



# U.S. Department of Energy Categorical Exclusion Determination Form

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Proposed Action Title: Starfire Energy - NH<sub>3</sub> Synthesis for Fuel, Energy Storage, and Agriculture Applications

Program or Field Office: Advanced Research Projects Agency - Energy

Location(s) (City/County/State): Aurora, CO; Golden, CO

Proposed Action Description:

Funding will support the project team's small-scale, research and development activities to develop a modular, small-scale Haber-Bosch (HB) type process for ammonia synthesis that is less energy-intensive and more economical than conventional, large-scale HB. Specifically, the project team will: (1) conduct electrified synthesis and catalyzation; (2) conduct electrified bench-top testing; and (3) model and develop a small-scale prototype reactor. If successful, small-scale HB reactors could enable distributed ammonia production as a zero-carbon fuel, for energy storage and agriculture and to be more compatible with energy inputs from intermittent distributed energy resources.

Project activities will be conducted at existing facilities that are designed for the applicable activities, and will be conducted in accordance with applicable Federal, State, and local safety and environmental requirements.

Categorical Exclusion(s) Applied:

B3.6 - Small-scale research and development, laboratory operations, and pilot projects

For the complete DOE National Environmental Policy Act regulations regarding categorical exclusions, including the full text of each categorical exclusion, see Subpart D of 10 CFR Part 1021.

Regulatory Requirements in 10 CFR 1021.410(b): (See full text in regulation)

The proposal 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.

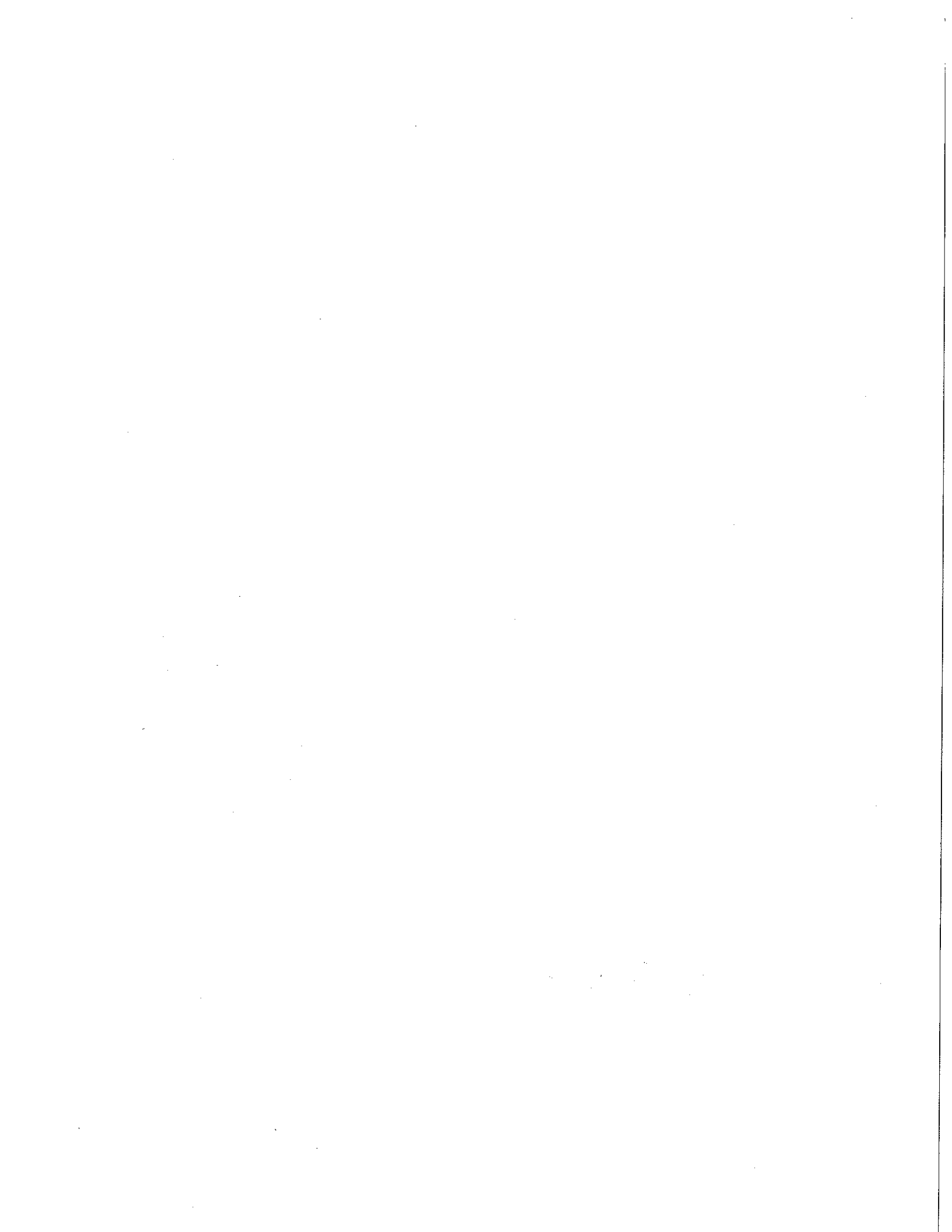
There are no extraordinary circumstances related to the proposal that may affect the significance of the environmental effects of the proposal.

