

PLEASE REFER TO THE GENERAL FAQs SECTION OF ARPA-E'S WEBSITE ([HTTP://ARPA-E.ENERGY.GOV/?Q=FAQ/GENERAL-QUESTIONS](http://arpa-e.energy.gov/?Q=FAQ/GENERAL-QUESTIONS)) FOR ANSWERS TO MANY GENERAL QUESTIONS ABOUT ARPA-E AND ARPA-E'S FUNDING OPPORTUNITY ANNOUNCEMENTS. ADDITIONAL QUESTIONS SPECIFIC TO THIS FOA ONLY ARE INCLUDED BELOW. PLEASE REVIEW ALL EXISTING GENERAL FAQs AND FOA-SPECIFIC QUESTIONS BEFORE SUBMITTING NEW QUESTIONS TO ARPA-E.

I. Questions for week ending: APRIL 29, 2016

Q1. While reading the announcement, I noticed that "biological processes" are excluded from this solicitation. We are specifically working on microbial pathway [redacted specific approach], which converts atmospheric CO₂ at a cathode to methane via microorganisms, We think (and have data) that this is a very efficient process of storing renewable electrical energy in form of methane, which can be used as transportation fuel.

Does the fact that this reaction is catalyzed in our system by microorganisms disqualify this project from participating in the solicitation?

ANSWER: Refer to the General FAQs Section of ARPA-E'S website ([HTTP://ARPA-E.ENERGY.GOV/?Q=FAQ/GENERAL-QUESTIONS](http://arpa-e.energy.gov/?Q=FAQ/GENERAL-QUESTIONS)), Question 2.7.

Q2. Would making a bio-crude qualify as an energy dense Carbon-Neutral Liquid Fuel (CNLF) under ARPA-E's Renewable Energy to Fuels through Utilization of Energy-dense Liquids (REFUEL) Program? Is there are more detailed definition of "Carbon-Neutral Liquid Fuel (CNLF)"?

ANSWER: Biocrude is allowed as an intermediate chemical as long as it meets the FOA criteria set forth **Section I. E**, provided a credible path for conversion to a standard drop in fuel is demonstrated. Please see Section I.B.1 of the FOA for the definition of CNLF.

Q3. A solid fuel such as zinc can meet the primary objectives of this FOA. That is, it can be efficiently produced by solar electrolysis, stored almost indefinitely at no cost, transported safely at lower cost than liquid fuel, and generate electricity on demand through zinc/air battery for stationary or vehicle applications. The zinc-zinc oxide loop emits little carbon, and most of the technologies for this loop are commercially available or ready.

In terms of the performance matrix in Table 1, zinc is better in some categories but worse in others as compared to ammonia. The biggest issue with zinc is probably its specific energy density in kWh/kg, which is only 25% of ammonia by the Haber-Bosch process. On the other hand, its energy density in kWh/L is twice as high as ammonia. The intrinsic energy efficiency of zinc oxide electrolysis is 35% higher than water electrolysis. With some efforts, I believe such a loop can meet all the requirements for subcategory 1B and 2B.

Would this be in the scope of this FOA?

ANSWER: Refer to the General FAQs Section of ARPA-E'S website ([HTTP://ARPA-E.ENERGY.GOV/?Q=FAQ/GENERAL-QUESTIONS](http://arpa-e.energy.gov/?Q=FAQ/GENERAL-QUESTIONS)), Question 2.7

Q4. If I am making a renewable fuel that can already be burned in an IC engine, do I also have to ask how that fuel can be turned back to hydrogen?

ANSWER: Refer to the General FAQs Section of ARPA-E'S website ([HTTP://ARPA-E.ENERGY.GOV/?Q=FAQ/GENERAL-QUESTIONS](http://arpa-e.energy.gov/?q=faq/general-questions)), Question 2.7.

Q5. Under Category 1, would ARPA-E consider a biocatalytic approach to producing CNLFs from renewable CO₂, water, and renewable energy?

ANSWER: Refer to the General FAQs Section of ARPA-E'S website ([HTTP://ARPA-E.ENERGY.GOV/?Q=FAQ/GENERAL-QUESTIONS](http://arpa-e.energy.gov/?q=faq/general-questions)), Question 2.7.

Q6. Would ammonia (NH₃) be considered as a fuel made from air (N₂)? Fuel cells can be constructed to use NH₃ as a fuel.

ANSWER: Refer to the General FAQs Section of ARPA-E'S website ([HTTP://ARPA-E.ENERGY.GOV/?Q=FAQ/GENERAL-QUESTIONS](http://arpa-e.energy.gov/?q=faq/general-questions)), Question 2.7.

