

**Department of Energy (DOE)
Office of Energy Efficiency and Renewable Energy (EERE)**

Productivity Enhanced Algae and Tool-Kits

**Funding Opportunity Announcement (FOA) Number: DE-FOA- 0001628
FOA Type: Initial**

CFDA Number: 81.087

FOA Issue Date	12/15/2016	
Informational Webinar	12/20/2016	
Submission Deadline for Concept Papers	1/13/2017	5:00pm ET
Submission Deadline for Full Applications	2/22/2017	5:00pm ET
Expected Submission Deadline for Replies to Reviewer Comments	3/17/2017	5:00pm ET
Expected Date for EERE Selection Notifications	6/15/2017	
Expected Timeframe for Award Negotiations	60 Days from selection	

- Applicants must submit a Concept Paper by 5:00pm ET the due date listed above to be eligible to submit a Full Application.
- To apply to this FOA, applicants must register with and submit application materials through EERE Exchange at <https://eere-Exchange.energy.gov>, EERE’s online application portal.
- Applicants must designate primary and backup points-of-contact in EERE Exchange with whom EERE will communicate to conduct award negotiations. If an application is selected for award negotiations, it is not a commitment to issue an award. It is imperative that the applicant/selectee be responsive during award negotiations and meet negotiation deadlines. Failure to do so may result in cancelation of further award negotiations and rescission of the Selection.

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I. Funding Opportunity Description

A. Description/Background

The Office of Energy Efficiency and Renewable Energy (EERE) is issuing, on behalf of the Bioenergy Technologies Office (BETO), a Funding Opportunity Announcement (FOA) DE-FOA-0001628, entitled “**P**roductivity **E**nhanced **A**lgae and Tool-**K**its (PEAK).”

The production, transportation, and consumption of liquid transportation fuels underpins the U.S. economy. BETO’s mission is to accelerate the research, development, and demonstration of advanced biofuels to provide enduring benefit to the nation. Advanced biofuels and bioproducts made from algae have the potential to enhance energy security, create domestic jobs, and spur the advancement of the bioeconomy.

Since 2009, BETO has used its statutory authority under the Energy Policy Act (EPA) of 2005, §932(c) to implement an algal biofuel program: the Advanced Algal Systems Program. The objective of the Advanced Algal Systems Program is to accelerate the commercialization of algal biofuels by overcoming barriers identified in the 2010 National Algal Biofuels Technology Roadmap, updated in June 2016.¹ Algal biofuels have the potential to be high-impact contributors to advanced biofuel and bioproduct markets.

BETO’s strategy, described in detail in the BETO Multi-Year Program Plan,² for supporting the commercialization of algal biofuels requires significant advances across the algal biofuels supply chain to achieve target modeled minimum fuel selling prices (MFSP). BETO’s Advanced Algal Systems Program has enabled progress in addressing this requirement through funding opportunities Advancements in Algal Biomass Yield (ABY 1&2) and Targeted Algal Biofuels and Bioproducts (TABB), where projects addressed strain improvement within a larger scope that included integration of cultivation processes in field settings and downstream conversion. While continuing to increase scale and integration of system components remains essential to advancing the algal biofuels state of the art, accelerating innovation also requires a dedicated focus on biological variables which most greatly contribute to modeled MFSP. These biological variables include: growth rate, biomass composition (e.g., lipid, protein, and carbohydrate content); predation and pathogen resistance; halotolerance; heat and cold tolerance; and high-intensity light (i.e., direct sunlight) tolerance. Specifically addressing advancements in algal biology to enable high areal productivity in representative outdoor cultivation is an important focus to continue making progress towards the Program’s technical milestones. Robust strains are necessary for continued progress. This FOA will use multidisciplinary biological innovation to deliver strains, tools, data, and techniques to enhance algal biofuel potential and enable

¹ 2016 National Algal Biofuels Technology Review at <http://www.energy.gov/eere/bioenergy/downloads/2016-national-algal-biofuels-technology-review>

² 2016 BETO Multi-Year Program Plan is accessible at:
http://energy.gov/sites/prod/files/2016/03/f30/mypp_beto_march2016_2.pdf

accelerated future innovation in algal biofuels and bioproducts.

To do so, this FOA will follow strategies used in plant domestication, agriculture, and microbial ecology. Plant domestication capitalizes on genetic diversity. Algae have a rich genetic pool compared to plants. However, it remains difficult to access this rich diversity due to a number of limiting factors, including: representative genomes; predictive gene annotation; robust high-throughput screening methods and tools; and robust genetic transformation and engineering tools. This FOA will capitalize on algae diversity and potential by encouraging multidisciplinary innovation that could accelerate innovation in algal biology with modern biotechnology and computational science practices and, in parallel, demonstrate the improvements such innovations can bring.

The timing of this FOA coincides with the emergence of a broad consensus in the scientific literature and stakeholder community (as captured in the 2016 Algal Biology Toolbox Workshop³) about how to develop superior, “cultivation-ready” strains. Leveraging knowledge about the constraints that the “cultivation-ready” framework imposes, including microbial ecology and environmental variability in outdoor cultivation, is fundamental to the FOA. Bringing the full power of modern biotechnology to improve algal strain and cultivation performance in conditions representative of envisioned commercial applications is a critical and timely need in algal biofuels.

This FOA has two topic areas: algal strain improvements (Topic Area 1); and algal cultivation biology improvements (Topic Area 2). This FOA will allow the selection of a variety of projects and approaches that overcome species-specific, ecological, and practical challenges to achieving improved algal areal productivity and to fuel yield (i.e. biomass composition). The FOA will also require selected projects to participate in a cultivation readiness validation and benchmarking, or friendly “challenge”, the PEAK Challenge. In the PEAK Challenge, project performers will, after passing an interim Go/No-Go decision point to validate seasonal areal productivity and biomass composition, and towards the conclusion of their development efforts, cultivate their organism(s) in an outdoor relevant environment – a field-based campaign with adequate controls and duration. Utilizing the growing season and cultivation equipment of their choice, each team will demonstrate their peak productivity potential over the course of their culture’s growth curve during this field challenge.

The FOA objectives are tightly focused on developing strain and cultivation improvements that increase algal areal productivity, in grams of ash-free dry weight of algae produced per square meter per day ($g/m^2/d$), and fuel yield, as understood by proximate analysis of biomass composition and paper-based calculation of gasoline-gallon equivalency (GGE) using literature-based conversion factors. Strain improvement methods may include gene discovery and

³ Summary report at <http://www.energy.gov/eere/bioenergy/downloads/algal-biology-toolbox-workshop-summary-report>

biological pathway analysis, directed evolution, breeding, and/or genetic engineering of novel algal strains that can reproducibly out-perform the current best available strains in outdoor conditions, where “performance” is represented by productivity, robustness, and composition. Cultivation biology development improvements may include leveraging natural or designed microbial assemblages of the cultivation ecosystem to boost performance and resist pathogens, and understanding under what cultivation conditions certain strains should be employed. These developments in algal biology will be validated under laboratory test environments as well as at outdoor field sites to evaluate cultivation readiness and potential.

Regardless of topic area, projects selected under this FOA will also support future biological innovation efforts through integrating the development of “toolkits” – analytical/screening methods, technologies, or omics⁴ datasets that are complementary to the biological improvement(s) being pursued. PEAK projects will contribute broadly to the community to collectively advance the state of the art and result in the development of a diverse set of superior algal strains and cultivation practices that are ready for application.

Technical targets for the FOA include both demonstrable improvements in cultivation performance as well as in toolkit availability. Therefore, technical targets at project conclusion (anticipated in 2020) include achievement of an annual average algal biomass productivity of at least 18 g/m²/day, extrapolated from the combination of relevant seasonal data from the project and literature values for seasonal regimes not targeted by a given project, while achieving a minimum of 80 GGE per ton of biomass potential. Targets for analytic and tool development may include efficiency, accuracy, and precision of the analytics and tools, and feasibility in industrial and academic settings. Specifically, this may include:

- Robust genetic transformation protocols for diverse strains of algae
- Increasing the number of sequenced algal genomes available to the community
- Improving algal gene annotation and biological pathway mapping
- Establishing methods for examining algal culture ecology in non-axenic systems
- Establishing methods for achieving or shifting algal composition from basal to target levels with novel techniques (stress techniques that arrest culture growth are not novel) within the context of relevant cultivation practices.

The PEAK FOA technical targets are derived from BETO’s SOT for the cultivation of algae for biofuels, which provides an open-source assessment of annual average productivity of robust production strains of algae in long-term field trials using outdoor raceway ponds.⁵ BETO’s SOT is released in an annual MYPP update. Annual average productivity is understood for the purposes of this FOA to represent the average of productivity achieved in at a minimum four

⁴ In this context, -omics approaches cover the following: genomics, transcriptomics, proteomics, metabolomics and lipidomics, and phenomics.

⁵ Use of Cultivation Data from the Algae Testbed Public Private Partnership as Utilized in NREL’s Algae State of Technology Assessments (2016). <http://www.nrel.gov/docs/fy17osti/67289.pdf>

discrete light and temperature regimes representative of winter, spring, summer, and fall in a specified geographical location within the continental United States (CONUS).

Achieving the PEAK FOA objective requires that projects achieve, at minimum, double the current BETO SOT seasonal algal biomass productivities (Table 1) through economical and LCA-appropriate strain improvement techniques or ecological or abiotic cultivation management techniques. The current BETO SOT is derived from public, long-term, open raceway pond cultivation data, provided for public use by the DOE BETO-supported Algae Testbed Public-Private Partnership (ATP3). These data are available at http://en.openei.org/wiki/ATP3_Data. A crop-rotation strategy is used in the 2016 SOT to achieve the SOT productivity of 9.1 g/m²/d and is envisioned as necessary in meeting the PEAK FOA technical targets. Applicants are only required to, at minimum, select one strain, rotation period, location, or season for improvement. To relate improvements in a single season to an annualized average, reasonable projections of progress from the SOT for seasons not targeted by a given project may be used.

Table 1: Current BETO SOT and PEAK FOA Productivity Performance Targets

Season	2016 BETO SOT (g/m ² /day), ash free basis	2020 PEAK Performance Target (g/m ² /day)
Spring	11.1 (<i>Nanno</i>)	22
Summer	13.3 (<i>Desmo</i>)	26
Fall	7.0 (<i>Desmo</i>)	14
Winter	5 (<i>Nanno</i>)	10
Annual average	9.1	18
* <i>Nanno</i> refers to <i>Nannochloropsis maritima</i> KA32 (saline media) and <i>Desmo</i> refers to <i>Desmodesmus</i> sp. C046 (saline media)		

Additionally meeting the PEAK FOA objective will also require projects to achieve advanced biofuel yields of greater than 80 GGE per ton of algae feedstock. Yield of advanced biofuel is understood to be tightly linked to both input biomass composition and the conversion process efficiency. However, as conversion of the algal biomass is not a focus of this FOA (but has been the focus of significant BETO investment), achievement of the advanced biofuel yield will be demonstrated through a paper analysis based on the proximate analysis of the biomass cultivated in the PEAK project in combination with conversion efficiencies from literature values. As discussed below, these conversion efficiencies based on realistic biorefinery processes are provided for applicant’s use within the FOA.

This yield objective is most understandable through the example of a fractionation pathway (represented by the Combined Algae Processing (CAP) Design Case),⁶ where constituents of algal biomass are fractionated and separately converted into a slate of appropriate products. In one recent result using the CAP design, the authors project very high yields (126 GGE per ton of biomass) in an integrated biorefinery setting, but it must be noted that this result is based on critical assumptions related to both composition and cost of biomass delivered to the conversion process.⁷ It is important, in the context of this FOA, to understand that the biomass used to generate the 126 GGE result was high in lipids as FAME (40%) and carbohydrates as fermentable sugars (40%) because it was subjected to lengthy nitrogen deprivation which arrested productivity and shifted composition and this deprivation strategy may not be representative of realistic, scalable cultivation practices. The cost and annual average productivity of that biomass was not provided by the authors, but it is expected to be of significantly higher cost and lower annual average productivity than the BETO SOT.

The BETO SOT shows that to enable progress and innovation in algal biofuels, productivity and composition must be linked together as well as to scalable cultivation designs. Therefore, it is necessary for applicants to understand the relationship between algal productivity, biomass composition, and potential GGE fuel yield when setting targets for biomass composition for the proposed strain or system of study. However, as this FOA is not intended for work on conversion of biomass to fuels, conversion factors for constituent components of proximate algal biomass compositions to GGE fuel yields that are based on BETO conversion SOT experimental results derived from pre-pilot unit operations that simulate future biorefinery operations are provided (Table 2). Notably, the applicant still must propose their own biomass composition targets that will be met simultaneously with their productivity targets.