The proposal 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.

Based on my review of the proposed action, as NEPA Compliance Officer (as authorized under DOE Order 451.1B), I have determined that the proposed action fits within the specified class(es) of action, the other regulatory requirements set forth above are met, and the proposed action is hereby categorically excluded from further NEPA review.

NEPA Compliance Officer:

Date Determined: 02/16/2016



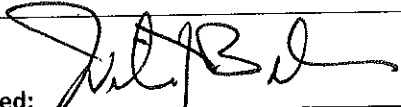
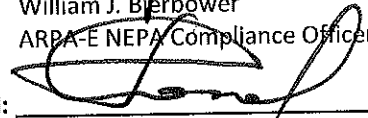


**PROJECT ENVIRONMENTAL REVIEW  
MEMORANDUM TO THE RECORD**

**Lead Organization:** Starfire Energy

**Project Title:** NH3 Synthesis for Fuel, Energy Storage,  
and Agriculture Applications

**Date:** February 16, 2016

<p><b>Approved:</b> </p> <p>William J. Bierbower ARPA-E NEPA Compliance Officer</p>
<p><b>Concurred:</b> </p> <p>Dr. Grigori Soloveichik ARPA-E Program Director</p>

**INSTRUCTIONS:** Please complete Sections I - V of this memorandum form. Please complete all relevant fields. Where a particular field is irrelevant to the project under review, please indicate "N/A" in the field.

**SECTION I. PROJECT INFORMATION**

**Funding Opportunity Announcement (if any):** DE-FOA-0001261: Open Funding Opportunity Announcement 2015 (OPEN 2015)

**Lead Organization:** Starfire Energy

**Other Participants (Subrecipients, Contractors, etc.):** Colorado School of Mines

**Locations of Work (City, State):** Aurora, CO; Golden, CO

**SECTION II. NEPA ANALYSIS**

**A. CATEGORICAL EXCLUSION(S) APPLIED**

The activities to be conducted under this project fit within the class(es) of actions listed in Categorical Exclusion(s) B3.6 (Small-scale research and development, laboratory operations, and pilot projects). Categorical Exclusion(s) cover(s):

**B3.6:** Small-scale research and development, laboratory operations, and pilot projects. Siting, construction, modification, operation, and decommissioning of facilities for small-scale 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.

The proposed activities satisfy the elements and requirements of Categorical Exclusion(s).

Funding will support research and development activities to develop a modular, small-scale Haber-Bosch (HB) type process for ammonia synthesis that is less energy-intensive and more economical than conventional, large-scale HB. Specifically, the project team will: (1) conduct electrified synthesis and catalyzation; (2) conduct electrified benchtop testing; and (3) model and develop a small-scale prototype reactor. If successful, small-scale HB reactors could enable distributed ammonia production as a zero-carbon fuel, for energy storage and agriculture and to be more compatible with energy inputs from intermittent distributed energy resources.