Q7. I am looking into DE-FOA-0001562: RENEWABLE ENERGY TO FUELS THROUGH UTILIZATION OF ENERGY-DENSE LIQUIDS (REFUEL) and am curious if direct utilization of light, water, and air to produce liquid fuels will meet ARPA-E's goals, or if the examples of electricity or thermal energy are intended to be the only energy input allowable.

ANSWER: Refer to the General FAQs Section of ARPA-E'S website ([HTTP://ARPA-E.ENERGY.GOV/?Q=FAQ/GENERAL-QUESTIONS](http://arpa-e.energy.gov/?q=faq/general-questions)), Question 2.7.

II. Questions for week ending: MAY 6, 2016

Q8.A. I AM FROM [a university] AT DEPARTMENT OF CHEMICAL & ENVIRONMENTAL ENGINEERING. SEVERAL OF THE RESEARCH GROUPS IN BOTH CHEMISTRY AND CHEME DEPARTMENTS AT [a university] HAVE CONTINUING INTERESTS IN ALTERNATIVE FUELS IN ADDITION TO THE CURRENT EXPERIENCE OF PRODUCING SOLAR H₂ FROM WATER SPLITTING. REGARDING THIS EXCITING FUNDING OPPORTUNITY, I'D LIKE TO ASK SEVERAL QUESTIONS ON BEHALF OF MY COLLEAGUES. WOULD HYDROGEN PEROXIDE (AQUEOUS SOLUTION OF H₂O₂) BE CONSIDERED CNLFS WITHIN THE SCOPE OF THIS FOA?

ANSWER 8A: ARPA-E may not provide pre-submission assessments of a project team's concepts. Regarding the use of hydrogen peroxide, applicants are encouraged to review all of the Technical Performance Targets in Section I.E. of the FOA.

Q8.B. ARE THERE LIMITATIONS ON THE NUMBER OF PIS INVOLVED? ARE MULTI-INSTITUTIONAL PROPOSALS ENCOURAGED, OR ARE THEY EQUALLY EVALUATED?

ANSWER 8B: The REFUEL FOA does not limit the number of principal investigators proposed; teaming structure is a choice of the applicant. ARPA-E will evaluate compliant and responsive Concept Paper submissions from eligible applicants/project team members under the merit review criteria set forth in Section V.A.1 (Criteria for Concept Papers) of the FOA. Please refer to Section III.A (Eligible Applicants) of the FOA for the complete list of eligible applicants for the REFUEL FOA.

Q9.A. PLEASE CLARIFY WHETHER: A "SINGLE CONCEPT OR TECHNOLOGY" FOR A "SYNTHESIS PROCESS" ALLOWS FOR DEVELOPING A SYNTHESIS REACTOR AND REFERRING TO RELATED ELECTROCHEMICAL HYDROGEN GENERATION, AIR CAPTURE OF CO₂, AND RELATED RENEWABLE ENERGY, OR IF IT ALSO REQUIRES THE MUCH LARGER EFFORT TO INCLUDE OR DEVELOP THOSE TECHNOLOGIES.

ANSWER: 9A. As stated in Section IV.C of the FOA, "Unrelated concepts and technologies should not be consolidated into a single Concept Paper." (emphasis added).

Q9.B. CAN SYNTHESIS OF FUELS WITH CO₂ INCLUDE NEAR TERM CO₂ CAPTURE FROM INDUSTRIAL EMISSIONS, AND REFER TO LONG TERM AIR CAPTURE TO REDUCE NEAR TERM RISK AND COST?

Answer 9B: As stated in Section I.B.1 of the FOA, "the synthesis of CNLFs using intermittent renewable energy sources and water and air (N₂ and CO₂) [are] the only chemical input streams."

Q9.C. PLEASE CORRECT THE TRANSMISSION AND STORAGE COSTS FOR GASOLINE AND SYNTHETIC GASOLINE.

TABLE 1 P 5 AND TABLE 3 P 16 BOTH REPORT 0.001 \$/KWH FOR TRANSMISSION AND STORAGE COSTS OF GASOLINE OR SYNTHETIC (CARBON-NEUTRAL) GASOLINE. HOWEVER, SECTION E TECHNICAL PERFORMANCE TARGETS PAGE 22 PARA 1 REQUIRES: "FOR SIMPLICITY, IN THE CONCEPT PAPER PHASE, TRANSMISSION AND STORAGE COSTS FOR THE CALCULATION SHOULD BE ASSUMED TO BE \$0.02/KWH FOR ANY CNLF."

Answer 9C. As stated on page 22 in Section I.E of the FOA, two different values are used for this calculation in the Concept Paper and Full Application stages of the application process. For simplicity, Concept Paper submissions must use the single assumed cost of transmission and storage of \$0.02/kWh for any CNLF. A more detailed cost calculation with references and stated assumptions will be required in the Full Application phase, at which point additional guidance will be provided.