In the factors provided, the conversion of protein-rich extraction residuals to biogas via anaerobic digestion is not included in the total GGE advanced biofuel yield as, within the cited design pathway, this biogas is used onsite for process heat and power. An applicant may use these provided conversion factors, and/or provide their own (with substantial supporting rationale, including but not limited to the theoretical maximum conversion efficiency, the applicant's design target efficiency, and the applicant's claimed current state of technology for conversion efficiency). In doing either, the applicant must clearly explain how achieving target biomass compositions is important to their overall process. The integration of high areal productivity (in scalable cultivation system designs) with desirable compositions is the key innovation sought by this FOA.

The BETO MYPP also describes a non-fractionation pathway, the whole algae hydrothermal liquefaction (HTL) pathway, which is represented by the Hydrothermal Liquefaction Design

⁶ Process Design and Economics for the Conversion of Algal Biomass to Biofuels: Algal Biomass Fractionation to Lipid-and Carbohydrate-Derived Fuel Products (2014). <http://www.nrel.gov/docs/fy14osti/62368.pdf>.

⁷ Tao Dong, et al, (2016). Combined algal processing: A novel integrated biorefinery process to product algal biofuels and bioproducts. *Algal Research*, 19 316-323, <http://dx.doi.org/10.1016/j.algal.2015.12.021> .

Case.⁸ In the HTL pathway, the relationship between constituent components of biomass composition and GGE yield is not as well characterized as it is for the fractionation pathway (though the overall yield may be higher on the whole algae basis versus a fractional approach using the given BETO conversion factors, as the given BETO conversion factors do not include a factor for the protein component). What is known about the relationship is that, while fuel yield may be slightly less sensitive to the input biomass composition, it is still affected by relative ratios of lipids to carbohydrates, proteins, and ash.^{9, 10} Targeted improvements in algal biomass composition are also expected to increase HTL-based fuel yields and thus it is understood that applicants who envision whole-algae conversion to fuels via HTL or other similar processes are still expected to be responsive to this FOA, even if achieving a certain biomass composition is not as important as improving productivity.

⁸ Process Design and Economics for the Conversion of Algal Biomass to Hydrocarbons: Whole Algae Hydrothermal Liquefaction and Upgrading (2014). http://www.pnnl.gov/main/publications/external/technical_reports/PNNL-23227.pdf

⁹ P. Biller, A.B. Ross (2011). Potential yields and properties of oil from the hydrothermal liquefaction of microalgae with different biochemical content. *Bioresource Technology* 102:1 215-225, <http://dx.doi.org/10.1016/j.biortech.2010.06.028> .

¹⁰ S. Leow, et al. (2015). Prediction of microalgae hydrothermal liquefaction products from feedstock biochemical composition. *Green Chem.* 17 3584-35999,

Table 2: PEAK FOA Composition Performance Targets and Yield Conversion Factors. Proximate compositions represent the average value from the four representative seasonal campaigns described in Table 1.

	2016 BETO SOT	2020 PEAK Performance Targets
Annual average productivity in grams per square meter per day (ash free basis)	9.1	≥18
Proximate Compositions (2016 SOT, annualized average)		
kg carbohydrates per kg biomass (as fermentable sugars)	0.225	To be specified by applicant’s proposed targets
kg lipids (as FAME) per kg biomass	0.143	
kg proteins per kg biomass	0.400	
kg ash per kg biomass	0.233	
BETO SOT Advanced Biofuel Yield Conversion Factors (biorefinery design target basis)		
GGE per kg algal FAME lipids (as renewable diesel + naphtha blend-stocks)		0.280
GGE per kg algal fermentable carbohydrates (as ethanol)		0.106
Calculated Advanced Biofuel Potential		
GGE Potential of Biomass, GGE per U.S. ton biomass (dry basis)	58	To be calculated by applicant; ≥80
“Farm” areal yield, U.S. tons per acre per year (dry basis)	15.9	To be calculated by applicant; ≥24
Advanced biofuel areal yield, GGE per acre per year (assuming BETO CAP Design)	922	To be calculated by applicant; ≥2,000

Projects that achieve the performance targets outlined above in Tables 1 and 2 will be on track to reduce minimum fuel selling price (MFSP) in the BETO nth plant design case model from approximately \$13.86/GGE to about \$8.50/GGE by 2020, without high value co-products. High value co-products may further improve the MFSP but may decrease the GGE potential of the biomass and, for the purposes of this FOA, pursuing composition targets in support of high value co-products may still be responsive. This cost reduction is expected to contribute to progress towards achieving the BETO strategic goal of modelling a scalable and sustainable system for production of cost competitive algal biofuels by 2025. Ultimately, further work in this area, beyond the scope of this particular FOA, is understood as likely necessary to achieve cost competitive algal biofuels.

B. Topic Areas/Technical Areas of Interest

1) Topic Area 1: Strain Improvement

This topic area is for small teams to develop enhanced algal strains with increased areal productivity and biofuel yield, along with improved or novel algal toolkits and/or methods. Strain improvement methods may include gene discovery and biological pathway analysis, directed evolution, breeding, and/or genetic engineering of novel algal strains that can reproducibly out-perform the current best available strains in outdoor conditions, where “performance” is represented by productivity, robustness, and composition. Applicants must include a detailed discussion of the reasoning behind their proposed strategy or strategies, strain choice, and why the proposed strain improvement approach has/have the highest probability of success.

2) Topic Area 2: Cultivation Biology Improvement

This topic area is for small teams to develop increased areal productivity and biofuel yield through enhanced management of ecological or abiotic contributions to cultivation biology, along with improved or novel algal toolkits and/or methods. Cultivation biology development improvements may include leveraging natural or designed microbial assemblages of the algal culture ecosystem to boost performance and resist pathogens, and understanding species-specific cultivation conditions.

This topic area is about improving management of a current cultivation system. Abiotic contributions, including nutrient and stochastic climatological variables, can have a profound effect on outdoor performance. Topic Area 2 supports improving the understanding of physiology and performance under fluctuating and uncontrollable abiotic conditions.

Applicants must include a detailed discussion of the reasoning behind their proposed strategy or strategies and why the proposed cultivation improvement approach has/have the highest probability of success.

C. Application Requirements for both Topic Areas

In addition to responding to sections I.A and B, the applicant must address each of the following requirements for either topic area. Failure to address all of the listed requirements will result in the application being considered “not of interest” as described in Section I.D.

1) Justification of the selected strain(s) requirement:

The algae selected in each topic area must be capable growth in saline, brackish, or otherwise non-potable water. Applicants must justify their selection(s) with a discussion of the potential strain performance in algal cultivation, a rationale behind how the proposed improvements are expected to increase the cultivation performance, and any previous work in enhancing the proposed strain(s).

2) Sustainability requirement:

In addition to growth using saline, brackish, or non-potable water, proposed technology and management approaches must include a discussion of lifecycle impacts (such as nutrient use and energy requirements) in an integrated, scaled system, and must support producing an advanced biofuel. Limited techno-economic and life-cycle analyses will be required of project performers.

3) Toolkit requirement:

Applicants must pursue the development of at least one novel omics tool, technique (method), or dataset that upon completion of the project will enable developers to accelerate innovation in that topic area. The types of tools, techniques, and omics datasets of interest span biological, computational, and analytic strategies that will advance the state of the art and are complementary to the scope of improved strain development work. Cultivation datasets and growth profiles do not satisfy this toolkit requirement because they are expected of all projects as part of the productivity data validation requirement (see validation requirement below). Examples of toolkits may include techniques that enable robust genetic engineering, datasets that predict enhanced productivity based on metagenomics or environmental conditions, and rapid computational tools that screen for indicators of environmentally robust or biochemically attractive algal strains. In the Market Transformation and Demonstration section of the application, the applicant must describe how innovations will be made available or incorporated into a business strategy. Applicants must make datasets available through <https://greenhouse.lanl.gov> if appropriate. Applicants must disseminate methods through publications or share on the above mentioned website.

4) “Cultivation ready” requirement:

Algae cultivation literature highlights the importance of evaluating the effect of temperature, light intensity, sinusoidal light, and light quality on biomass productivity.^{11, 12} Applicants must demonstrate proficiency in culturing algae and particularly their proposed strain(s) of interest under actual or simulated climate conditions, including but not limited to media composition, analytical standard operating procedures and quality control, and prior handling of the strain(s) of interest at the facilities proposed for the PEAK project. Applicants must have an internal baseline for the performance of their proposed system.

The cultivation ready requirement means that applicants must discuss how their demonstrated proficiency with their strain(s) and system(s) of choice and their internal baseline compares to the BETO SOT for algal productivities, which was (as stated above) developed through several

¹¹ Ooms, M. D., Dinh, C. T., Sargent, E. H., & Sinton, D. (2016). Photon management for augmented photosynthesis. *Nature Communications*, 7.

¹² Huesemann, et al. (2017). Simulation of outdoor pond cultures using indoor LED-lighted and temperature-controlled raceway ponds and Phenometrics photobioreactors. *Algal Research* 21, 178-190

years of continuous outdoor cultivation efforts undertaken through the test-bed network. Applicants are not required to have long-term cultivation datasets as their baseline, but are required to discuss why their proposed development is likely to surpass the BETO SOT by the end of the project performance period. Cultivation readiness is subject to validation prior to proceeding with proposed development efforts, as described below.

5) Validation requirement:

All projects in both Topic Areas will be required to undergo external validation after selection, at an interim review, and toward the end of the projects. The initial external validation will verify cultivation readiness. The interim validation will measure productivity and yield improvements and verify outdoor preparedness through an outdoor cultivation. The final validation, called the PEAK Challenge, will evaluate outdoor robustness using a set of decathlon-like criteria. These validations will support developing biological improvements in the lab, testing innovation outdoors, and increasing shared learnings in practicing robust lab-to-field transfer functions.

All steps are performed in concert with BETO's validation team and the project team. The project's basic process operation parameters, and the information requested in the technical datasheet template, will be disclosed to non-conflicted DOE National Laboratory personnel and/or external third party non-conflicted validators performing the validations (BETO's validation team). The objectives of the initial validation effort are to verify the applicant's technical data, performance metrics, baseline, and targets as proposed in the original application; establish a framework to evaluate and track progress over time; update the technical datasheet to specifically match the project scope; establish benchmark and baseline and associated target values; identify potential major showstoppers; and align project goals with BETO's expectations and therefore projects must pass the initial validation before commencing the full scope of proposed work.

The processes and advancements in technical performance are expected to be shared by the project team with the public via technical publications in journals or conference proceedings after invention disclosures (e.g., patent applications) are filed.

i. Initial Validation

The initial validation will verify the applicant's proposed cultivation readiness and initial technical baseline by direct observation of laboratory handling of proposal strain(s) of interest, as well as validation of experimental procedures and data records.

During the initial validation step, the validation team will work closely with the project team to discuss the effort in detail, initiate the review of data, metrics, and procedures as provided in the original application, and set the date for the on-site meeting. This is an iterative process between the two teams and establishes the agenda for the on-site meeting. The on-site meeting will include a demonstration of cultivation readiness. During the on-site meeting, the

teams will work together to discuss the goals and performance metrics, ideas for tracking project progress, and alignment with BETO's goals. At the conclusion of the on-site meeting the validation team will prepare a report-out to DOE BETO that documents the initial validation. The post-validation step includes DOE BETO making the Go/No-go decision to proceed from Budget Period (BP) 1 to BP2.

All applicants must include the initial validation task within their scope as Task 1. It must be separated from the rest of the scope of work by a Go/No-Go decision point, and applicants should estimate three months for the validation effort. This task, Task 1, will also be within a separate budget period, BP1, from the remainder of the project (see the section on Project Management for detail on budget periods and the Go/No-Go decision points that separate Budget Periods). The duration of BP1 should not exceed 3 months. Other than a task for management and reporting, tasks and scope should not overlap between BP1 and BP2. BP1 is solely to undertake the initial validation.

As noted, all applicants must include this task in their scope, schedule and budget. By way of example, the inclusion of the validation in the scope should include something like the following:

“Task 1. Validation. At the beginning of the project, we will work with DOE to demonstrate cultivation readiness. Process information and data will be provided to DOE to support the process claims within the original application. Technical metrics for project progress will be confirmed and or refined, including adding or changing future Go/No-Go decision points.

There will be a Go/No-Go associated with Task 1 as follows: Process information and data support the technology readiness level of the overall process, the baseline, and the original application. Cultivation readiness was demonstrated. Technical metrics are based on preliminary data and represent meaningful project progress toward the final project goals.

