

PMC-ND

(1.08.09.13)

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

**RECIPIENT:** Opus 12 Inc.**STATE:** CA

**PROJECT TITLE:** PEM CO<sub>2</sub> Electrolyzer Scale-Up to Enable MW-Scale Electrochemical Modules

<b>Funding Opportunity Announcement Number</b>	<b>Procurement Instrument Number</b>	<b>NEPA Control Number</b>	<b>CID Number</b>
DE-FOA-0002203	DE-EE0009288	GFO-0009288-001	GO9288

**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 Opus 12 Inc. to develop a novel single-cell electrolyzer to convert carbon dioxide to carbon monoxide. Opus 12 would build on past efforts and further develop components of the device, including scaling up integrated membrane electrode assemblies (MEAs) to have a larger active area (>750 cm<sup>2</sup>). Pilot electrolyzer cells would be fabricated and tested for performance efficiency.

Proposed project activities would focus on material characterization, component fabrication, and performance testing. Specific tasks to be performed are discussed further below:

**Task 1 – Initial Verification:** This task would consist of the experimental verification of baseline data. Opus 12 and its project partners would demonstrate the processes that would be performed as part of the project. This would occur in the laboratory facilities of Opus 12 and its project partners, discussed further below.

**Task 2 – Fabrication of MEAs:** Activities to be performed as part of this task include the development of the specifications for cathode layer synthesis. Synthesis of MEA layers and MEA fabrication would also be performed. MEA's and their component parts would be characterized and subjected to performance testing. MEA fabrication and performance testing would be performed by Opus 12, at its facility in Berkeley, CA. Characterization work would be performed in a coordinated manner by Opus 12 and its project partners, as discussed further below.

This task work was initiated and partially undertaken prior to NEPA review and accordingly, this task cannot be reviewed as part of this NEPA Determination.

**Task 3 – Electrolyzer Hardware Development:** Task work would focus on the optimization of MEA components. Work activities would include computer modeling, design development, material synthesis, electrolyzer cell stack fabrication, and performance testing. Approximately 6 stacks would be fabricated over the course of the project. Stack fabrication would be performed by project partner Nel Hydrogen at its facilities in Wallingford, CT. Performance testing of the assembled stacks would be performed by Opus 12, utilizing existing testing platforms at its facility Berkeley, CA.

**Task 4 – Advanced Characterization:** Characterization techniques would be developed and applied to catalyst layers to measure parameter including compositional structure, ionic conductivity, and chemical interactions within MEAs. Characterization work would be performed in a coordinated manner by Opus 12 and its project partners, as discussed

further below.

**Task 5 – Technoeconomic and Life Cycle Analysis:** Technoeconomic and life cycle analysis (TEA/LFA) models would be developed from project data. TEA/LFA modeling would be performed by the National Renewable Energy Laboratory ('NREL' – Golden, CO)

**Task 6 – MEA Production:** Opus 12 would fabricate additional MEAs, optimized for performance based on the results of previous tasks. This task would continue the production initiated as part of Task 2.

**Task 7 – Single Cell Development and Testing:** This task would focus on fabrication of optimized electrolyzer cell stacks and long-term performance testing of the stacks. Nel Hydrogen would fabricate cell stacks at its facilities in Wallingford, CT. Assembled stacks would then be transferred to Opus 12 for long-term performance testing, in which the assembled cell stacks would be operated for approximately 1,000 hours, either continuously or non-continuously, depending on operating parameters.

**Task 8 – Ex situ and in operando characterization:** This task would consist of the characterization of MEA components and performance. This work would build on characterization tasks performed during as part of Task 4. Characterization work would be performed in a coordinated manner by Opus 12 and its project partners.

**Task 9 – Final analysis and reporting:** TEA/LFA modeling work would be finalized by NREL. Final reports on project work would be compiled and furnished by Opus 12.