Q9.D. PLEASE CLARIFY FUEL PURITY REQUIREMENTS.

CATEGORY 1 P 18 PARA 1 REQUIRES: "THE REQUIRED PURITY OF FUELS DEPENDS ON THE FUEL TYPE AS WELL AS ON THE APPLICATION AND THIS METRIC HAS TO BE DEFINED BY THE APPLICANT AND EXPRESSED IN TERMS OF THE CONTENT OF THE MAIN COMPONENT AND THE MAXIMUM CONCENTRATION OF INDIVIDUAL IMPURITIES THAT HAVE OR MAY HAVE A DELETERIOUS EFFECT ON FUEL USE."

HOWEVER, SECTION E TECHNICAL PERFORMANCE TARGETS SUBCATEGORY 1B TABLE SPECIFIC TO SUBCATEGORY 1A: CHEMICAL PRODUCTION REQUIRES 1A6 "FUEL PURITY > 99%."

FUEL PURITY VARIES WIDELY DEPENDING USE IN IC ENGINES VERSUS FUEL CELLS. I RECOMMEND CORRECTING THE TABLE 1A6 99% PURITY TO THE EARLIER USER SPECIFIED PROVISION.

THE ASTM D5798 STANDARD SPECIFICATION FOR ETHANOL FUEL BLENDS FOR FLEXIBLE-FUEL AUTOMOTIVE SPARK-IGNITION ENGINES WHICH COVERS 53% TO 85% ETHANOL AND ALLOWS 2.5% OF METHANOL AND HIGHER ALCOHOLS. THIS ALLOWS UP TO 4.7% OF METHANOL AND HIGHER ALCOHOLS IN A 53% BLEND (=2.5%/53%). INTERNATIONAL USE OF FUEL METHANOL ALREADY EXCEEDS 7 BILLION GALLONS/YEAR (22 MILLION METRIC TONS) WITH MUCH WIDER COMPOSITION TOLERANCES

ANSWER 9D: Per of Section I.D of the FOA states "The required purity of fuels depends on the fuel type as well as on the application and this metric has to be defined by an applicant and expressed in terms of content of the main component and the maximum concentration of individual impurities that have or may have a deleterious effect on the fuel use."

Per Section II.A (Award Overview) of the FOA, "ARPA-E encourages applications stemming from ideas that still require proof-of-concept R&D efforts as well as those for which some proof-of-concept demonstration already exists. ...[A]pplications requiring proof-of-concept R&D can propose a project with the project end deliverable being an extremely creative, but partial solution. However, the Applicants are required to provide a convincing vision how these partial solutions can enable the realization of the program metrics with further development." Refer to Section II.A of the FOA for more information on partial solution submissions.

Q10. ARE BIOMASS OR BIOMASS-DERIVED STREAMS ALLOWABLE INPUTS TO THE FUEL SYNTHESIS STEP (CATEGORY 1)?

ANSWER: Refer to the General FAQs Section of ARPA-E'S website ([HTTP://ARPA-E.ENERGY.GOV/?Q=FAQ/GENERAL-QUESTIONS](http://arpa-e.energy.gov/?Q=FAQ/GENERAL-QUESTIONS)), Question 2.7.

Q11. THE FOA STATES THE CO2 SOURCE MUST BE TAKEN FROM A SUSTAINABLE SOURCE, AND NOT PRODUCED FROM FOSSIL FUELS. MAY WE USE CO2 THAT HAS ALREADY BEEN CAPTURED FROM POINT SOURCES, SUCH AS POWER-PLANTS, BIOMASS COMBUSTION, ETC., TO PRODUCE CARBON-NEUTRAL LIQUID FUELS?

ANSWER: As stated in Section I.B.1 of the FOA, “the synthesis of CNLFs using intermittent renewable energy sources and water and air (N₂ and CO₂) [are] the only chemical input streams.”

Q12. I AM PLANNING TO SUBMIT A CONCEPT PAPER TO THE REFUEL PROGRAM ON A NOVEL WAY TO GENERATE FORMIC ACID IN HIGH CONCENTRATION (85%) FROM CO2. AT THIS CONCENTRATION, FORMIC ACID IS NON-FLAMMABLE AND 4.4 WT.% OF HYDROGEN WITH A VOLUMETRIC CAPACITY OF 53.4 G/L AT STANDARD TEMPERATURE AND PRESSURE.

IN READING THE FOA, I NOTICED THERE WAS AN EMPHASIS ON USING AMMONIA AND HYDRAZINE AS FUELS. WOULD FORMIC ACID SYNTHESIS FROM RENEWABLE RESOURCES BE CONSIDERED FOR THIS PROGRAM?