Upon successful completion of the data validation effort and Go/No-Go decision point, the project will commence with work on the proposal development scope as discussed.”

ii. Interim Validation

The interim validation will require, at the minimum, realistic simulation of project-appropriate fluctuating temperature and light, as well as a reasonable method for estimation of areal productivity. The interim validation activities support a Go/No-go milestone between 18-24 months that determines if a project will do its final validation and participate in the PEAK Challenge. The interim validation and accompanying Go/No Go decision point separates BP2 from BP3. The Go/No Go determination will be based on biological productivity and yield improvements and on indication of preparedness of the project to transition outdoors. Unlike the initial validation, the project team must produce in real time (cultivation through analysis) their productivity and yield improvements.

The interim validation will measure biological improvement in productivity and biomass composition against the applicant's internal baseline and, at a minimum, a seasonally and geographically representative set of temperature and light intensities to the applicant's target season. Adequate capability to iterate between indoor and outdoor cultivation must be demonstrated. As the metrics in Table 1 of this FOA represent a crop rotation strategy, it is not the expectation that one set of developments is necessarily valid across all seasons – rather, it is recognized that in all seasons, improvements are needed, and one strain and project may not be able to address all the seasons.

The minimum scale for research reported in the interim validation will be 500mL per replicate or the minimum needed for biomass compositional analysis, whichever is larger. However; this minimum may not be appropriate for the broad range of biology which can be researched under this funding opportunity. The applicant is to justify the scale of their research and validation with respect to the question they are investigating.

The interim validation also evaluates the project's readiness to transition outdoors. The minimum data required to indicate viability is demonstration of growth in a cultivation system that does not regulate temperature or light in the region where the project would pursue future work (i.e., an outdoor culture).

As the experimental period needed to provide the interim validation data may be a long duration, it is not anticipated that the validation team will be on-site for all or most of the interim validation period. However, an on-site visit will be necessary during the experimental period; the nature and length of the on-site validation will be subject to discussion following the initial validation. Applicants must account for this interim validation in their scope and schedule by proposing the duration of the validation cultivation and proposed timeframe within the schedule. Details of the validation cultivation will be negotiated with those projects selected for negotiation for award.

Following a DOE "Go" decision, BP3 will pursue outdoor work and the PEAK Challenge. Projects that receive a DOE "No-go" will not proceed to BP3.

iii. Final Validation (PEAK Challenge)

Productivity and composition are evaluated in the interim validation. The final validation, called the PEAK Challenge, tests the robustness of a project's improved organism(s) and or cultivation strategies in outdoor conditions and larger than bench-scale cultivation practices. The PEAK Challenge will require projects to utilize specialized field sites suitable for algal cultivation trials that meet minimum requirements, such as adequate infrastructure to conduct experiments in triplicate over extended time. Projects that do not have access to such sites within the project facilities will be required to partner with appropriate algal testbeds or field sites to ensure access to such sites. DOE-supported algae testbed facilities may be available for projects should

the applicant choose to utilize them (e.g. Arizona State University Testbeds – <http://azcati.com>); however, DOE will not facilitate teaming arrangements with the testbeds or any other partners. It is the sole responsibility of the applicant to propose adequate teaming arrangements to meet the FOA requirements for access to a field site for conducting the PEAK Challenge. The PEAK Challenge evaluation criteria (Appendix E) represent ideal performing strain and culture characteristics recommended by expert stakeholders during the Algal Biology Toolbox Workshop.

The PEAK Challenge will support shared learnings in developing and practicing robust lab-to-field transfer functions. The practice of shared learnings will be achieved by convening all selected PEAK FOA project teams for PEAK Challenge kick-off and conclusion meetings. At the kick-off, projects in the portfolio will convene prior to initiating the field cultivation challenge to present plans. At the conclusion of the PEAK Challenge, projects will be required to participate in open symposium, held in coordination with an existing conference, in which they present the results, conclusions, and lessons learned from their experiences in participating in the project.

6) Additional requirements:

The following list of additional requirements must also be addressed by the applicant:

1. Identification of which Topic Area the applicant is applying to is required.
2. Discussion of why the applicant believes their proposed technologies are currently at a minimum of Technology Readiness Level 3 – demonstrated proof of concept stage is required. Please refer to Appendix F.
3. Definition of baseline state of technology and establishment of target improvements for improved productivity is required.
4. Completion of the technical and financial datasheet (TechFin data) is required.
5. The use of robust production strains and explicit feedback between laboratory-based studies and field cultivation is required to meet the FOA objectives.
6. Description of proposed methods for compositional analysis of algal biomass is required. DOE BETO strongly supports standardized analytical methods for measuring the key biochemical constituents. Applicants should plan to use or implement the standard procedures developed by BETO that are available at: http://www.nrel.gov/biomass/microalgal_procedures.html or discuss in detail how their own proposed methods can be comparable to BETO's standard methods. Conversion to fuel yield given in Table 2 of this FOA are based on use of the standard methods developed by BETO; if an applicant wishes to use other methods, the applicant must also discuss the methods used and the comparability to the standard method used by BETO in its SOT. Alternative methods may be verified through the validation process.
7. Discussion of what strain(s) will be utilized within their project, why, and inclusion of data to show that their proposed strain(s) can be compared to the SOT shown in Tables 1 and 2 is required. Project funding may not be used for bioprospecting activities.

8. If experimental plans rely on genetically modified organism (GMO) technology, a discussion of U.S. regulatory landscape – e.g., Toxic Substance Control Act (TSCA), the Animal and Plant Health Inspection Service (APHIS) – and the impacts of regulations on the project objectives, scope, and schedule are required.
9. The applicant’s algae cultivation systems for the PEAK outdoor field challenge must be one of the following: open ponds, attached growth systems, closed photobioreactors (PBRs), or combinations of these systems.
10. Facilities to conduct the proposed project scope must be available; construction and capital costs to build cultivation acreage or capacity are not allowed within this FOA.
11. Facilities for the PEAK Challenge must support simultaneous replicate experiments with experimental controls and operated continuously outdoors for days to weeks.
12. Applications must propose to work on algal biomass (i.e., proposing research activities on biofuels and bioproducts derived from lignocellulosic biomass (e.g., agricultural residues, woody biomass) is considered non-responsive and will not be accepted). Cellulosic biomass and derivatives may be used for mixotrophic growth strategies.
13. Applicants that propose to use mixotrophic growth strategies to boost productivity or alter compositions must provide in their proposals, at minimum, a concise description of the likely economics of their envisioned commercial strategy that includes sufficient details for a reviewer to understand how the procurement and use of the substrate results in a net positive economic benefit.
14. All work under EERE funding agreements must be performed in the United States. See Section IV.J.4 and Appendix C for information on waiver requests.

D. Applications Specifically Not of Interest

The following types of applications will be deemed nonresponsive and will not be reviewed or considered (See Section III.D of the FOA):

- Applications for proposed technologies that are not based on sound scientific principles (e.g., violates the laws of thermodynamics).
- Applications that do not follow the requirements specified in Section I.C of the FOA
- Applications that envision potable or fresh water as primary cultivation media.
- Applications that propose heterotrophic or mixotrophic algae cultivation strategies that utilize food-based sugars (i.e., derived from food-based crops including but not limited to corn, beets, sorghum, and sugar cane).
- Applications that propose to develop technology for the artificial lighting-based cultivation of algae for energy products (other than as an enabling tool for high-throughput laboratory-based screening). Bench-top laboratory systems to improve strains and cultivation practices are allowable provided there is clear iteration between lab and outdoor cultivation in the proposed project scope.
- Applications that propose to work on biomass other than algae biomass (e.g., lignocellulosic biomass).
- Applications that propose research activities on biofuels and bioproducts derived from lignocellulosic biomass (e.g., agricultural residues, woody biomass).

- Applications that propose construction of new facilities or expansion of existing facilities.

E. Authorizing Statutes

The programmatic authorizing statute is the Energy Policy Act (EPAcT) of 2005 (Public Law 109-58, August 8, 2005), and the Energy Independence and Security Act (EISA) of 2007 (Public Law 110-140, December 19, 2007). Section 932 of the EPAcT legislation includes provisions directing that DOE carry out a program of bioenergy research, development, demonstration, and deployment for the development of advanced biofuels from biomass. BETO has utilized this statutory authority to implement its algal biofuels and bioproducts program (the Advanced Algal Systems Program). Section 202 of EISA includes provisions that establish a Renewable Fuel Standard (RFS). The final Renewable Fuel Standard 2 (RFS2) rules issued by the Environmental Protection Agency (EPA) in March, 2010 require the production of 36 billion gallons per year of renewable fuels by 2022 with annual requirements for advanced biofuels, including cellulosic biofuels and biomass-based diesel. Under the RFS2 rules, algal biomass qualifies as a renewable feedstock and biomass-based diesel generated from algal oils qualifies as an advanced biofuel.

Awards made under this announcement will fall under the purview of 2 CFR Part 200 as amended by 2 CFR Part 910.

II. Award Information

A. Award Overview

1) Estimated Funding

EERE expects to make approximately \$3-\$8 million of Federal funding available in FY17 for new awards under this FOA, subject to the availability of appropriated funds. EERE anticipates making approximately 2-6 awards under this FOA, with 1-4 selections from each Topic Area. EERE may issue one, multiple, or no awards. Individual awards may vary between \$1.5 and \$3 million.

EERE may issue awards in one, multiple, or none of the topic areas.

EERE may establish more than one budget period for each award and fund only the initial budget period(s). Funding for all budget periods, including the initial budget period, is not guaranteed. Before the expiration of the initial budget period(s), EERE may perform a down-select among different recipients and provide additional funding only to a subset of recipients.

2) Period of Performance

EERE anticipates making awards that will run up to 36 months in length, comprised of one or more budget periods. Project continuation will be contingent upon satisfactory performance and Go/No-go decision review. At the Go/No-go decision points, EERE will evaluate project performance, project schedule adherence, meeting milestone objectives, compliance with reporting requirements, and overall contribution to the program goals and objectives. As a result of this evaluation, EERE will make a determination to continue the project, re-direct the project, or discontinue funding the project.

3) New Applications Only

EERE will accept only new applications under this FOA. EERE will not consider applications for renewals of existing EERE-funded awards through this FOA.

B. EERE Funding Agreements

Through Cooperative Agreements and other similar agreements, EERE provides financial and other support to projects that have the potential to realize the FOA objectives. EERE does not use such agreements to acquire property or services for the direct benefit or use of the United States Government.

1) Cooperative Agreements

EERE generally uses Cooperative Agreements to provide financial and other support to Prime Recipients.

Through Cooperative Agreements, EERE provides financial or other support to accomplish a public purpose of support or stimulation authorized by Federal statute. Under Cooperative Agreements, the Government and Prime Recipients share responsibility for the direction of projects.

EERE has substantial involvement in all projects funded via Cooperative Agreement. See Section VI.B.9 of the FOA for more information on what substantial involvement may involve.

2) Funding Agreements with FFRDCs

In most cases, Federally Funded Research and Development Centers (FFRDC) are funded independently of the remainder of the Project Team. The FFRDC then executes an agreement with any non-FFRDC Project Team members to arrange work structure, project execution, and any other matters. Regardless of these arrangements, the entity that applied as the Prime Recipient for the project will remain the Prime Recipient for the project.

III. Eligibility Information

To be considered for substantive evaluation, an applicant's submission must meet the criteria set forth below. If the application does not meet these initial requirements, it will be considered non-responsive, removed from further evaluation, and ineligible for any award.

A. Eligible Applicants

1) Individuals

U.S. citizens and lawful permanent residents are eligible to apply for funding as a Prime Recipient or Subrecipient.

2) Domestic Entities

For-profit entities, educational institutions, and nonprofits that are incorporated (or otherwise formed) under the laws of a particular State or territory of the United States are eligible to apply for funding as a Prime Recipient or Subrecipient. Nonprofit organizations described in section 501(c)(4) of the Internal Revenue Code of 1986 that engaged in lobbying activities after December 31, 1995, are not eligible to apply for funding.

State, local, and tribal government entities are eligible to apply for funding as a Prime Recipient or Subrecipient.

DOE/NNSA Federally Funded Research and Development Centers (FFRDCs) are eligible to apply for funding as a Prime Recipient or Subrecipient.

Non-DOE/NNSA FFRDCs are eligible to apply for funding as a Subrecipient, but are not eligible to apply as a Prime Recipient.

Federal agencies and instrumentalities (other than DOE) are eligible to apply for funding as a Subrecipient, but are not eligible to apply as a Prime Recipient.

3) Foreign Entities

Foreign entities, whether for-profit or otherwise, are eligible to apply for funding under this FOA. Other than as provided in the "Individuals" or "Domestic Entities" sections above, all Prime Recipients receiving funding under this FOA must be incorporated (or otherwise formed) under the laws of a State or territory of the United States. If a foreign entity applies for funding as a Prime Recipient, it must designate in the Full Application a subsidiary or affiliate incorporated (or otherwise formed) under the laws of a State or territory of the United States to be the Prime Recipient. The Full Application must state the nature of the corporate relationship between the foreign entity and domestic subsidiary or affiliate.

