

PMC-ND

(1.08.09.13)

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



RECIPIENT: Linde, Inc

STATE: NY

**PROJECT TITLE:** Decarbonization of Hydrogen Production by Flameless Oxidation

<b>Funding Opportunity Announcement Number</b>	<b>Procurement Instrument Number</b>	<b>NEPA Control Number</b>	<b>CID Number</b>
DE-FOA-0002252	DE-EE0009414	GFO-0009414-001	G09414

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.

**B1.31 Installation or relocation of machinery and equipment** Installation or relocation and operation of machinery and equipment (including, but not limited to, laboratory equipment, electronic hardware, manufacturing machinery, maintenance equipment, and health and safety equipment), provided that uses of the installed or relocated items are consistent with the general missions of the receiving structure. Covered actions include modifications to an existing building, within or contiguous to a previously disturbed or developed area, that are necessary for equipment installation and relocation. Such modifications would not appreciably increase the footprint or height of the existing building or have the potential to cause significant changes to the type and magnitude of environmental impacts.

Rationale for determination:

The U.S. Department of Energy (DOE) is proposing to provide funding to Linde, Inc. to develop a ceramic membrane technology for use in hydrogen production via steam-methane reforming (SMR), a process for converting natural gas to hydrogen. Specifically, flameless oxidation (FOx) burners would be developed, which would replace traditional air-fired burners in SMR reactors. The FOx burners would be designed to improve carbon dioxide (CO<sub>2</sub>) capture rates and decrease CO<sub>2</sub> emissions when producing hydrogen, as compared to existing SMR technologies. An existing pilot reformer system operated by Linde would be modified to integrate the FOx burners. The project would be completed over two Budget Periods (BPs), with a Go/No-Go Decision Point in between each BP.

All project work would be performed by Linde. Proposed project activities can be split into three broad areas: 1) upgrading the existing pilot reformer system, 2) fabrication of the FOx burners for testing, and 3) operational testing and analysis utilizing the upgraded system with FOx burners integrated into the process. The project activities will be discussed below:

Currently, the pilot reformer system consists of a 35 ft tall structure within an indoor testing facility at Linde's research and development campus in Tonawanda, NY. The structure has a total area of 40 ft x 30 ft and consists of various integrated components, including a central reactor, burners, a steam boiler, various process heaters, and an access walkway, among other equipment. Outside of the facility, an induced draft fan and process flare are connected to the equipment indoors. This structure would be upgraded to enable hydrogen production as an SMR utilizing FOx burners. This would entail the removal of select components from the existing structure and the integration of new equipment. The major pieces of equipment to be integrated into the structure include a process gas boiler, heat exchangers, a syngas cooler, a condensate separator, a methanation unit, electric heaters, and auxiliary components (e.g., controllers, instrumentation, etc.). New walkways, guardrails, stairs, and other access infrastructure would also be installed in the structure. All modifications would be performed indoors on the pilot reformer structure itself. No

physical modifications to the existing facility, ground disturbance, or changes to the use, mission, or operation of the existing facility would be required. No additional permits or authorizations would be required.

Fabrication of the FOx burner assemblies would be performed at the Praxair Surface Technologies Plant in Indianapolis, IN. Praxair is a subsidiary of Linde. Approximately 50 – 70 FOx burner assemblies would be fabricated via an established process in which oxygen transport membrane (OTM) tubes are fabricated, coated, and grouped together to form the FOx burner assemblies. Between 6 and 10 OTM tubes would be used for each assembly. Each assembly would measure 40" L x 5" W. The Praxair Plant where fabrication would take place is an industrial coating facility that regularly performs component assembly, coating, and finishing. No physical modifications to existing facilities, ground disturbance, or changes to the use, mission, or operation of existing facilities would be required at this location. No additional permits or authorizations would be required.

Once fabricated, the FOx burner assemblies would be integrated into the upgraded pilot reformer system at Linde's facility in Tonawanda, NY. The pilot reformer system would then be used for operational testing to verify hydrogen production via SMR. The integrated system would be operated utilizing a natural gas/steam mixture and assessed for its CO2 capture rates and emissions reductions capabilities.

Proposed project activities would involve the use and handling of chemicals/catalysts, ceramic powders, flammable and toxic materials, and powered laboratory equipment operating at high temperatures and pressures. All such handling would be performed in controlled laboratory and manufacturing environments that routinely perform experimental chemistry as part of their regular course of business. Potential hazards would be mitigated through adherence to 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. Emissions produced from FOx array testing would be combusted prior to ventilation to the open air. All waste materials would be stored in appropriate waste containers and disposed of by qualified waste management service providers. Linde 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

This NEPA determination does not require a tailored NEPA Provision.

NEPA review completed by Jonathan Hartman, 05/07/2021

## 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: Casey Strickland

NEPA Compliance Officer

Date: 5/13/2021

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