ANSWER: ARPA-E will review responsive and compliant Concept Paper submissions utilizing any energy carrier that is produced from renewable energy, water and air and can be converted to electricity or hydrogen and also meets the Technical Performance Targets provided in Section I.E of the FOA . Concept Paper submissions are compliant if they meet the requirements of “Compliant Criteria” in Section III.C.1 of the FOA, and are responsive if they meet the Program Objectives and other requirements set forth in the “Technical Performance Targets” in Section I.E of the FOA and do not fall under the list of “Responsiveness Criteria” or “Submissions Specifically Not of Interest” in Sections III.C.2 and III.C.3 the FOA.

Q13. REGARDING THE ENERGY DENSITY TARGET FOR CATEGORY 1 ON PAGE 22. IF THE ENERGY DENSITY TARGET IS NOT MET BUT THE OVERALL COST AND EFFICIENCY TARGETS ARE AS GOOD OR BETTER THAN A FUEL THAT MEETS THE ENERGY DENSITY REQUIREMENT, CAN A FUEL OF ENERGY DENSITY LOWER THAN 3.5 KWH/L BE USED?

ANSWER: Per Section II.A (Award Overview) of the FOA, “ARPA-E encourages applications stemming from ideas that still require proof-of-concept R&D efforts as well as those for which some proof-of-concept demonstration already exists. ...[A]pplications requiring proof-of-concept R&D can propose a project with the project end deliverable being an extremely creative, but partial solution. However, the Applicants are required to provide a convincing vision how these partial solutions can enable the realization of the program metrics with further development.” Refer to Section II.A of the FOA for more information on partial solution submissions. In addition, please refer to General Question 1.2 for information on the types of projects that ARPA-E funds.

Q14. Questions:

- 1. HOW IS THE FUEL PRODUCTION COST (CF) DEFINED? IS IT JUST THE OPERATING COST, I.E. FEEDSTOCK AND ENERGY (AT THE STATED COST OF \$0.05/KWH FOR ELECTRICITY)? SHOULD WE ASSUME SOME STANDARDIZED COST FOR THE FEEDSTOCKS OF AIR AND WATER, OR CAN THOSE COSTS BE ASSUMED NEGLIGIBLE? ARE THERE OTHER CONTRIBUTIONS TO OPERATING COST THAT SHOULD BE INCLUDED? IS CAPITAL COST INCLUDED, AND IF SO, HOW SHOULD THAT BE AMORTIZED?**
- 2. HOW, PRECISELY, IS CONVERSION EFFICIENCY DEFINED?**

ANSWER:

1. The fuel production cost (CF) should be calculated as outlined in Table 1 of the FOA, Section I.B.1, and as described in references to this table. CF is defined as a sum of operational and capital costs, assuming negligible cost of air and water feedstocks and amortization over 20 years.
2. Per Footnote f in Table 2 of the FOA, "Energy efficiency (EE) is defined as $EE = P/(P+E)$ where P is the primary energy of extracted hydrogen and E is energy consumed for the conversion process." Similarly, conversion efficiency (to electricity) is the ratio of produced electrical energy to primary energy of a CNLF.

Q15. THE CALL DISCUSSES FUEL CONVERSION FROM CO₂. DOES THE CO₂ HAVE TO COME FROM THE AIR (WHERE IT IS VERY DILUTE) OR CAN IT COME FROM A MORE CONCENTRATED SOURCE SUCH AS INDUSTRIAL FLUE GAS?

ANSWER: Please see the response to Q&A 10 above.

III. Questions for week ending: MAY 13, 2016

Q16. THE TEAM I AM LEADING FOR PREPARATION OF A CONCEPT PAPER FOR THIS FOA HAS QUESTION. THE INTEGRATED PROCESS WE ARE PROPOSING IS PRINCIPALLY ELECTROCHEMICAL AND THERMOCHEMICAL IN NATURE, BUT SOME OF THE STRATEGIES WE WERE CONSIDERING TO EXAMINE AS ALTERNATIVE FOR INDIVIDUAL STEPS IN THE CO₂ □ HYDROCARBON FUEL PATHWAY ARE BIOLOGICALLY ASSISTED (E.G., MICROBIAL-ASSISTED ELECTROSYNTHESIS STEPS). WE ARE AWARE THE FOA STATES THAT “GENERATION OF FUELS BY BIOLOGICAL OR ENZYMATIC METHODS” ARE NOT SPECIFICALLY OF INTEREST, BUT IS THERE POTENTIAL INTEREST FROM ARPA-E IN TECHNOLOGICAL PATHWAYS THAT CONSIDER THE APPLICATION BIOLOGICAL PROCESSING STEPS WITHIN A LARGER ELECTROCHEMICAL/BIOLOGICAL/THERMOCHEMICAL PROCESS?