Foreign entities may request a waiver of the requirement to designate a subsidiary in the United States as the Prime Recipient in the Full Application (i.e., a foreign entity may request that it remains the Prime Recipient on an award). To do so, the Applicant must submit an explicit written waiver request in the Full Application. Appendix C lists the necessary information that must be included in a request to waive this requirement. The applicant does not have the right to appeal EERE's decision concerning a waiver request.

In the waiver request, the applicant must demonstrate to the satisfaction of EERE that it would further the purposes of this FOA and is otherwise in the economic interests of the United States to have a foreign entity serve as the Prime Recipient. EERE may require additional information before considering the waiver request.

A foreign entity may receive funding as a Subrecipient.

4) Incorporated Consortia

Incorporated consortia, which may include domestic and/or foreign entities, are eligible to apply for funding as a Prime Recipient or Subrecipient. For consortia incorporated (or otherwise formed) under the laws of a State or territory of the United States, please refer to "Domestic Entities" above. For consortia incorporated in foreign countries, please refer to the requirements in "Foreign Entities" above.

Each incorporated consortium must have an internal governance structure and a written set of internal rules. Upon request, the consortium must provide a written description of its internal governance structure and its internal rules to the EERE Contracting Officer.

5) Unincorporated Consortia

Unincorporated Consortia, which may include domestic and foreign entities, must designate one member of the consortium to serve as the Prime Recipient/consortium representative. The Prime Recipient/consortium representative must be incorporated (or otherwise formed) under the laws of a State or territory of the United States. The eligibility of the consortium will be determined by the eligibility of the Prime Recipient/consortium representative under Section III.A of the FOA.

Upon request, unincorporated consortia must provide the EERE Contracting Officer with a collaboration agreement, commonly referred to as the articles of collaboration, which sets out the rights and responsibilities of each consortium member. This agreement binds the individual consortium members together and should discuss, among other things, the consortium's:

- Management structure;
- Method of making payments to consortium members;
- Means of ensuring and overseeing members' efforts on the project;

- Provisions for members' cost sharing contributions; and
- Provisions for ownership and rights in intellectual property developed previously or under the agreement.

B. Cost Sharing

1) Cost Sharing Generally

The cost share must be at least 20% of the total allowable costs for research and development projects (i.e., the sum of the Government share, including FFRDC costs if applicable, and the recipient share of allowable costs equals the total allowable cost of the project) and must come from non-Federal sources unless otherwise allowed by law. (See 2 CFR 200.306 and 2 CFR 910.130 for the applicable cost sharing requirements.)

2) Special Cost Share Waiver for Domestic Institutions of Higher Education, Domestic Nonprofit Entities, FFRDCs, or U.S. State, Local, or Tribal Government Entity

The Assistant Secretary for the Office of Energy Efficiency and Renewable Energy has issued a Cost Share Reduction determination pursuant to Section 988(b)(3) of the Energy Policy Act of 2005 that is applicable to certain entities applying under this FOA. Specifically, recipient cost share requirement for applied research and development activities projects is reduced from 20% to 10% where:

1. The Prime Recipient is a domestic institution of higher education; domestic nonprofit entity; FFRDC; or U.S. State, local, or tribal government entity; and
2. The Prime Recipient performs more than 50% of the project work, as measured by the Total Project Cost.

Applicants who believe their project qualifies for the reduced recipient cost share must be able to provide verification that the above requirements are satisfied.

To assist applicants in calculating proper cost share amounts, EERE has included a cost share information sheet and sample cost share calculation as Appendices B and C to this FOA.

3) Legal Responsibility

Although the cost share requirement applies to the project as a whole, including work performed by members of the project team other than the Prime Recipient, the Prime Recipient is legally responsible for paying the entire cost share. The Prime Recipient's cost share obligation is expressed in the Assistance Agreement as a static amount in U.S. dollars (cost share amount) and as a percentage of the Total Project Cost (cost share percentage). If the funding agreement is terminated prior to the end of the project period, the Prime Recipient is required to contribute at least the cost share percentage of total expenditures incurred through the date of termination.

The Prime Recipient is solely responsible for managing cost share contributions by the Project Team and enforcing cost share obligation assumed by Project Team members in subawards or related agreements.

4) Cost Share Allocation

Each Project Team is free to determine how best to allocate the cost share requirement among the team members. The amount contributed by individual Project Team members may vary, as long as the cost share requirement for the project as a whole is met.

5) Cost Share Types and Allowability

Every cost share contribution must be allowable under the applicable Federal cost principles, as described in Section IV.J.1 of the FOA. In addition, cost share must be verifiable upon submission of the Full Application.

Project Teams may provide cost share in the form of cash or in-kind contributions. Cash contributions may be provided by the Prime Recipient or Subrecipients. Allowable in-kind contributions include, but are not limited to: rental value of buildings or equipment, the value of a donated service or resource, or third party in-kind contribution.

Project teams may use funding or property received from state or local governments to meet the cost share requirement, so long as the funding was not provided to the state or local government by the Federal Government.

The Prime Recipient may not use the following sources to meet its cost share obligations including, but not limited to:

- Revenues or royalties from the prospective operation of an activity beyond the project period;
- Proceeds from the prospective sale of an asset of an activity;
- Federal funding or property (e.g., Federal grants, equipment owned by the Federal Government); or
- Expenditures that were reimbursed under a separate Federal Program.

Project Teams may not use the same cash or in-kind contributions to meet cost share requirements for more than one project or program.

Cost share contributions must be specified in the project budget, verifiable from the Prime Recipient's records, and necessary and reasonable for proper and efficient accomplishment of the project. As all sources of cost share are considered part of total project cost, the cost share dollars will be scrutinized under the same Federal regulations as Federal dollars to the project. Every cost share contribution must be reviewed and approved in advance by the Contracting Officer and incorporated into the project budget before the expenditures are incurred.

Applicants are encouraged to refer to 2 CFR 200.306 as amended by 2 CFR 910.130 & 10 CFR 603.525-555 for additional guidance on cost sharing.

6) Cost Share Contributions by FFRDCs

Because FFRDCs are funded by the Federal Government, costs incurred by FFRDCs generally may not be used to meet the cost share requirement. FFRDCs may contribute cost share only if the contributions are paid directly from the contractor's Management Fee or another non-Federal source.

7) Cost Share Verification

Applicants are required to provide written assurance of their proposed cost share contributions in their Full Applications.

Upon selection for award negotiations, applicants are required to provide additional information and documentation regarding their cost share contributions. Please refer to Appendix A of the FOA.

8) Cost Share Payment

EERE requires Prime Recipients to contribute the cost share amount incrementally over the life of the award. Specifically, the Prime Recipient's cost share for each billing period must always reflect the overall cost share ratio negotiated by the parties (i.e., the total amount of cost sharing on each invoice when considered cumulatively with previous invoices must reflect, at a minimum, the cost sharing percentage negotiated).

In limited circumstances, and where it is in the government's interest, the EERE Contracting Officer may approve a request by the Prime Recipient to meet its cost share requirements on a less frequent basis, such as monthly or quarterly. Regardless of the interval requested, the Prime Recipient must be up-to-date on cost share at each interval. Such requests must be sent to the Contracting Officer during award negotiations and include the following information: (1) a detailed justification for the request; (2) a proposed schedule of payments, including amounts and dates; (3) a written commitment to meet that schedule; and (4) such evidence as necessary to demonstrate that the Prime Recipient has complied with its cost share obligations to date. The Contracting Officer must approve all such requests before they go into effect.

C. Compliance Criteria

Concept Papers and Full Applications must meet all Compliance criteria listed below or they will be considered noncompliant. EERE will not review or consider noncompliant submissions, including Concept Papers, Full Applications, and Replies to Reviewer Comments that were: submitted through means other than EERE Exchange; submitted after the applicable deadline;

and/or submitted incomplete. EERE will not extend the submission deadline for applicants that fail to submit required information due to server/connection congestion.

1) Concept Papers

Concept Papers are deemed compliant if:

- The Concept Paper complies with the content and form requirements in Section IV.C of the FOA; and
- The applicant successfully uploaded all required documents and clicked the “Submit” button in EERE Exchange by the deadline stated in this FOA.

2) Full Applications

Full Applications are deemed compliant if:

- The applicant submitted a compliant Concept Paper;
- The Full Application complies with the content and form requirements in Section IV.D of the FOA; and
- The applicant successfully uploaded all required documents and clicked the “Submit” button in EERE Exchange by the deadline stated in the FOA.

3) Replies to Reviewer Comments

Replies to Reviewer Comments are deemed compliant if:

- The Reply to Reviewer Comments complies with the content and form requirements in Section IV.E of the FOA; and
- The applicant successfully uploaded all required documents to EERE Exchange by the deadline stated in the FOA.

D. Responsiveness Criteria

All “Applications Specifically Not of Interest,” as described in Section I.C of the FOA, are deemed nonresponsive and are not reviewed or considered.

E. Other Eligibility Requirements

1) Requirements for DOE/NNSA Federally Funded Research and Development Centers (FFRDC) Listed as the Applicant

A DOE/NNSA FFRDC is eligible to apply for funding under this FOA if its cognizant Contracting Officer provides written authorization and this authorization is submitted with the application. If a DOE/NNSA FFRDC is selected for award negotiation, the proposed work will be authorized under the DOE work authorization process and performed under the laboratory’s Management and Operating (M&O) contract.

The following wording is acceptable for the authorization:

Authorization is granted for the [Enter Laboratory Name] Laboratory to participate in the proposed project. The work proposed for the laboratory is consistent with or complementary to the missions of the laboratory, and will not adversely impact execution of the DOE assigned programs at the laboratory.

2) Requirements for DOE/NNSA and non-DOE/NNSA Federally Funded Research and Development Centers Included as a Subrecipient

DOE/NNSA and non-DOE/NNSA FFRDCs may be proposed as a Subrecipient on another entity's application subject to the following guidelines:

i. Authorization for non-DOE/NNSA FFRDCs

The Federal agency sponsoring the FFRDC must authorize in writing the use of the FFRDC on the proposed project and this authorization must be submitted with the application. The use of a FFRDC must be consistent with its authority under its award.

ii. Authorization for DOE/NNSA FFRDCs

The cognizant Contracting Officer for the FFRDC must authorize in writing the use of the FFRDC on the proposed project and this authorization must be submitted with the application. The following wording is acceptable for this authorization:

Authorization is granted for the [Enter Laboratory Name] Laboratory to participate in the proposed project. The work proposed for the laboratory is consistent with or complementary to the missions of the laboratory, and will not adversely impact execution of the DOE assigned programs at the laboratory.

iii. Value/Funding

The value of and funding for the FFRDC portion of the work will not normally be included in the award to a successful applicant. Usually, DOE will fund a DOE/NNSA FFRDC contractor through the DOE field work proposal system and non-DOE/NNSA FFRDC through an interagency agreement with the sponsoring agency.

iv. Cost Share

Although the FFRDC portion of the work is usually excluded from the award to a successful applicant, the applicant's cost share requirement will be based on the total cost of the project, including the applicant's and the FFRDC's portions of the project.

v. Responsibility

The Prime Recipient will be the responsible authority regarding the settlement and satisfaction of all contractual and administrative issues including, but not limited to disputes and claims arising out of any agreement between the Prime Recipient and the FFRDC contractor.

vi. Limit on FFRDC Effort

The FFRDC effort, in aggregate, shall not exceed 25% of the total estimated cost of the project, including the applicant's and the FFRDC's portions of the effort.

F. Limitation on Number of Concept Papers and Full Applications Eligible for Review

Applicants may submit more than one Full Application to this FOA, provided that each application describes a unique, scientifically distinct project.

G. Questions Regarding Eligibility

EERE will not make eligibility determinations for potential applicants prior to the date on which applications to this FOA must be submitted. The decision whether to submit an application in response to this FOA lies solely with the applicant.

IV. Application and Submission Information

A. Application Process

The application process will include two phases: a Concept Paper phase and a Full Application phase. **Only applicants who have submitted an eligible Concept Paper will be eligible to submit a Full Application.** At each phase, EERE performs an initial eligibility review of the applicant submissions to determine whether they meet the eligibility requirements of Section III of the FOA. EERE will not review or consider submissions that do not meet the eligibility requirements of Section III. All submissions must conform to the following form and content requirements, including maximum page lengths (described below) and must be submitted via EERE Exchange at <https://eere-exchange.energy.gov/>, unless specifically stated otherwise. **EERE will not review or consider submissions submitted through means other than EERE Exchange, submissions submitted after the applicable deadline, and incomplete submissions.** EERE will not extend deadlines for applicants who fail to submit required information and documents due to server/connection congestion. A control number will be issued when an applicant begins the Exchange application process. This control number must be included with all Application documents, as described below.

