

## QUESTIONS AND ANSWERS

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. Concept Paper Phase Questions:

**Q1. ... While I and most members of my team have either the citizenship or the Green Card (i.e. Permanent residency), one of our team members ... has not yet received the Green Card. ... I was wondering whether she can be part of our team then? ...**

**ANSWER:** Applicants are responsible for personnel staffing decisions concerning their proposal, including for foreign researchers working on ARPA-E awards. Principal Investigators and other researchers are not necessarily required to be U.S. citizens or permanent residents. Hiring/work assignment decisions for ARPA-E research should consider that ARPA-E awards normally involve technology or software - including any manufacturing know-how - that is "restricted or proprietary" as cited in export control regulations (at 15 C.F.R Section 734.8(a)). This includes when a university awardee partners with/licenses to a for-profit team entity, or if the university awardee seeks ARPA-E approval of "protected data" resulting from the research. Also, awardees' inventions resulting from ARPA-E research must be reported and protected, and are subject to U.S. manufacturing requirements. Refer to Attachment 1, Clauses 4 and 12, and Attachment 2 of the ARPA-E Model Cooperative Agreement for awardee immigration and export control obligations.

**Q2. I am writing to ask if your interest in this program is limited to heat exchanger design and heat exchanger materials that are used only to fabricate said heat exchangers? ... Are you interested in alternative heat transfer fluids and their design and fabrication?**

**ANSWER:** Refer to General FAQ 6.19.

**Q3: You may not have heard of, but we manufacture micro tube heat exchangers. ... Anyway, we will be submitting a proposal for the high temp, high pressure program. I'm trying to find the right application, and the right partner to complete the testing. ... I have a few ideas, but if you can offer any suggestions on ... some partners I may not be aware of, I'd be appreciative. ...**

**ANSWER:** Please refer to the RFI-0000034: Announcement of Teaming Partner List, found on the ARPA-E Funding Opportunity Exchange website <http://arpa-e-foa-energy.gov>.

**Q4. We are interested in responding to the FOA on HITEMMP. For this topic, there are two FOAs, one to general applicants, one specially for small business. Is it OK to apply to both FOAs with similar approach but different team members? Thank you for your consideration and assistance.**

**ANSWER:** Please see Section III.C.2. of FOA Number DE-FOA-0001970 (the "general" FOA) and Section III.F.3. of FOA Number DE-FOA-0001972 (the "SBIR/STTR" FOA), which state that submissions that are not scientifically distinct from applications submitted in response to other currently

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issued ARPA-E FOAs may be deemed nonresponsive and may not be reviewed or considered. Additionally, Section III.F.4. of the SBIR/STTR FOA provides that small businesses that qualify as a "Small Business Concern" may only apply to either DE-FOA-0001970 or DE-FOA-0001972. Applicants that qualify as a "Small Business Concern" are strongly encouraged to apply to DE-FOA-0001972.

**Q5. Another question: we are looking for a user facility for supercritical carbon dioxide facility, or any kind of powder generation system, or a recuperator with the operation condition listed in Table 1. Unfortunately, the test facility is still under construction. The other supercritical steam facilities are not operating in that kind of high temperatures. Would you link us to any DOE lab with that facility running in the condition listed in Table 1? ...**

**ANSWER:** Please refer to the RFI-0000034: Announcement of Teaming Partner List, found on the ARPA-E Funding Opportunity Exchange website <http://ARPA-E-FOA-energy.gov>.

**Q6. I am a proposal developer at assisting with concept paper submissions to this opportunity. Is there a requirement for the amount of work (%) that must be performed by the prime recipient?**

**ANSWER:** There is not a specific percentage requirement regarding the work that must be performed by the Prime Recipient under FOA Number DE-FOA-0001970.

**Q7. There is considerable opportunity for recovering lower grade heat in biological and chemical processes. Are innovative, low cost heat exchanger concepts that target lower temperatures of interest?**

**ANSWER:** Refer to General FAQ 6.19.

**Q8. The steel industry uses 2.25 GJ/tonne to remelt scrap steel and direct reduced iron. With 60 million tonnes/year of steel remelted in the US, that's 135 PJ/year (128 TBTU), or about 0.13% of US energy consumption. Using advanced heat exchangers, particularly around the 1500° C melting point, it may be possible to cut this number in half or better. Is this high-temperature - but not high-pressure - heat exchanger application within the scope of this FOA?**