ANSWER: Refer to the General FAQs Section of ARPA-E'S website ([HTTP://ARPA-E.ENERGY.GOV/?Q=FAQ/GENERAL-QUESTIONS](http://arpa-e.energy.gov/?q=faq/general-questions)), Question 2.7.

Q17. THE TARGET RATE REQUIREMENT IN THE FOA IS LISTED IN SURFACE AREA METRICS FOR CATALYSIS (MOL S⁻¹ CM⁻²), IS THERE AN EQUIVALENT RATE TARGET MORE SUITABLE FOR REDOX MATERIALS (E.G. MMOL S⁻¹ G⁻¹)?

ANSWER: Per Section I.B.1 of the FOA, if the surface rate target is not applicable for a particular concept, applicants must still demonstrate that their proposed concept is capable of meeting the SUE target value stated in the FOA.

Q18. AS FOR THE TARGET LIQUID FUELS, IS THIS FOA GENERALLY LOOKING FOR AMMONIA OR HYDRAZINE HYDRATE? WOULD IDEAS INVOLVES GENERATION OF OTHER FUEL TYPES, SUCH AS FORMIC ACID, BE ENCOURAGED IN THIS FOA?

ANSWER: Please see the response to Q&A No. 12 above.

Q19. MY QUESTION IS: IS ANY MATERIAL OTHER THAN N₂, CO₂, AND H₂O, ALLOWED TO BE PART OF RAW MATERIAL BLEND, SUCH AS SOLID CARBON, BIOCHAR ETC., IN THE PROPOSED TECHNOLOGY?

ANSWER: Refer to the General FAQs Section of ARPA-E'S website ([HTTP://ARPA-E.ENERGY.GOV/?Q=FAQ/GENERAL-QUESTIONS](http://arpa-e.energy.gov/?q=faq/general-questions)), Question 2.7.

IV. Questions for week ending: MAY 18, 2016

Q20. Questions:

- 1. CAN A SINGLE COMPANY SERVE AS LEAD ON TWO SEPARATE SUBMISSIONS?**
- 2. WE HAVE A FULL SYSTEM CONCEPT, FROM LIQUID FUEL SYNTHESIS THROUGH ELECTRIC POWER REGENERATION. TWO OF THE IMBEDDED TECHNOLOGIES ARE IN THE DEVELOPMENT STAGE.**
 - A. IS A SINGLE SYSTEMS INTEGRATION SUBMISSION ACCEPTABLE? OR**
 - B. WOULD IT BE BETTER TO SUBMIT ONE PROPOSAL ON SYNTHESIS, AND A SECOND ON REGENERATION?**

ANSWER: Q20A Refer to the General FAQs Section of ARPA-E's website (<http://arpa-e.energy.gov/?q=faq/general-questions>), Question 6.4.

ANSWER Q20B ARPA-E may not provide pre-submission assessments of a project team's concept paper submissions. As stated in Section I.D. of the FOA, "[A]pplications in Category 1 proposing the synthesis of a novel fuel for which there is no commercially accepted method for manufacturing and conversion to electricity or hydrogen are strongly encouraged to also propose an approach for the conversion of that fuel to electricity or hydrogen, i.e. must address both Category 1 and Category 2." Applicants must review the requirements of the FOA and independently determine whether decide whether to submit one or two concept papers.

Q21. Can you clarify the difference between Subcategories 1A and 1B? In particular, if we propose to combine water electrolysis (to produce H₂) with subsequent chemical (catalytic) synthesis of a fuel, which set of metrics applies?

ANSWER: Subcategory 1A is Chemical Production and Subcategory 1B is Electrochemical Production. As stated in Section I.E. (pg 23) of the FOA, Subcategory 1B includes "electrochemical reactors and thermochemical systems."

Q22. We are a small business planning to bid as prime on this FOA and hope to take advantage of the 1 year initial grace period on the cost-share requirement.

Clarification -- Does the same cost share grace period extend to our national lab technical partner [Name of National Laboratory] provided their total cost stays below 20% of total project cost?

ANSWER: The Prime Recipient is legally responsible for paying the entire cost share (see FOA Section III.B.4). As set forth in FOA Section III.B.3: "Project Teams where a small business is the lead organization and small businesses perform greater than or equal to 80%, but less than 100%, of the total work under the funding agreement (as measured by the Total Project Cost) the Project Team are entitled to the same cost share reduction and Cost Share Grace Period as provided [in FOA Section III.B.1] to Standalone small businesses or consortia of small businesses."