The Concept Paper, Full Application, and Reply to Reviewer Comments must conform to the following requirements:

- Each must be submitted in Adobe PDF format unless stated otherwise.
- Each must be written in English.
- All pages must be formatted to fit on 8.5 x 11 inch paper with margins not less than one inch on every side. Use Times New Roman typeface, a black font color, and a font size of 12 point or larger (except in figures or tables, which may be 10 point font). A symbol font may be used to insert Greek letters or special characters, but the font size requirement still applies. References must be included as footnotes or endnotes in a font size of 10 or larger. Footnotes and endnotes are counted toward the maximum page requirement.
- The Control Number must be prominently displayed on the upper right corner of the header of every page. Page numbers must be included in the footer of every page.
- Each submission must not exceed the specified maximum page limit, including cover page, charts, graphs, maps, and photographs when printed using the formatting requirements set forth above and single spaced. If applicants exceed the maximum page lengths indicated below, EERE will review only the authorized number of pages and disregard any additional pages.

Applicants are responsible for meeting each submission deadline. **Applicants are strongly encouraged to submit their Concept Papers and Full Applications at least 48 hours in advance of the submission deadline.** Under normal conditions (i.e., at least 48 hours in advance of the submission deadline), applicants should allow at least 1 hour to submit a Concept Paper, Full Application, or Reply to Reviewer Comments. Once the Concept Paper, Full Application, or

Reply to Reviewer Comments is submitted in EERE Exchange, applicants may revise or update that submission until the expiration of the applicable deadline. If changes are made, the applicant must resubmit the Concept Paper, Full Application, or Reply to Reviewer Comments before the applicable deadline.

EERE urges applicants to carefully review their Concept Papers and Full Applications and to allow sufficient time for the submission of required information and documents. All Full Applications that pass the initial eligibility review will undergo comprehensive technical merit review according to the criteria identified in Section V.A.2 of the FOA.

1) Additional Information on EERE Exchange

EERE Exchange is designed to enforce the deadlines specified in this FOA. The “Apply” and “Submit” buttons will automatically disable at the defined submission deadlines. Should applicants experience problems with Exchange, the following information may be helpful.

Applicants that experience issues with submission PRIOR to the FOA deadline: In the event that an applicant experiences technical difficulties with a submission, the Application should contact the Exchange helpdesk for assistance (EERE-ExchangeSupport@hq.doe.gov). The Exchange helpdesk and/or the EERE Exchange system administrators will assist Applicants in resolving issues.

Applicants that experience issue with submissions that result in late submissions: In the event that an applicant experiences technical difficulties so severe that they are unable to submit their application by the deadline, the applicant should contact the Exchange helpdesk for assistance (EERE-ExchangeSupport@hq.doe.gov). The Exchange helpdesk and/or the EERE Exchange system administrators will assist the applicant in resolving all issues (including finalizing submission on behalf of and with the applicant’s concurrence). PLEASE NOTE, however, those applicants who are unable to submit their application on time due to their waiting until the last minute when network traffic is at its heaviest to submit their materials will not be able to use this process.

B. Application Forms

The application forms and instructions are available on EERE Exchange. To access these materials, go to <https://eere-Exchange.energy.gov> and select the appropriate funding opportunity number.

Note: The maximum file size that can be uploaded to the EERE Exchange website is 10MB. Files in excess of 10MB cannot be uploaded, and hence cannot be submitted for review. If a file exceeds 10MB but is still within the maximum page limit specified in the FOA, it must be broken into parts and denoted to that effect. For example:

ControlNumber_LeadOrganization_Project_Part_1

ControlNumber_LeadOrganization_Project_Part_2, etc.

C. Content and Form of the Concept Paper

To be eligible to submit a Full Application, applicants must submit a Concept Paper by the specified due date and time.

1) Concept Paper Content Requirements

EERE will not review or consider ineligible Concept Papers (see Section III of the FOA).

Each Concept Paper must be limited to a single concept or technology. Unrelated concepts and technologies should not be consolidated into a single Concept Paper.

The Concept Paper must conform to the following content requirements:

Section	Page Limit	Description
Cover Page	1 page maximum	The cover page should include the project title, the specific FOA Topic Area being addressed, both the technical and business points of contact, names of all team member organizations, and any statements regarding confidentiality. Also reproduce the non-proprietary abstract entered in the EERE Exchange concept paper submission form.
Technology Description	3 pages maximum	<p>Applicants are required to describe succinctly:</p> <ul style="list-style-type: none"> • The proposed technology, including its basic principles, level of development, and how it is unique and innovative, where “basic principles is understood to mean the strains, tools, techniques, etc. that will form the core of the full proposal; • The proposed technology’s target level of performance (applicants should provide technical data or other support to show how the proposed target could be met); • The current state-of-the-art in the relevant field and application, including key shortcomings, limitations, and challenges; • How the proposed technology will overcome the shortcomings, limitations, and challenges in the relevant field and application; • The potential impact that the proposed project would have on the relevant field and application; • The key technical risks/issues associated with the proposed technology development plan and possible mitigation strategies; • The impact that EERE funding would have on the proposed project; and • How, if successful, the project will meet the objectives of the FOA • Applicants should identify the strain(s) and improvement techniques. • Applicant’s proposed approach to the PEAK Challenge
Qualifications, Team, and Resources	1 pages maximum	<p>Applicants are required to describe the qualifications, experience, and capabilities of the proposed Project Team, including:</p> <ul style="list-style-type: none"> • The Principal Investigator (PI) and Project Team skill and expertise to successfully execute the project plan; • Applicant’s prior experience demonstrating ability to perform tasks of similar risk and complexity; • Applicant’s history working together with its teaming partners on prior projects or programs; • Applicant access to equipment and facilities necessary to accomplish the effort and/or plans to obtain access to the necessary equipment and facilities.

EERE makes an independent assessment of each Concept Paper based on the criteria in Section V.A.i of the FOA. EERE will encourage a subset of applicants to submit Full Applications. Other applicants will be discouraged from submitting a Full Application. An applicant who receives a “discouraged” notification may still submit a Full Application. EERE will review all eligible Full Applications. However, by discouraging the submission of a Full Application, EERE intends to convey its lack of programmatic interest in the proposed project in an effort to save the applicant the time and expense of preparing an application that is unlikely to be selected for award negotiations.

EERE may include general comments provided from reviewers on an applicant’s Concept Paper in the encourage/discourage notification sent to applicants at the close of that phase.

D. Content and Form of the Full Application

Applicants must submit a Full Application by the specified due date and time to be considered for funding under this FOA. Applicants must complete the following application forms found on the EERE Exchange website at <https://eere-Exchange.energy.gov/>, in accordance with the instructions.

Applicants will have approximately 30 days from receipt of the Concept Paper Encourage/Discourage notification to prepare and submit a Full Application. Regardless of the date the applicant receives the Encourage/Discourage notification, the submission deadline for the Full Application remains the date and time stated on the FOA cover page.

All Full Application documents must be marked with the Control Number issued to the applicant. Applicants will receive a control number upon submission of their Concept Paper, and should include that control number in the file name of their Full Application submission (i.e., Control number_Applicant Name_Full Application)."

1) Full Application Content Requirements

EERE will not review or consider ineligible Full Applications (see Section III of the FOA).

Each Full Application shall be limited to a single concept or technology. Unrelated concepts and technologies shall not be consolidated in a single Full Application.

Full Applications must conform to the following requirements:

Submission	Components	File Name
Full Application (PDF, unless stated otherwise)	Technical Volume (30 page limit, See Chart in Section IV.D.2)	ControlNumber_LeadOrganization_TechnicalVolume
	Statement of Project Objectives	ControlNumber_LeadOrganization_SOPO
	SF-424	ControlNumber_LeadOrganization_App424
	Budget Justification (EERE 335) (Microsoft Excel format. Applicants must use the template available in EERE Exchange)	ControlNumber_LeadOrganization_Budget_Justification
	Summary for Public Release (1 page limit)	ControlNumber_LeadOrganization_Summary
	Summary Slide (1 page limit, Microsoft PowerPoint format)	ControlNumber_LeadOrganization_Slide
	Subaward Budget Justification, if applicable (EERE 335) (Microsoft Excel format. Applicants must use the template available in EERE Exchange)	ControlNumber_LeadOrganization_Subawardee_Budget_Justification
	Budget for FFRDC, if applicable	ControlNumber_LeadOrganization_FWP
	Authorization from cognizant Contracting Officer for FFRDC, if applicable	ControlNumber_LeadOrganization_FFRDCAuth
	SF-LLL Disclosure of Lobbying Activities	ControlNumber_LeadOrganization_SF-LLL
	Foreign Entity and Performance of Work in the United States waiver requests, if applicable	ControlNumber_LeadOrganization_Waiver
	U.S. Manufacturing Plans	ControlNumber_LeadOrganization_USMP
	Technical and Financial datasheet	ControlNumber_LeadOrganization_t echfin

Note: The maximum file size that can be uploaded to the EERE Exchange website is 10MB. Files in excess of 10MB cannot be uploaded, and hence cannot be submitted for review. If a file exceeds 10MB but is still within the maximum page limit specified in the FOA it must be broken into parts and denoted to that effect. For example:

ControlNumber_LeadOrganization_TechnicalVolume_Part_1
ControlNumber_LeadOrganization_TechnicalVolume_Part_2, etc.

EERE will not accept late submissions that resulted from technical difficulties due to uploading files that exceed 10MB.

EERE provides detailed guidance on the content and form of each component below.

2) Technical Volume

The Technical Volume must be submitted in Adobe PDF format. The Technical Volume must conform to the following content and form requirements, including maximum page lengths. If applicants exceed the maximum page lengths indicated below, EERE will review only the authorized number of pages and disregard any additional pages. This volume must address the Merit Review Criteria as discussed in Section V.A.2 of the FOA. Save the Technical Volume in a single PDF file using the following convention for the title: “ControlNumber_LeadOrganization_TechnicalVolume”.

Applicants must provide sufficient citations and references to the primary research literature in a bibliography to justify the claims and approaches made in the Technical Volume. However, EERE and reviewers are under no obligation to review cited sources. Therefore, applicants must describe key claims, supporting data, etc. within the narrative page limit and must not direct reviewers to references for evaluation of these materials. The bibliography can be attached to the narrative as an appendix and does not count towards the page limit.

The Technical Volume to the Full Application may not be more than 30 pages, including the cover page, table of contents, charts, graphs, maps, photos, or other graphics, and must include all of the information in the table below. The applicant should consider the weighting of each of the evaluation criteria (see Section V.A.2 of the FOA) when preparing the Technical Volume.