No modifications will be made to existing facilities to accommodate the proposed work.

**B. EXTRAORDINARY CIRCUMSTANCES ANALYSIS (All Categorical Exclusions)**

The proposed project will involve the following:

- a. Use, handling, storage, transport, or disposal of radioactive, toxic, or hazardous chemicals or materials  
 Yes  No
  
- b. Use, handling, storage, transport, or disposal of genetically engineered organisms recombinant DNA.  
 Yes  No

c. Use, handling, storage, transport, or disposal of nanoscale materials

Yes  No

d. Use, handling, storage, transport, or disposal of solid wastes

Yes  No

e. Emissions into the ambient air

Yes  No

f. Release of pollutants/contaminants into water resources

Yes  No

g. Substantial noise pollution

Yes  No

h. Adverse community-based environmental impacts

Yes  No

Comments: Project activities will include the use of small quantities of hazardous materials including ammonia. All handling, storage, transport, and disposal will be in accordance with proper handling and processing protocols and in compliance with applicable federal, state, and local regulations and any applicable permits.

Project activities will include the use, handling, storage, transport, and disposal of small quantities of routine, non-hazardous, solid wastes from normal laboratory operations (e.g., scrap paper, gloves, wipes, and office waste). Solid wastes will be disposed according to existing facility management plans, and in accordance with all federal, state, and local requirements.

Project activities may result in emissions of small quantities of hydrogen, ammonia, solvent vapors, and acid vapors. Emissions will be in compliance with all applicable federal, state, and local requirements, including any associated permits.

### C. INTEGRAL ELEMENTS ANALYSIS (Appendix B Categorical Exclusions Only)

The proposed project will:

a. Threaten a violation of applicable statutory, regulatory, or permit requirements for environment, safety, and health or similar requirements of DOE or Executive Orders.

Yes  No

b. Require siting/construction or major expansion of waste storage, disposal, recovery, or treatment facilities.

Yes  No

- c. Disturb hazardous substances, pollutants, contaminants, or petroleum/natural gas products that preexisted in the environment, resulting in an uncontrolled/unpermitted release.

Yes  No

- d. Have potential to cause significant impacts on environmentally sensitive resources.

Yes  No

- e. For projects involving genetically engineered (GE) organisms, synthetic biology, governmentally designated noxious weeds, or invasive species:

- i. Such organisms will be contained and confined in a manner designed and operated to prevent unauthorized release into the environment.

N/A  Yes  No

- ii. Activities involving recombinant DNA will be conducted in accordance with NIH Guidelines for Research Involving Recombinant DNA Molecules

N/A  Yes  No

- iii. Activities involving GE organisms with pesticidal qualities will be conducted in accordance with the Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA) (7 U.S.C. § 136 et seq.) and EPA's FIFRA Implementing Regulations (40 C.F.R. Parts 150-189).

N/A  Yes  No

- iv. Activities involving GE organisms that may pose a risk to plant/animal health will be conducted in accordance with the APHIS Regulations (7 C.F.R. Part 340).

N/A  Yes  No

- v. Activities involving new GE organisms will be conducted in accordance with the Toxic Substances Control Act (TSCA) (15 U.S.C. § 2601 et seq.) and EPA's TSCA Implementing Regulations (7 C.F.R. Parts 700-790).

N/A  Yes  No

Comments: None

**SECTION III. ADDITIONAL COMMENTS/ANALYSIS**

None

**SECTION IV. RECOMMENDATION FOR CONDITION ON AWARD**

It is recommended that the following condition be included in the award:

No NEPA-related condition need be included in the award.

**SECTION V. RECOMMENDATION FOR CATEGORICAL EXCLUSION**

The activities to be conducted under this project fit within the class of activities identified under the Department of Energy Categorical Exclusion(s) identified above.

The review has not identified any extraordinary circumstances related to the specific project that may affect the significance of the environmental effects of the project.

It is recommended that no further review under NEPA is required; however, any changes to the project may require further review.

Please find attached the selectee's completed and signed NEPA Questionnaire.