Q23. Please let us know if it is preferable or advantageous to submit the concept paper under the SBIR/STTR opportunity or the standard REFUEL FOA.

ANSWER: Prospective applicants are encouraged to read the funding opportunity announcements and independently assess if a submission is warranted under DE-FOA-0001562 or DE-FOA-0001563. DE-FOA-0001563 is targeted at small business concerns under the Small Business Innovative Research (SBIR) and Small Business Technology Transfer (STTR) programs, and reflects the unique rules and regulations applicable to those programs. Entities that qualify as “Small Business Concerns” are strongly encouraged to apply under DE-FOA-0001563. To determine eligibility as a “Small Business Concern” under DE-FOA-0001563, review the eligibility requirements in Sections III.A-III.D of the FOA.

Q24. For projects falling into category 1A, requirement 1A.1 specifies a reaction rate, given in units of mol cm⁻² s⁻¹. Can you please clarify what area should be used for this metric? For example, is it total catalyst surface area, active catalyst surface area, or something else?

ANSWER: ARPA-E will review compliant and responsive concept paper submissions and provide feedback either encouraging or discouraging submission of a Full Application. Concept Paper submissions are compliant if they meet the requirements of “Compliant Criteria” in Section III.C.1 of the FOA, and are responsive if they meet the Program Objectives and other requirements set forth in the “Technical Performance Targets” in Section I.E of the FOA and do not fall under the list of “Responsiveness Criteria” or “Submissions Specifically Not of Interest” in Sections III.C.2 and III.C.3 of the FOA. Applicants must review the technical requirements of the FOA and independently determine whether their proposed concept warrants a submission.

Q25. I am wondering if you can tell me more about ARPA E REFUEL? Is this appropriate for early stage research? We make catalysts for CO₂ hydrogenation and methanol dehydrogenation. However, much of this work is early stage.

More specifically, we are making transition metal catalysts for these hydrogenation/dehydrogenation reactions. I am asking because the questions about efficiency in the pre-application suggested to me that this may be late stage research. As we have just recently made the catalysts, we don't know how efficient they are quite yet.

ANSWER: Please see response to Question 12 above.

V. Full Application Phase Questions:

Q26. I wonder if you can give me some advice on the SUE calculations:

A) How should we account for the intermittent nature of renewable energy in our SUE calculation? What percentage of the available time in the year should we assume carbon-free energy is available? I can imagine using 33% if my process could only draw energy from a single wind farm, 50% if I can draw energy from sun or wind, or 99% if my process is near a nuclear plant a hydroelectric facility or was tied in to the grid so I could draw energy from anywhere. Do you have a suggested fraction of uptime or are we free to choose any number we like?

B) The FOA gives two different values for Fuel transportation cost (CT) for gasoline. Table 1 says 0.001 \$/kw-hr. The suggested values in cost spreadsheet suggests \$0.053/liter, or about \$0.003/kw-hr. Which value should I use? I believe that \$0.053/lit is correct.

C) If we are proposing to topic 1B, can we choose any engine efficiency provided we can justify it.

D) The present REFUEL cost estimation workbook does have tabs to show where all of the numbers come from. Can we simply add worksheets, or do we need to put the information in the proposal.

ANSWER 26(A): As stated in Section I.E (Technical Performance Targets) of the FOA, “[f]or fuel production technologies, a lifetime of 25 years must be assumed, with a capacity factor of 32.5% for wind, 28.6% for PV solar, and 22.7% for thermal solar... ..If the proposed technology requires different values than those stated above, Applicants must mark the related cells in color and provide suitable references to justify.” In addition, Section I.B.1 (Program Overview – Summary) of the FOA states that “...[t]echnologies developed under the REFUEL program will enable long-term (i.e. multi-day capacity) energy storage and long-distance renewable energy delivery from remote, isolated, and/or stranded locations.” Thus, applicants can combine renewable resources (e.g., sun and wind) in determining the capacity factor, but grid resources - such as nuclear - that are not available at remote, isolated, and/or stranded locations cannot be included.

ANSWER 26(B): The value provided in Table 1 for transmission cost of gasoline (0.001 \$/kWh) is based on costs associated with using a pipeline, and is only intended to provide applicants with a potential future cost analysis for REFUEL technologies. Per Section I.E (Technical Performance Targets) of the FOA, applicants must calculate Fuel transportation cost (CT) “...based on the value of \$0.053/L for CNLF liquid at ambient conditions and \$0.057/L for liquefied gases” in their Full Applications. These costs are based on trucking/hauling transportation costs.