SECTION/PAGE LIMIT (30 Pages Maximum)	DESCRIPTION
Cover Page	The cover page should include the project title, the specific FOA Topic Area being addressed (if applicable), both the technical and business points of contact, names of all team member organizations, and any

	<p>statements regarding confidentiality. Also reproduce the non-proprietary abstract entered in the EERE Exchange concept paper submission form.</p>
<p>Project Overview (This section should constitute approximately 10% of the Technical Volume)</p>	<p>The Project Overview should contain the following information:</p> <ul style="list-style-type: none"> • Background: The applicant should discuss the background of their organization, including the history, successes, and current research and development status (i.e., the technical baseline) relevant to the technical topic being addressed in the Full Application. • Project Goal: The applicant should explicitly identify the targeted improvements to the baseline technology and the critical success factors in achieving that goal. • DOE Impact: The applicant should discuss the impact that DOE funding would have on the proposed project. Applicants should specifically explain how DOE funding, relative to prior, current, or anticipated funding from other public and private sources, is necessary to achieve the project objectives.
<p>Technical Description, Innovation, and Impact (This section should constitute approximately 40% of the Technical Volume)</p>	<p>The Technical Description should contain the following information:</p> <ul style="list-style-type: none"> • Relevance and Outcomes: The applicant should provide a detailed description of the technology, including the scientific and other principles and objectives that will be pursued during the project. This section should describe the relevance of the proposed project to the goals and objectives of the FOA, including the potential to meet specific DOE technical targets or other relevant performance targets. The applicant should clearly specify the expected outcomes of the project. • Feasibility: The applicant should demonstrate the technical feasibility of the proposed technology and capability of achieving the anticipated performance targets, including a description of previous work done and prior result. Describe the current level of development and the level of advancement needed to advance from from baseline to target. • Innovation and Impacts: The applicant should describe the current state of the art in the applicable field, the specific innovation of the proposed technology, the advantages of proposed technology over current and emerging technologies, and the overall impact on advancing the state of the art/technical baseline if the project is successful.
<p>Research Plan (This section should constitute approximately 30% of the Technical Volume)</p>	<p>The Research Plan should include a summary of the Project Objectives, Technical Scope, Work Breakdown Structure, Milestones, Go/No-Go Decision Points, and Project Schedule. A more detailed Statement of Project Objectives (SOPO) is separately requested.</p> <p>The Research Plan should contain the following information:</p> <ul style="list-style-type: none"> • Project Objectives: The applicant should provide a clear and concise (high-level) statement of the goals and objectives of the project as well as the expected outcomes. • Technical Scope Summary: The applicant should provide a summary description of the overall work scope and approach to achieve the objective(s). The overall work scope is to be divided by budget periods that are separated by discrete decision points (see below for more information on go/no-go decision points). These decision points must capture reasonable project evaluation points and align with

	<p>progress towards the project objective. The applicant should describe the specific expected end result of each performance period.</p> <ul style="list-style-type: none"> • Work Breakdown Structure (WBS) and Task Description Summary: The Workplan should describe the work to be accomplished and how the applicant will achieve the milestones, will accomplish the final project goal(s), and will produce all deliverables. The Workplan is to be structured with a hierarchy of performance period (approximately annual), task and subtasks, which is typical of a standard work breakdown structure (WBS) for any project. The Workplan shall contain a concise description of the specific activities to be conducted over the life of the project. The description shall be a full explanation and disclosure of the project being proposed (i.e., a statement such as “we will then complete a proprietary process” is unacceptable). Task descriptions should be comprehensive. It is the applicant’s responsibility to prepare an adequately detailed task plan to describe the proposed project and the plan for addressing the objectives of this FOA. The summary provided should be consistent with the SOPO. The SOPO will contain a more detailed description of the WBS and tasks that allows thorough review of applicant’s approach. • Milestone Summary: The applicant should provide a summary of appropriate milestones throughout the project to demonstrate success. A milestone may be either a progress measure (which can be activity based) or a SMART technical milestone. SMART milestones should be Specific, Measurable, Achievable, Relevant, and Timely, and must demonstrate a technical achievement rather than simply completing a task. Unless otherwise specified in the FOA, the minimum requirement is that each project must have at least one milestone per quarter for the duration of the project with at least one SMART technical milestone per year (depending on the project, more milestones may be necessary to comprehensively demonstrate progress). The applicant should also provide the means by which the milestone will be verified. The summary provided should be consistent with the Milestone Summary Table in the SOPO. • Go/No-Go Decision Points: The applicant should provide a summary of project-wide go/no-go decision points at appropriate points in the Workplan. A go/no-go decision point is a risk management tool and a project management best practice to ensure that, for the current phase or period of performance, technical success is definitively achieved and potential for success in future phases or periods of performance is evaluated, prior to actually beginning the execution of future phases. The minimum requirement is that each project must have at least 3 budget periods. The Applicant should also provide the specific technical criteria to be used to make the go/no-go decision. The summary provided should be consistent with the SOPO. Go/no-go decision points are considered “SMART” and can fulfill the requirement for an annual SMART milestone. • End of Project Goal: The applicant should provide a summary of the end of project goal(s). The minimum requirement is that each project must have one SMART end of project goal. The summary provided should be consistent with the SOPO. • Project Schedule (Gantt Chart or similar): The applicant should provide a schedule for the entire project, including task and subtask durations, milestones, and go/no-go decision points. • Project Management: The applicant should discuss the team’s proposed management plan, including the following: <ul style="list-style-type: none"> ○ The overall approach to and organization for managing the work ○ The roles of each Project Team member
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	<ul style="list-style-type: none"> ○ Any critical handoffs/interdependencies among Project Team members ○ The technical and management aspects of the management plan, including systems and practices, such as financial and project management practices ○ A thorough identification of technology risks and the risk management approach ○ A description of how project changes will be handled ○ How communications will be maintained among Project Team members ○ Applicants approach to the PEAK Challenge
<p>Market Transformation Plan (Approximately 5% of the Technical Volume)</p>	<p>The applicant should provide a market transformation plan, including the following:</p> <ul style="list-style-type: none"> ● Identification of target market, competitors, and distribution channels for proposed technology along with known or perceived barriers to market penetration, including a mitigation plan ● Identification of a product development and/or service plan, commercialization timeline, financing, product marketing, legal/regulatory considerations including intellectual property, infrastructure requirements, data dissemination, U.S. manufacturing plan etc., and product distribution
<p>Technical Qualifications and Resources (Approximately 15% of the Technical Volume)</p>	<p>The Technical Qualifications and Resources should contain the following information:</p> <ul style="list-style-type: none"> ● Describe the Project Team’s unique qualifications and expertise, including those of key Subrecipients. ● Describe the Project Team’s existing equipment and facilities that will facilitate the successful completion of the proposed project; include a justification of any new equipment or facilities requested as part of the project. ● This section should also include relevant, previous work efforts, demonstrated innovations, and how these enable the applicant to achieve the project objectives. ● Describe the time commitment of the key team members to support the project. ● Describe the technical services to be provided by DOE/NNSA FFRDCs, if applicable. ● Attach one-page resumes for key participating team members as an appendix. Resumes do not count towards the page limit. Multi-page resumes are not allowed. ● Attach other active and pending support levels for the proposed key personnel as an appendix, no more than one page per person. This appendix does not count toward the page limit. ● Attach letters of commitment from all Subrecipient/third party cost share providers as an appendix. Letters of commitment do not count towards the page limit. ● Attach any letters of support from partners/end users as an appendix (1 page maximum per letter). Letters of support do not count towards the page limit. ● For multi-organizational or multi-investigator projects, describe succinctly: <ul style="list-style-type: none"> ○ The roles and the work to be performed by each PI and Key Participant; ○ Business agreements between the applicant and each PI and Key Participant; ○ How the various efforts will be integrated and managed;

	<ul style="list-style-type: none"> ○ Process for making decisions on scientific/technical direction; ○ Publication arrangements; ○ Intellectual Property issues; and ○ Communication plans
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3) Statement of Project Objectives

Applicants are required to complete a Statement of Project Objectives (SOPO). A SOPO template is available on EERE Exchange at <https://eere-Exchange.energy.gov/>. The SOPO, including the Milestone Table, must use when printed standard 8.5 x 11 paper with 1” margins (top, bottom, left, and right) with font not smaller than 12 point. Save the SOPO in a single file using the following convention for the title “ControlNumber_LeadOrganization_SOPO”.

4) SF-424: Application for Federal Assistance

Complete all required fields in accordance with the instructions on the form. The list of certifications and assurances in Field 21 can be found at <http://energy.gov/management/office-management/operational-management/financial-assistance/financial-assistance-forms>, under Certifications and Assurances. Note: The dates and dollar amounts on the SF-424 are for the complete project period and not just the first project year, first phase or other subset of the project period. Save the SF-424 in a single PDF file using the following convention for the title “ControlNumber_LeadOrganization_App424”.

5) Budget Justification Workbook (EERE 335)

Applicants are required to complete the Budget Justification Workbook. This form is available on EERE Exchange at <https://eere-Exchange.energy.gov/>. Prime Recipients must complete each tab of the Budget Justification Workbook for the project as a whole, including all work to be performed by the Prime Recipient and its Subrecipients and Contractors, and provide all requested documentation (e.g., a Federally-approved rate agreement, vendor quotes). Applicants should include costs associated with required annual audits and incurred cost proposals in their proposed budget documents. The “Instructions and Summary” included with the Budget Justification Workbook will auto-populate as the applicant enters information into the Workbook. Applicants must carefully read the “Instructions and Summary” tab provided within the Budget Justification Workbook. Save the Budget Justification Workbook in a single Microsoft Excel file using the following convention for the title “ControlNumber_LeadOrganization_Budget_Justification”.

6) Summary/Abstract for Public Release

Applicants are required to submit a one-page summary/abstract of their project. The project summary/abstract must contain a summary of the proposed activity suitable for dissemination to the public. It should be a self-contained document that identifies the name of the applicant, the project director/principal investigator(s), the project title, the objectives of the project, a

description of the project, including methods to be employed, the potential impact of the project (e.g., benefits, outcomes), and major participants (for collaborative projects). This document must not include any proprietary or sensitive business information as DOE may make it available to the public after selections are made. The project summary must not exceed 1 page when printed using standard 8.5 x 11 paper with 1" margins (top, bottom, left, and right) with font not smaller than 12 point. Save the Summary for Public Release in a single PDF file using the following convention for the title "ControlNumber_LeadOrganization_Summary".

7) Summary Slide

Applicants are required to provide a single PowerPoint slide summarizing the proposed project. The slide must be submitted in Microsoft PowerPoint format. This slide is used during the evaluation process. Save the Summary Slide in a single file using the following convention for the title "ControlNumber_LeadOrganization_Slide".

The Summary Slide template requires the following information:

- A technology Summary;
- A description of the technology's impact;
- Proposed project goals;
- Any key graphics (illustrations, charts and/or tables);
- The project's key idea/takeaway;
- Project title, Prime Recipient, Principal Investigator, and Key Participant information; and
- Requested EERE funds and proposed applicant cost share.

8) Subaward Budget Justification (EERE 335) (if applicable)

Applicants must provide a separate budget justification, EERE 335 (i.e., budget justification for each budget year and a cumulative budget) for each subawardee that is expected to perform work estimated to be more than \$250,000 or 25 percent of the total work effort (whichever is less). The budget justification must include the same justification information described in the "Budget Justification" section above. Save each subaward budget justification in a Microsoft Excel file using the following convention for the title "ControlNumber_LeadOrganization_Subawardee_Budget_Justification".

9) Budget for DOE/NNSA FFRDC (if applicable)

If a DOE/NNSA FFRDC contractor is to perform a portion of the work, the applicant must provide a DOE Field Work Proposal (FWP) in accordance with the requirements in DOE Order 412.1, Work Authorization System. DOE Order 412.1 and DOE O 412.1 (Field Work Proposal form) area available at the following link, under "DOE Budget Forms": <https://www.directives.doe.gov/directives/0412.1-BOrder-a/view>. Save the FWP in a single PDF file using the following convention for the title "ControlNumber_LeadOrganization_FWP".

10) Authorization for non-DOE/NNSA or DOE/NNSA FFRDCs (if applicable)

The Federal agency sponsoring the FFRDC must authorize in writing the use of the FFRDC on the proposed project and this authorization must be submitted with the application. The use of a FFRDC must be consistent with the contractor's authority under its award. Save the Authorization in a single PDF file using the following convention for the title "ControlNumber_LeadOrganization_FFRDCAuth".

11) SF-LLL: Disclosure of Lobbying Activities

Prime Recipients and Subrecipients may not use any Federal funds to influence or attempt to influence, directly or indirectly, congressional action on any legislative or appropriation matters.

Prime Recipients and Subrecipients are required to complete and submit SF-LLL, "Disclosure of Lobbying Activities" (<http://www.whitehouse.gov/sites/default/files/omb/grants/sflllin.pdf>) if any non-Federal funds have been paid or will be paid to any person for influencing or attempting to influence any of the following in connection with your application:

- An officer or employee of any Federal agency;
- A Member of Congress;
- An officer or employee of Congress; or
- An employee of a Member of Congress.

Save the SF-LLL in a single PDF file using the following convention for the title "ControlNumber_LeadOrganization_SF-LLL".

12) Waiver Requests: Foreign Entities and Performance of Work in the United States (if applicable)

i. Foreign Entity Participation:

As set forth in Section III.A.3, all Prime Recipients receiving funding under this FOA must be incorporated (or otherwise formed) under the laws of a State or territory of the United States. To request a waiver of this requirement, the applicant must submit an explicit waiver request in the Full Application. Appendix C lists the necessary information that must be included in a request to waive this requirement.

ii. Performance of Work in the United States

As set forth in Section IV.K.iii, all work under EERE funding agreements must be performed in the United States. This requirement does not apply to the purchase of supplies and equipment, so a waiver is not required for foreign purchases of these items. However, the Prime Recipient should make every effort to purchase supplies and equipment within the United States.

Appendix C lists the necessary information that must be included in a request to waive the Performance of Work in the United States requirement.

13) U.S. Manufacturing Commitments

As part of the application, applicants are required to submit a U.S. Manufacturing Plan. The U.S. Manufacturing Plan represents the applicant's measurable commitment to support U.S. manufacturing as a result of its award.

The weight given to the U.S. Manufacturing Plans during the review and selection process varies based on the particular FOA. Applicants should review Section V.A.2 of this FOA to determine the weight given to the U.S. Manufacturing Plans under this FOA.