**ANSWER:** Refer to General FAQ 6.19.

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**Q9. Section I.B, 1. Introduction and Objectives, page 8: ARPA-E expectations. If we are interpreting this paragraph correctly, ARPA-E is expecting selected teams to execute three main groups of tasks: (1) Analytical/computational (numerical) analysis to support design effort and develop micro-channel topology likely to meet project objectives. (2) Small-scale heat exchanger module experiments. Task group 2 includes manufacturing and testing of a small scale micro-channel heat exchanger. (3) Manufacture larger scale heat exchanger (50 kWth or larger) and test it at actual operating conditions given in Table 1 to determine its thermo-hydraulic performance, durability, and shock resistance.**

**Q9.1. Is our interpretation of ARPA-E expectations correct?**

**ANSWER:** ARPA-E expects each Applicant to develop a reasonable and sound work plan to design, develop, test, and validate their proposed heat exchanger while mitigating the risks early on during the project cycle and presenting a reasonable budget to accomplish the project objectives.

**Q9.2. Task 1: Are we to select one micro-channel topology or we can consider several promising topologies and materials of construction (for example, ceramic and glass-ceramics)?**

**ANSWER:** Applicants are not limited to any specific type of topology and material as long as the final deliverable meets the performance targets listed in Section 1.D, Table 1, pages 18-21

**Q9.3 Task 2: Can we manufacture heat exchanger smaller than 50 kWth and test it to reduce the risk?**

**ANSWER:** As mentioned in Section 1.D, Table 1, page 19, the anticipated final heat exchanger prototype thermal duty must be greater than or equal to 50 kW thermal. ARPA-E does not limit the number of intermediate heat exchangers the Applicant can build to test and validate the proposed technology as long as the proposed budget is reasonable to accomplish the proposed project objectives.

**Q9.4 Task 2: Can we manufacture and test more than one small-scale heat exchanger and based on the results select the best design for larger scale testing?**

**ANSWER:** ARPA-E expects each Applicant to develop a reasonable and sound work plan to design, develop, test, and validate their proposed heat exchangers while mitigating the risk early on during the project cycle and presenting a reasonable budget to accomplish the proposed project.

**Q9.5 Task 3: By testing is meant determination of heat exchanger defectiveness, pressure drop, and shock resistance. Is pressure drop metric related to the heat exchanger core only, or does it also include headers and flow splitters, aka is ARPA-E interested in performance of the core or performance of the entire heat exchanger?**

**ANSWER:** ARPA-E is interested in the pressure drop performance of the entire heat exchanger.

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**Q10. Section I.D. Technical categories and program metrics -- The metrics presented in Table 1 suggest sHe as a hot fluid and sCO<sub>2</sub> as a cold fluid, as it would be the case for the VHTR application, or sCO<sub>2</sub> as the hot and cold fluid as it would be the case for the high temperature recuperator (HTR) in the recuperated sCO<sub>2</sub> Brayton cycle with recompression (Feher cycle).**

**Q10.1 Is the nuclear application one of the objectives, or is ARPA-E interested primary in non-nuclear applications? The application makes a significant difference in determining flow rates of the hot and cold fluids and HXE size.**

**ANSWER:** The targeted application is left to the Applicant's discretion as long as the proposed technology can meet the objectives of the FOA and has the potential for a transformational and disruptive advancement compared to the respective existing or emerging technologies.

**Q10.2 Is the choice of working fluids important to ARPA-E?**

**ANSWER:** As set forth in the FOA Section 1.D, Table 1, Items 4 and 15 in pages 18-19, the choice of working fluid is not restricted to supercritical CO<sub>2</sub> or Helium and is left to the Applicant's choice.

**Q11. Does this FOA focus exclusively on power generation? We have identified an application outside of power generation for which high temperature, high pressure operation is desired. If our target application is not power generation, will that be considered nonresponsive to this FOA?**

**ANSWER:** The targeted application(s) is left to the Applicant's discretion so long as the proposed technology can meet the objectives listed in the FOA and has the potential for a transformational and disruptive advancement compared to the respective existing or emerging technologies.

**Q12. Does the pressure drop design constraint apply only to the heat exchanger itself, or does it also include the flow sections that deliver the fluid (i.e. the manifold)?**

**ANSWER:** ARPA-E is interested in the pressure drop performance of the heat exchanger, which includes the core and the connections bringing the fluid into and out of the heat exchanger core.