ANSWER: 26(C): Per Section I.B.1 of the FOA, Table 1 lists a conversion efficiency of 55% for hydrogen and ammonia. Per Section I.E (Technical Performance Targets) of the FOA, “If the proposed technology requires different values than those stated above [in the FOA], Applicants must mark the related cells in color and provide suitable references to justify” the selected values.

ANSWER 26(D): Per Section I.E (Technical Performance Targets) of the FOA, “If there is no available data on SUE cost components the Applicant is expected to provide literature data (marked in color) or describe the assumptions made to generate the cost metrics and provide any calculations in a separate spreadsheet tab.” At a minimum, applicants need to conform to the content requirements for the Cost Analysis Workbook described in Section IV.D.8 (Content and Form - Eighth Component: Cost Analysis Workbook) of the FOA.

Q27. We have a question regarding submission of budget information and required forms. Two of our partners are DOE national laboratories. What information is required of them and where do we include it in our submission? I know they are required to submit the authorization letter, but are they also required to submit the budget justification form and/or a field work proposal. Please advise on the proper way to submit their information with the proposal.

ANSWER: Refer to the *ARPA-E Budget Justification Guidance* (pp. 7-8), found under the Template Application Documents hyperlink on the REFUEL funding opportunity announcement on the ARPA-E Funding Opportunity Exchange web page (<http://ARPA-E-FOA.energy.gov>). A link to the Guidance document is provided here for convenience: <https://arpa-e-foa.energy.gov/FileContent.aspx?FileID=36bf9d9a-2dc8-43a6-9741-f2e32ba6c4d0>

Q28. Several Questions:

- 1. Are expenses for H1B visa reimbursable under the program?**
- 2. It looks like that we have no choice but to perform at least some research in Australia. Would it be a problem? If not, how are foreign travel expenses regulated?**
- 3. Category 2a. Because of readily available membranes for H2 and N2 separation are very big and require high pressure input, would only novel ammonia cracker unit, producing mixed H2 and N2 stream (with lab test of the combined stream) be acceptable as a bench scale deliverable?**
- 4. If the topic related conference will be held outside the US, would attending it be reimbursable? If yes, does it have to be approved by the contract officer first?**
- 5. Would traveling outside the US for promoting the technology be reimbursable? If yes, does it have to be approved by the contract officer first?**
- 6. How and when we will be able to see your answers?**

ANSWER:

1. No. Only short-term, travel visa costs (as opposed to longer-term, immigration visas) are generally allowable expenses and may be proposed as a direct cost. Since short-term visas are issued for a specific period and purpose, they can be clearly identified as directly connected to work performed on an ARPA-E sponsored project. For these costs to be directly charged to an ARPA-E award, they must be:

- a. critical and necessary for the conduct of the project;
 - b. allowable under the applicable cost principles;
 - c. consistent with the organization's cost accounting practices and organizational policy; and
 - d. meet the definition of "direct cost" as described in the applicable cost principles.
2. ARPA-E requires all work under ARPA-E funding agreements to be performed in the United States – i.e., Prime Recipients must expend 100% of the Total Project Cost in the United States. However, Applicants may request a waiver of this requirement where their project would materially benefit from, or otherwise requires, certain work to be performed overseas. ARPA-E's provision of a foreign work waiver is a fact dependent, case-by-case determination that is made only in exceptional circumstances and only for discrete parts of an award that necessitate foreign work. Pertinent facts are communicated to ARPA-E via the Business Assurances and Disclosures form that is submitted with the Full Application and considered in conjunction with the merit review process. Foreign travel expenses must have the prior approval of the Contracting Officer and are governed by the pertinent part of the applicable cost principles – i.e., FAR 31.205-46 for commercial businesses or 2 CFR § 200.474 for all others.
 3. Refer to FAQ 2.7, found in the General FAQ Section of ARPA-E's website ([HTTP://ARPA-E.ENERGY.GOV/?Q=FAQ/GENERAL-QUESTIONS](http://arpa-e.energy.gov/?Q=FAQ/GENERAL-QUESTIONS)).
 4. Refer to FAQ 10.3, found in the General FAQ Section of ARPA-E's website ([HTTP://ARPA-E.ENERGY.GOV/?Q=FAQ/GENERAL-QUESTIONS](http://arpa-e.energy.gov/?Q=FAQ/GENERAL-QUESTIONS)).
 5. Refer to FAQ 10.3, found in the General FAQ Section of ARPA-E's website ([HTTP://ARPA-E.ENERGY.GOV/?Q=FAQ/GENERAL-QUESTIONS](http://arpa-e.energy.gov/?Q=FAQ/GENERAL-QUESTIONS)).
 6. Refer to FAQ 2.4, found in the General FAQ Section of ARPA-E's website ([HTTP://ARPA-E.ENERGY.GOV/?Q=FAQ/GENERAL-QUESTIONS](http://arpa-e.energy.gov/?Q=FAQ/GENERAL-QUESTIONS)).