A U.S. Manufacturing Plan should contain the following or similar preamble: "If selected for funding, the applicant agrees to the following commitments as a condition of that funding:" and, after the preamble, the plan should include one or more specific and measurable commitments. For example, an applicant may commit particular types of products to be manufactured in the U.S. In addition to or instead of making a commitment tied to a particular product, the applicant may make other types of commitments still beneficial to U.S. manufacturing. An applicant may commit to a particular investment in a new or existing U.S. manufacturing facility, keep certain activities based in the U.S. (i.e., final assembly) or support a certain number of jobs in the U.S. related to the technology and manufacturing. For an applicant which is likely to license the technology to others, especially universities for which licensing may be the exclusive means of commercialization the technology, the U.S. manufacturing plan may indicate the applicant's plan and commitment to use a licensing strategy that would likely support U.S. manufacturing.

When an applicant that is a domestic small business, domestic educational institution, or nonprofit organization is selected for an award, the U.S. Manufacturing Plan submitted by the applicant becomes part of the terms and conditions of the award. The applicant/awardee may request a waiver or modification of the U.S. Manufacturing Plan from DOE upon a showing that the original U.S. Manufacturing Plan is no longer economically feasible.

When an applicant that is a domestic large business is selected for an award, a class patent waiver applies as set forth in Section VIII. L. Under this class patent waiver, domestic large businesses may elect title to their subject inventions similar to the right provided to the domestic small businesses, educational institutions, and nonprofits by law. In order to avail itself of the class patent waiver, a domestic large business must agree that any products embodying or produced through the use of an invention conceived or first actually reduced to practice under the award will be substantially manufactured in the United States, unless DOE agrees that the commitments proposed in the U.S. Manufacturing Plan are sufficient.

For other entity types that are selected for award, please see Section VIII.L regarding U.S. manufacturing commitments.

14) Data Management Plan

Applicants whose Full Applications are selected for award negotiations will be required to submit a Data Management Plan during the award negotiations phase. The Data Management Plan is a document that outlines the proposed plan for data sharing or preservation. Submission of this plan is required, and failure to submit the plan may result in the termination of award negotiations. As a courtesy, guidance for preparing a Data Management Plan is provided in Appendix D of the FOA.

E. Content and Form of Replies to Reviewer Comments

EERE will provide applicants with reviewer comments following evaluation of all eligible Full Applications. Applicants will have a brief opportunity to review the comments and to prepare a short Reply to Reviewer Comments responding to comments however they desire or supplementing their Full Application. The Reply to Reviewer Comments will be provided to the original reviewers for consideration and discussion. The reviewers may use the information provided in the reply to change, add, or remove review comments.

The Reply to Reviewer Comments is an optional submission; applicants are not required to submit a Reply to Reviewer Comments. EERE will notify applicants via email when the Reviewer Comments are available for reply. The expected submission deadline is on the cover page of the FOA; however, it is the applicant’s responsibility to monitor email in the event that the expected date changes. The deadline will not be extended for applicants who are unable to timely submit their reply due to failure to check email or relying on the expected date alone. Applicants should anticipate having approximately three (3) business days to submit Replies to Reviewer Comments.

EERE will not review or consider ineligible Replies to Reviewer Comments (see Section III of the FOA). EERE will review and consider each eligible Full Application, even if no Reply is submitted or if the Reply is found to be ineligible.

Replies to Reviewer Comments must conform to the following content and form requirements, including maximum page lengths, described below. If a Reply to Reviewer Comments is more than three pages in length, EERE will review only the first three (3) pages and disregard any additional pages.

SECTION	PAGE LIMIT	DESCRIPTION
Text	3 pages max	Applicants may respond to one or more reviewer comments or supplement their Full Application.

Optional	1 page max	Applicants may use this page however they wish; text, graphs, charts, or other data to respond to reviewer comments or supplement their Full Application are acceptable.
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F. Post-Award Information Requests

If selected for award, EERE reserves the right to request additional or clarifying information for any reason deemed necessary, including but not limited to:

- Indirect cost information
- Other budget information
- Commitment Letters from Third Parties Contributing to Cost Share, if applicable
- Name and phone number of the Designated Responsible Employee for complying with national policies prohibiting discrimination (See 10 CFR 1040.5)
- Representation of Limited Rights Data and Restricted Software, if applicable
- Environmental Questionnaire

G. Dun and Bradstreet Universal Numbering System Number and System for Award Management

Each applicant (unless the applicant is an individual or Federal awarding agency that is excepted from those requirements under 2 CFR §25.110(b) or (c), or has an exception approved by the Federal awarding agency under 2 CFR §25.110(d)) is required to: (1) Be registered in the System for Award Management (SAM) at <https://www.sam.gov> before submitting its application; (2) provide a valid Dun and Bradstreet Universal Numbering System (DUNS) number in its application; and (3) continue to maintain an active SAM registration with current information at all times during which it has an active Federal award or an application or plan under consideration by a Federal awarding agency. DOE may not make a Federal award to an applicant until the applicant has complied with all applicable DUNS and SAM requirements and, if an applicant has not fully complied with the requirements by the time DOE is ready to make a Federal award, the DOE may determine that the applicant is not qualified to receive a Federal award and use that determination as a basis for making a Federal award to another applicant.

H. Submission Dates and Times

Concept Papers, Full Applications, and Replies to Reviewer Comments must be submitted in EERE Exchange no later than 5 p.m. Eastern on the dates provided on the cover page of this FOA.

I. Intergovernmental Review

Technology Office not subject to Executive Order 12372

This FOA is not subject to Executive Order 12372 – Intergovernmental Review of Federal Programs.

J. Funding Restrictions

1) Allowable Costs

All expenditures must be allowable, allocable, and reasonable in accordance with the applicable Federal cost principles.

Refer to the following applicable Federal cost principles for more information:

- FAR Part 31 for For-Profit entities; and
- 2 CFR Part 200 Subpart E - Cost Principles for all other non-federal entities.

2) Pre-Award Costs

Selectees must request prior written approval to charge pre-award costs. Pre-award costs are those incurred prior to the effective date of the Federal award directly pursuant to the negotiation and in anticipation of the Federal award where such costs are necessary for efficient and timely performance of the scope of work. Such costs are allowable only to the extent that they would have been allowable if incurred after the date of the Federal award and **only** with the written approval of the Federal awarding agency, through the Contracting Officer assigned to the award.

Pre-award costs cannot be incurred prior to the Selection Official signing the Selection Statement and Analysis. Pre-award costs can only be incurred if such costs would be reimbursable under the agreement if incurred after award.

Pre-Award expenditures are made at the Selectee's risk; EERE is not obligated to reimburse costs: (1) in the absence of appropriations; (2) if an award is not made; or (3) if an award is made for a lesser amount than the Selectee anticipated.

3) Pre-Award Costs Related to National Environmental Policy Act (NEPA) Requirements

EERE's decision whether and how to distribute Federal funds under this FOA is subject to NEPA. Applicants should carefully consider and should seek legal counsel or other expert advice before taking any action related to the proposed project that would have an adverse effect on the environment or limit the choice of reasonable alternatives prior to EERE completing the NEPA review process.

EERE does not guarantee or assume any obligation to reimburse costs where the Prime Recipient incurred the costs prior to receiving written authorization from the Contracting Officer. If the applicant elects to undertake activities that may have an adverse effect on the environment or limit the choice of reasonable alternatives prior to receiving such written authorization from the Contracting Officer, the applicant is doing so at risk of not receiving Federal funding and such costs may not be recognized as allowable cost share. Likewise, if a project is selected for negotiation of award, and the Prime Recipient elects to undertake

activities that are not authorized for Federal funding by the Contracting Officer in advance of EERE completing a NEPA review, the Prime Recipient is doing so at risk of not receiving Federal Funding and such costs may not be recognized as allowable cost share. Nothing contained in the pre-award cost reimbursement regulations or any pre-award costs approval letter from the Contracting Officer override these NEPA requirements to obtain the written authorization from the Contracting Officer prior to taking any action that may have an adverse effect on the environment or limit the choice of reasonable alternatives.

4) Performance of Work in the United States

i. Requirement

All work performed under EERE Awards must be performed in the United States. This requirement does not apply to the purchase of supplies and equipment; however, the Prime Recipient should make every effort to purchase supplies and equipment within the United States. The Prime Recipient must flow down this requirement to its Subrecipients.

ii. Failure to Comply

If the Prime Recipient fails to comply with the Performance of Work in the United States requirement, EERE may deny reimbursement for the work conducted outside the United States and such costs may not be recognized as allowable recipient cost share. The Prime Recipient is responsible should any work under this Award be performed outside the United States, absent a waiver, regardless of if the work is performed by the Prime Recipient, Subrecipients, contractors or other project partners.

iii. Waiver

There may be limited circumstances where it is in the interest of the project to perform a portion of the work outside the United States. To seek a waiver of the Performance of Work in the United States requirement, the applicant must submit a written waiver request to EERE. Appendix C lists the necessary information that must be included in a request to waive the Performance of Work in the United States requirement.

The applicant must demonstrate to the satisfaction of EERE that a waiver would further the purposes of the FOA and is in the economic interests of the United States. EERE may require additional information before considering a waiver request. Save the waiver request(s) in a single PDF file titled "ControlNumber_PerformanceofWork_Waiver". The applicant does not have the right to appeal EERE's decision concerning a waiver request.

5) Construction

Recipients are required to obtain written authorization from the Contracting Officer before incurring any major construction costs.

6) Foreign Travel

If international travel is proposed for your project, please note that your organization must comply with the International Air Transportation Fair Competitive Practices Act of 1974 (49 USC 40118), commonly referred to as the “Fly America Act,” and implementing regulations at 41 CFR 301-10.131 through 301-10.143. The law and regulations require air transport of people or property to, from, between, or within a country other than the United States, the cost of which is supported under this award, to be performed by or under a cost-sharing arrangement with a U.S. flag carrier, if service is available. Foreign travel costs are allowable only with the written prior approval of the Contracting Officer assigned to the award.

7) Equipment and Supplies

To the greatest extent practicable, all equipment and products purchased with funds made available under this FOA should be American-made. This requirement does not apply to used or leased equipment.

Property disposition will be required at the end of a project if the current fair market value of property exceeds \$5,000. The rules for property disposition are set forth in 2 CFR 200.310 – 200.316 as amended by 2 CFR 910.360.

8) Lobbying

Recipients and Subrecipients may not use any Federal funds to influence or attempt to influence, directly or indirectly, congressional action on any legislative or appropriation matters.

Recipients and Subrecipients are required to complete and submit SF-LLL, “Disclosure of Lobbying Activities” (<http://www.whitehouse.gov/sites/default/files/omb/grants/sflllin.pdf>) if any non-Federal funds have been paid or will be paid to any person for influencing or attempting to influence any of the following in connection with your application:

- An officer or employee of any Federal agency;
- A Member of Congress;
- An officer or employee of Congress; or
- An employee of a Member of Congress.

9) Risk Assessment

Prior to making a Federal award, the DOE is required by 31 U.S.C. 3321 and 41 U.S.C. 2313 to review information available through any OMB-designated repositories of government-wide eligibility qualification or financial integrity information, such as SAM Exclusions and “Do Not Pay.”

In addition, DOE evaluates the risk(s) posed by applicants before they receive Federal awards. This evaluation may consider: results of the evaluation of the applicant's eligibility; the quality

of the application; financial stability; quality of management systems and ability to meet the management standards prescribed in this part; history of performance; reports and findings from audits; and the applicant's ability to effectively implement statutory, regulatory, or other requirements imposed on non-Federal entities.

In addition to this review, DOE must comply with the guidelines on government-wide suspension and debarment in 2 CFR 180, and must require non-Federal entities to comply with these provisions. These provisions restrict Federal awards, subawards and contracts with certain parties that are debarred, suspended or otherwise excluded from or ineligible for participation in Federal programs or activities.

10) Invoice Review and Approval

DOE employs a risk-based approach to determine the level of supporting documentation required for approving invoice payments. Recipients may be required to provide some or all of the following items with their requests for reimbursement:

- Summary of costs by cost categories
- Timesheets or personnel hours report
- Invoices/receipts for all travel, equipment, supplies, contractual, and other costs
- UCC filing proof for equipment acquired with project funds by for-profit recipients and subrecipients
- Explanation of cost share for invoicing period
- Analogous information for some subrecipients
- Other items as required by DOE

V. Application Review Information

A. Technical Review Criteria

1) Concept Papers

Concept Papers are evaluated based on consideration the following factors. All sub-criteria are of equal weight.