Opus 12 would coordinate all project activities and perform material synthesis, MEA fabrication, material characterization, and performance testing of MEAs and assembled electrolyzer cell stacks at its laboratory facilities in Berkeley, CA. MEA fabrication would be performed via material deposition utilizing existing hardware that would be modified for scaled-up production (e.g., adjustments to nozzle specifications). MEAs would be integrated into electrolyzer hardware furnished by Nel Hydrogen and subjected to performance testing utilizing existing test stands, which would deliver CO<sub>2</sub>, water, and electrical current to the electrolyzer hardware. Performance testing would assess the electrolyzers' carbon dioxide conversion efficiency.

Electrolyzer hardware for integration of the scaled-up MEAs developed by Opus 12 would be designed, fabricated, and assembled by Nel Hydrogen at its facilities in Wallingford, CT. Approximately 6 cell stacks would be assembled by Nel Hydrogen utilizing materials provided by Opus 12. Materials for testing would be transferred between Opus 12 and Nel Hydrogen's facilities.

NIST Center for Neutron Research would perform electrolyzer characterization (i.e. neutron imaging) on sample materials utilizing existing equipment at its laboratory facilities in Gaithersburg, MD. Additional MEA characterizations would be performed utilizing existing equipment at laboratory facilities operated by the National Renewable Energy Laboratory ('NREL' – Golden, CO), Lawrence Berkeley National Laboratory ('LBNL' – Berkeley, CA), University of Connecticut (UConn), and University of Toronto (Toronto, ON). NREL would also perform a technoeconomic analysis and life cycle assessment.

Long-term performance testing would be performed at Opus 12's laboratory facilities in Berkeley, CA. To support this testing, Opus 12 is in the process of upgrading its facility. A 6-ton liquid CO<sub>2</sub> tank has been installed outdoors on a concrete pad, adjacent the facility. To increase electrical current to the facility, a new transformer, switchgear, and associated wiring would also be installed in coordination with the electrical utility company that services Opus 12's facility. All upgrades would be made in compliance with local regulations and requirements. No other physical modifications to existing facility, ground disturbance, or changes to the use mission or operation of existing facilities would be required. No permits or authorizations would be required.

Project work would involve the use and handling of industrial chemicals, hazardous gases, pressurized equipment, and x-ray emitting laboratory equipment. To mitigate potential risks, all participating entities 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. Appropriate equipment and safety controls would be utilized when handling potentially hazardous materials. This would include the use of fume hoods and gas leak detectors. All hazardous waste materials would be disposed of properly, in accordance with established institutional waste management policies and procedures. Wastewater would be treated prior to discharge. Opus 12 and its project partners would observe all applicable Federal, state, and local health, safety, and environmental regulations.

In addition to the above, Opus 12 and NREL would both perform work involving the use and handling of metal nanoparticles. Both institutions would adhere to established institutional policies guiding the handling and disposal of these materials. To mitigate the risk of inhalation, designated fume hoods would be used for handling nanoparticles. Nanoparticle containing substances would be contained in storage vials designed for this purpose.

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 conditional NEPA determination.

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

Task 1: Initial Verification  
 Task 3: Electrolyzer Hardware Development  
 Task 4: Advanced Characterization  
 Task 5: Technoeconomic and Life Cycle Analysis  
 Task 6: MEA Production  
 Task 7: Single Cell Development and Testing  
 Task 8: Ex situ and in operando characterization  
 Task 9: Final analysis and reporting

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

Task 2: Fabrication of MEAs

Notes:

Bioenergy Technologies Office  
 This NEPA determination does not require a tailored NEPA provision.  
 Review completed by Jonathan Hartman, 02/17/2021

## 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.

DOE has determined that work to be carried out outside of the United States, its territories and possessions is exempt from further review pursuant to Section 5.1.1 of the DOE Final Guidelines for Implementation of Executive Order 12114; "Environmental Effects Abroad of Major Federal Actions."

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:

  
 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: \_\_\_\_\_