Q29. [On the SF-424:] What is the difference, if any, between item #4 and item #5a? Item #9: Are DOE National Labs GOGOs or GOCOs? Item #13: What is the Competition Identification Number and Title for REFUEL? Is this the same as CFDA in section 15?

ANSWER: Instructions for completing the SF-424 can be found at <http://www.grants.gov/web/grants/form-instructions/sf-424-instructions.html>. Department of Energy National Laboratories are government-owned, contractor-operated except for the National Energy Technology Laboratory, which is government-owned, government-operated.

Q30. It has come to our attention that some cells in the template cost analysis workbook contained errors, or needed some additional clarification.

ANSWER: If you are planning on using the template workbook to input your cost analysis, we suggest that you download the revised version from our website (<https://arpa-e->

foa.energy.gov/Default.aspx#Foald1f46538f-5fae-45c0-a12d-59cbe2e6992e). The changes and supplemental explanations are highlighted in yellow. Note that in some cells, formulas were edited or removed.

Q31. Has or will a Class Waiver in accordance with 10 CFR 784 be granted for this funding opportunity?

ANSWER: A copy of the class patent waiver can be downloaded from the following website: <http://arpa-e.energy.gov/?q=arpa-e-site-page/award-guidance>. After clicking on the link, scroll to the bottom of the page and look for the section titled “Class Patent Waiver”.

Q32. I have a question about the cost analysis required for the REFUEL full application:

The FOA provides the guidance “For conversion technologies, a lifetime of 15 years must be assumed, with a capacity factor of 65%, assuming the storage tanks can be appropriately oversized to supply continuous fuel input.” This section does not distinguish between subcategory 2A, which is a stationary application supplying hydrogen to a refueling station, and subcategory 2B, which is onboard power generation for transportation applications. The economic requirements for a transportation power source are drastically different than those for stationary applications, with the capacity factor at least an order of magnitude lower. We suggest 5000 hours of operation as a reasonable basis in contrast to the 78000 hours implied by a 65% capacity factor over 15 years. Understanding that a reduction in operating hours will proportionally increase the levelized capital costs in the cost analysis, we do not want to unilaterally change the assumptions in a way that ARPA-E does not expect. However, we feel that transportation is by far the most important application of liquid fuels, and an economic analysis assuming a 65% capacity factor for a transportation power source will wildly misstate the economic viability of proposed technologies. Would ARPA-E like to provide any revised assumptions for subcategory 2B that are more appropriate for transportation applications or reaffirm that 65% is the required capacity factor despite the above concerns?

ANSWER: Per Section I.E (Technical Performance Targets) of the FOA, “For conversion technologies, a lifetime of 15 years must be assumed, with a capacity factor of 65%, assuming the storage tanks can be appropriately oversized to supply continuous fuel input.” The primary technical performance targets for Category 2B submissions are Metric Nos. 2B.1 through 2B.7 located in the table titled “Subcategory 2B: Direct use of fuel” provided in Section I.E. of the FOA.

Q33. Throughout the FOA, but specifically in Section III.D, ARPA-E uses the term “sub-recipient”. Would a party providing only cost share to the project be considered a “sub-recipient”?

ANSWER: This is a fact-dependent determination based on the specific role of a proposed project team member. ARPA-E may not provide pre-submission determinations on a team member’s role as a subrecipient or otherwise.

Q34. Referencing the DE-FOA-0001562 FOA ..., we note the following on page 53 of the FOA; it states:

- All TT&O costs requested must be included in the Applicant’s proposed budget and identified as TT&O costs in the Budget Justification Workbook/SF-424A with the costs being requested under the “Other” budget category. All budgeted activities must relate to achieving specific objectives, technical milestones and deliverables outlined in Section 2.4 Task Descriptions of the Technical Volume.

On Page 64 it states:

8. TECHNOLOGY TRANSFER AND OUTREACH

ARPA-E is required to contribute a percentage of appropriated funds to Technology Transfer and Outreach (TT&O) activities. In order to meet this mandate every Project Team must spend at least 5% of the Federal funding (i.e., the portion of the award that does not include the recipient’s cost share) provided by ARPA-E on TT&O activities to promote and further the development and deployment of ARPA-E-funded technologies. Project Teams must also seek a waiver from ARPA-E to spend less than the minimum 5% TT&O expenditure requirement.

The first statement indicates that all TT&O cost must be on Applicant budget, but the second statement speaks of the entire team.

Can the applicant propose TT&O costs and also the team members propose TT&O costs?

ANSWER: Yes.