**Q13. A team ... seeks clarification on the following questions:**

**Q13.1 Direct solar receivers can be interpreted to function as recuperator-type heat exchangers with an external heat source. Many of the same principles that apply to the HITEMMP technical challenge apply to the modularization and miniaturization of solar receivers, especially for concentrating solar power applications using supercritical CO<sub>2</sub> as both heat transfer fluid and working fluid. Would ARPA-E consider a concept paper focused on the design and manufacture of advanced solar receiver concepts with or without integrated thermal energy storage heat exchanger technology be responsive to the HITEMMP solicitation?**

**ANSWER:** Refer to General FAQ 6.19.

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**Q13.2 The solicitation calls for technology demonstration of a heat exchanger at 50 kWth scale. Associated turbomachinery is not yet sufficiently mature to operate at the proposed temperatures and pressures and is explicitly called out as a category specifically not of interest in this solicitation. Will respondents be required to demonstrate power generation in addition to heat exchanger functionality?**

**ANSWER:** As mentioned in the FOA Section 1.B, page 7, and reiterated in the FOA Section 1.D, page 17, ARPA-E anticipates that applicants will demonstrate the performances and durability of the heat exchanger prototype at 50 kWth thermal.

**Q14. Our team for the funding opportunity DE-FOA-0001970 (HITEMMP) is mainly composed of one educational institution (lead organization) and one industrial partner in the US. We are wondering whether our industrial partner can be regarded as a domestic entity even if some tests including “demonstrating a heat exchanger with the desired performance and durability at 50 kW thermal scale” would be done in Europe because our industrial partner has some test facilities there. These tests would not induce any cost.**

**ANSWER:** Refer to FOA Section III.A and General FAQ 3.1.

**Q15. [We have] a few questions to the [Funding Opportunity Announcement]:**

**Q15.1 Do the teams have to provide a testing facility for 250bar – 800-1500C or will ARPA-e provide a testing facility?**

**ANSWER:** Please refer to the RFI-0000034: Announcement of Teaming Partner List, found on the ARPA-E Funding Opportunity Exchange website <http://ARPA-E-FOA-energy.gov>

**Q15.2 Are there size targets for the heat exchanger technology?**

**ANSWER:** The size target is a design outcome and left to the Applicant’s discretion as long as the proposed technology can meet the objectives of the FOA and has the potential for a transformational and disruptive advancement compared to the respective existing or emerging technologies.

**Q15.3 If a company has good concepts in alloys and in ceramics, could they potentially both be awarded as separate proposals or is this discouraged?**

**ANSWER:** Yes, any applicant can submit multiple proposals to this FOA so long as they are scientifically distinct. Refer to General FAQ 6.4.

**Q16. I would like to know if an entity can be a sub-recipient on multiple Concept Papers as long as the Concept Papers are distinguishably different?**

**ANSWER:** Subject to the eligibility criteria set forth at FOA Section III.A, entities may participate in multiple Concept Papers as a prospective sub-recipient.

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**Q17. Should the concept paper include full details of the proposed heat exchanger device (configuration, dimensions.etc) or just the concept and a few sketches and schematics is enough at this stage?**

**ANSWER:** Refer to the guidance provided at FOA Section IV.C. Additional guidance on preparing your Concept Paper can be found in the "HITEMMP - Concept Paper Template" which is provided in the "Required Application Documents" section of the funding opportunity announcement on the ARPA-E Funding Opportunity Exchange website.

**Q18. We have two questions regarding the HITEMMP concept paper FOA.**

**Q18.1 Table 1, row 5: the cold side inlet pressure is  $\geq 250$ bar, however the high side inlet pressure is  $\geq 80$ bar. Usually, the high side will have higher pressure. Is 250bar correctly listed?**

**ANSWER:** Yes, the 250 bar value listed in the FOA Section 1.D, Table 1, item 5 "Cold-side inlet temperature," is correctly listed. It corresponds to a potential recuperator in a recuperated, closed Brayton cycle with supercritical working fluid.

**Q18.2 To demonstrate the project, do we have to demo a 50kW heat exchanger or is it possible to demo something like two 10 kW heat exchanger and prove by modulizing those heat exchanger to reach 50 kW?**

**ANSWER:** As mentioned in the FOA Section 1.B, page 7 and reiterated in the FOA Section 1.D, page 17, ARPA-E anticipates that applicants will demonstrate the performances and durability of the heat exchanger prototype at 50 kWth thermal.

**Q19. We have several questions for the HITEMMP FOA (see below).**

**Q19.1 Is ARPA-E planning any central facility or unified equipment to do prototype testing or would all test equipment be the responsibility of the project team to secure?**

**ANSWER:** Please refer to the RFI-0000034: Announcement of Teaming Partner List, found on the ARPA-E Funding Opportunity Exchange website <http://ARPA-E-FOA-energy.gov>

**Q19.2 Table 1 has some fields provided (i.e.,  $>800$ C,  $>80$  bar). Should we leave these values as given, or should we provide exact target specs for our concept which meets or exceeds the example value?**

**ANSWER:** Applicants are expected to provide anticipated metric value listed in the FOA Section 1.D, Table 1, such as hot-side inlet temperature, hot-side inlet pressure, hot and cold sides pressure drops, etc.

