions for improved health and safety. All waste products would be disposed of by licensed waste management service providers. Quino Energy 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.

Notes:

Advanced Manufacturing Office  
Review completed by Shaina Aguilar on 3/4/22.

## 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: \_\_\_\_\_



Signed By: Casey Strickland

NEPA Compliance Officer

Date: 3/7/2022

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