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**Q19.3 What is ARPA-E expecting in the Table 1 row, "Materials and Heat Exchanger performances characterization?" Is it the tests that we will perform to verify material properties and the heat exchanger performance?**

**ANSWER:** That is correct. In the FOA Section 1.D, Table 1, Item 17, Applicants are expected to list the equipment and experimental and analytical techniques they plan to use to characterize the claimed durability of the developed heat exchanger.

**Q19.4 Should we provide specifications in Table 1 for production of our 50 kW prototype, or for the commercial production of devices matching the our target application scale, which may be much larger?**

**ANSWER:** ARPA-E anticipates that production specifications for both the prototype and a potential commercial product be listed by the Applicant.

**Q20. After reading the FOA, we still have some questions.**

**Q20.1 We are considering involving a foreign research institute (in a US ally country) in this proposal. This foreign research institute has the unique capability of testing heat exchanger at high temperature, high pressure and high power. This is perfect for the scale-up demonstration required in this FOA. We were wondering if doing the scale-up testing for heat changers at a foreign research institute is allowed and/or encouraged by this FOA.**

**ANSWER:** Refer to FOA Section III.A and General FAQ 3.1.

**Q20.2 If doing the scale-up testing at the aforementioned institute is allowed, does ARPA-E prefer the institute to be a participant of the Project Team or to be a subcontractor?**

**ANSWER:** Membership on the project team is a matter left to the Applicant's discretion. Applicants are reminded of the criteria for subrecipient and contractor determinations found at 2 C.F.R. § 200.330.

### II. Full Application Phase Questions:

**Q21. We have a few questions about the appropriate way to represent particular partnerships in our HITEMMP proposal. We currently have three companies who are interested in participating in the project in a consultative role. They will not receive any funding or provide any in kind funds, but will provide input on our commercialization pathway and ultimately help commercialize technology related to the project. Our questions are:**

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### **Q21.1 Should we include these companies in our Team Organization and Capabilities section, even though they will not be included in our budget?**

**ANSWER:** The content of an Applicant's Technical Volume and its Team Organization and Capabilities section is within the Applicant's discretion. The qualifications, experience, and capabilities of the proposed project team are subject to merit review (refer to FOA Section V.A.2).

### **Q21.2 Do we need to provide an SF-LLL and Business Assurances and Disclosures from these companies?**

**ANSWER:** Instructions concerning submission of SF-LLL can be found at FOA Section IV.D.2. Refer to General FAQ 13.3 regarding submission of the Business Assurances and Disclosure form.

### **Q21.3 Since the companies will not be receiving any budget, we assume our team (comprised of an FFRDC and a domestic education institution) would still meet the cost share exemption on page 30 of the FOA which states "Project Teams composed exclusively of domestic educational institutions, domestic nonprofits, FFRDCs/DOE Labs, and/or Federal agencies and instrumentalities (other than DOE) are not required to provide cost share," can you confirm?**

**ANSWER:** Refer to General FAQ 4.21.

### **Q22. I have a question about cost-share. Our proposed effort will introduce a new manufacturing technology and the equipment is unique. A third-party company, not part of the proposal team, will donate the equipment ... to enable us to perform the research and development. Can this equipment's market value be used as cost-share? If so, will the entire value of the new equipment be counted as cost-share or only a fraction of it. If only a fraction of it, how can one decide what is the right fraction?**

**ANSWER:** Valuing donated equipment for cost sharing purposes is necessarily a fact-driven determination, addressed, if a Full Application is selected, during the award negotiation process. Federal regulations for valuing third-party equipment donations are set forth at 2 C.F.R. § 200.306(g)-(i). In particular, refer to 2 C.F.R. § 200.306(h)(2) regarding valuing third-party equipment donations if the purpose of any Federal award is to support activities requiring the use of donated equipment.

### **Q23. Can the indirect costs associated with the TTO direct costs, count towards the 5% requirement? If yes, how should that be shown between the two tabs in the budget justification?**

**ANSWER:** Indirect costs properly allocated to TT&O activities are considered TT&O costs and may be included in the 5% requirement. Refer to FOA Section IV.G.3 (p.44) for instructions on preparing the SF-424A Workbook and identifying TT&O costs therein.