Criterion 1: Overall Responsiveness and Viability of the Project (Weight: 100%)

- The degree to which the applicant clearly describes the proposed technology, describes how the technology is unique and innovative, and how the technology will advance the current state-of-the-art as evidenced by proposed progress from the applicant’s baseline to the performance target.
- The degree to which the applicant identifies risks and challenges, including possible mitigation strategies, and has shown the impact that EERE funding and the proposed project would have on the relevant field and application.
- The degree to which the applicant’s qualifications, experience, capabilities and other resources are adequate to complete the proposed project with available resources.
- The degree to which the proposed work, if successfully accomplished, could clearly meet the objectives as stated in the FOA.

2) Full Applications

Applications will be evaluated against the merit review criteria shown below. All sub-criteria within a given criterion are of equal weight.

Criterion 1: Technical Merit, Innovation, and Impact (50%)

- Extent to which the proposal is responsive to the FOA objectives and the application requirements.
- Extent to which the proposed technology or process has merit and is innovative.
- Degree to which the current state of the technology and the proposed advancement are clearly described.
- Extent of technical detail in the application to allow assesment of whether:
 - the proposed work is at the claimed level of development;
 - the applicant’s baseline is supported by data;
 - the state of art can be advanced within the project
- Extent to which relevant data, calculations, and discussion of prior work by the applicant are provided within the technical volume and support the viability of the proposed work.
- Extent to which the project supports the topic area objectives and target specifications and metrics.
- The extent of the impact to the state of the art in achieving the project objectives.

Criterion 2: Project Research Plan (30%)

- Extent to which applicant’s approach is reasonable, informed by prior work, and efficient.
- Degree to which the approach is likely to succeed within the timeline and a critical path has been identified.
- Degree to which the task descriptions are comprehensive, detailed, and reasonable.
- Degree to which the Workplan and SOPO are aligned with the project objectives, contain meaningful, timely milestones that relate to the project objectives, and provide strong Go/No-go decision points that encompass the critical points in the project progression.
- Extent to which the discussion and demonstrated understanding of the key technical risks is forthcoming and comprehensive and the proposed mitigation strategies to address identified risks are reasonable.
- Extent to which the baseline and metrics are clear, measurable, and supported within the proposal.
- Extent to which interim deliverables will demonstrate measurable progress towards objectives.
- Extent to which the approach to the PEAK challenge is integrated with the research plan and objectives.

Criterion 3: Market Transformation Plan, Team, and Resources (20%)

Market Transformation Plan

- Extent of identification of target market, competitors, and distribution channels for proposed technology along with known or perceived barriers to market penetration, including mitigation plan.
- Comprehensiveness of commercialization plan including but not limited to product development and/or service plan, commercialization timeline, financing, product marketing, legal/regulatory considerations including intellectual property, infrastructure requirements, data dissemination, U.S. manufacturing plan etc., and product distribution.

Team and Resources

- The capability of the Principal Investigator(s) and the proposed team to address all aspects of the proposed work with a good chance of success. Qualifications, relevant expertise, and time commitment of the individuals on the team.
- Degree to which the proposed consortia/team demonstrates the ability to facilitate and expedite further development and commercial deployment of the proposed technologies.
- Level of participation by project participants as evidenced by letter(s) of commitment and how well they are integrated into the Workplan.
- The sufficiency of the facilities to support the work.
- Reasonableness of budget and spend plan for proposed project and objectives.

3) Criteria for Replies to Reviewer Comments

EERE has not established separate criteria to evaluate Replies to Reviewer Comments. Instead, Replies to Reviewer Comments are attached to the original applications and evaluated as an extension of the Full Application.

B. Standards for Application Evaluation

Applications that are determined to be eligible will be evaluated in accordance with this FOA, by the standards set forth in EERE's Notice of Objective Merit Review Procedure (76 Fed. Reg. 17846, March 31, 2011) and the guidance provided in the "Department of Energy Merit Review Guide for Financial Assistance," which is available at:

<http://energy.gov/management/downloads/merit-review-guide-financial-assistance>.

C. Other Selection Factors

1) Program Policy Factors

In addition to the above criteria, the Selection Official may consider the following program policy factors in determining which Full Applications to select for award negotiations:

- The degree to which the proposed project exhibits technological diversity when compared to the existing DOE project portfolio and other projects selected from the subject FOA.
- The degree to which the proposed project, including proposed cost share, optimizes the use of available EERE funding to achieve programmatic objectives.
- The level of industry involvement and demonstrated ability to accelerate commercialization and overcome key market barriers.
- The degree to which the proposed project is likely to lead to increased employment and manufacturing in the United States.
- The degree to which the proposed project will accelerate transformational technological advances in areas that industry by itself is not likely to undertake because of technical and financial uncertainty.
- The degree to which the proposed project collectively represents diverse types and sizes of applicant organizations.
- The degree to which the proposed project, or group of projects, represent a desired geographic distribution (considering past awards and current applications).
- Whether the applicant is a Climate Action Champion¹³ designated under DOE's Request for Applications DE-FOA-0001189 (RFA) or the applicant has a letter of support from a Climate Action Champion designated under the above referenced RFA.

¹³ In recognition of the importance of the dual policy goals of reducing greenhouse gas emissions and enhancing climate resilience, the U.S. Department of Energy (DOE) – in close collaboration with other Federal agencies – launched the Climate Action Champion initiative to identify and showcase U.S. local and tribal governments that have proven to be climate leaders through pursuing opportunities to advance both of these goals in their communities. Recently, DOE selected sixteen (16) U.S. local governments and tribal governments – or regional collaborations or consortia thereof – that demonstrated a strong and ongoing commitment to implementing

D. Evaluation and Selection Process

1) Overview

The evaluation process consists of multiple phases; each includes an initial eligibility review and a thorough technical review. Rigorous technical reviews of eligible submissions are conducted by reviewers that are experts in the subject matter of the FOA. Ultimately, the Selection Official considers the recommendations of the reviewers, along with other considerations such as program policy factors, in determining which applications to select.

2) Pre-Selection Interviews

As part of the evaluation and selection process, EERE may invite one or more applicants to participate in Pre-Selection Interviews. Pre-Selection Interviews are distinct from and more formal than pre-selection clarifications (See Section V.D.3 of the FOA). The invited applicant(s) will meet with EERE representatives to provide clarification on the contents of the Full Applications and to provide EERE an opportunity to ask questions regarding the proposed project. The information provided by applicants to EERE through Pre-Selection Interviews contributes to EERE's selection decisions.

EERE will arrange to meet with the invited applicants in person at EERE's offices or a mutually agreed upon location. EERE may also arrange site visits at certain applicants' facilities. In the alternative, EERE may invite certain applicants to participate in a one-on-one conference with EERE via webinar, videoconference, or conference call.

EERE will not reimburse applicants for travel and other expenses relating to the Pre-Selection Interviews, nor will these costs be eligible for reimbursement as pre-award costs.

EERE may obtain additional information through Pre-Selection Interviews that will be used to make a final selection determination. EERE may select applications for funding and make awards without Pre-Selection Interviews. Participation in Pre-Selection Interviews with EERE does not signify that applicants have been selected for award negotiations.

3) Pre-Selection Clarification

EERE may determine that pre-selection clarifications are necessary from one or more applicants. Pre-selection clarifications are distinct from and less formal than pre-selection interviews. These pre-selection clarifications will solely be for the purposes of clarifying the application, and will be limited to information already provided in the application documentation. The pre-selection clarifications may occur before, during or after the merit

strategies that both reduce greenhouse gas emissions and enhance climate resilience, with a particular emphasis on strategies that further both goals. <http://www.whitehouse.gov/blog/2014/12/03/announcing-first-class-climate-action-champions>

review evaluation process. Information provided by an applicant that is not necessary to address the pre-selection clarification question will not be reviewed or considered. Typically, a pre-selection clarification will be carried out through either written responses to EERE's written clarification questions or video or conference calls with EERE representatives.

The information provided by applicants to EERE through pre-selection clarifications is incorporated in their applications and contributes to the merit review evaluation and EERE's selection decisions. If EERE contacts an applicant for pre-selection clarification purposes, it does not signify that the applicant has been selected for negotiation of award or that the applicant is among the top ranked applications.

EERE will not reimburse applicants for expenses relating to the pre-selection clarifications, nor will these costs be eligible for reimbursement as pre-award costs.

4) Recipient Integrity and Performance Matters

DOE, prior to making a Federal award with a total amount of Federal share greater than the simplified acquisition threshold, is required to review and consider any information about the applicant that is in the designated integrity and performance system accessible through SAM (currently FAPIIS) (see 41 U.S.C. 2313).

The applicant, at its option, may review information in the designated integrity and performance systems accessible through SAM and comment on any information about itself that a Federal awarding agency previously entered and is currently in the designated integrity and performance system accessible through SAM.

DOE will consider any written comments by the applicant, in addition to the other information in the designated integrity and performance system, in making a judgment about the applicant's integrity, business ethics, and record of performance under Federal awards when completing the review of risk posed by applicants as described in 2 C.F.R. § 200.205.

5) Selection

The Selection Official may consider the technical merit, the Federal Consensus Board's recommendations, program policy factors, and the amount of funds available in arriving at selections for this FOA.

E. Anticipated Notice of Selection and Award Dates

EERE anticipates notifying applicants selected for negotiation of award by spring 2017 and making awards by summer 2017.

VI. Award Administration Information

A. Award Notices

1) Ineligible Submissions

Ineligible Concept Papers and Full Applications will not be further reviewed or considered for award. The Contracting Officer will send a notification letter by email to the technical and administrative points of contact designated by the applicant in EERE Exchange. The notification letter will state the basis upon which the Concept Paper or the Full Application is ineligible and not considered for further review.

2) Concept Paper Notifications

EERE will notify applicants of its determination to encourage or discourage the submission of a Full Application. EERE will send a notification letter by email to the technical and administrative points of contact designated by the applicant in EERE Exchange.

Applicants may submit a Full Application even if they receive a notification discouraging them from doing so. By discouraging the submission of a Full Application, EERE intends to convey its lack of programmatic interest in the proposed project. Such assessments do not necessarily reflect judgments on the merits of the proposed project. The purpose of the Concept Paper phase is to save applicants the considerable time and expense of preparing a Full Application that is unlikely to be selected for award negotiations.

A notification letter encouraging the submission of a Full Application does not authorize the applicant to commence performance of the project. Please refer to Section IV.J.2 of the FOA for guidance on pre-award costs.

3) Full Application Notifications

EERE will notify applicants of its determination via a notification letter by email to the technical and administrative points of contact designated by the applicant in EERE Exchange. The notification letter will inform the applicant whether or not its Full Application was selected for award negotiations. Alternatively, EERE may notify one or more applicants that a final selection determination on particular Full Applications will be made at a later date, subject to the availability of funds or other factors.

4) Successful Applicants

Receipt of a notification letter selecting a Full Application for award negotiations does not authorize the applicant to commence performance of the project. If an application is selected for award negotiations, it is not a commitment by EERE to issue an award. Applicants do not receive an award until award negotiations are complete and the Contracting Officer executes the funding agreement, accessible by the Prime Recipient in FedConnect.

The award negotiation process will take approximately 60 days. Applicants must designate a primary and a backup point-of-contact in EERE Exchange with whom EERE will communicate to conduct award negotiations. The applicant must be responsive during award negotiations (i.e., provide requested documentation) and meet the negotiation deadlines. If the applicant fails to do so or if award negotiations are otherwise unsuccessful, EERE will cancel the award negotiations and rescind the Selection. EERE reserves the right to terminate award negotiations at any time for any reason.

Please refer to Section IV.J.2 of the FOA for guidance on pre-award costs.

5) Alternate Selection Determinations

In some instances, an applicant may receive a notification that its application was not selected for award and EERE designated the application to be an alternate. As an alternate, EERE may consider the Full Application for Federal funding in the future. A notification letter stating the Full Application is designated as an alternate does not authorize the applicant to commence performance of the project. EERE may ultimately determine to select or not select the Full Application for award negotiations.

6) Unsuccessful Applicants

EERE shall promptly notify in writing each applicant whose application has not been selected for award or whose application cannot be funded because of the unavailability of appropriated funds.

B. Administrative and National Policy Requirements

1) Registration Requirements

There are several one-time actions before submitting an application in response to this FOA, and it is vital that applicants address these items as soon as possible. Some may take several weeks, and failure to complete them could interfere with an applicant's ability to apply to this FOA, or to meet the negotiation deadlines and receive an award if the application is selected. These requirements are as follows:

i. EERE Exchange

Register and create an account on EERE Exchange at <https://eere-Exchange.energy.gov>. This account will then allow the user to register for any open EERE FOAs that are currently in EERE Exchange. It is recommended that each organization or business unit, whether acting as a team or a single entity, use only one account as the contact point for each submission. Applicants should also designate backup points of contact so they may be easily contacted if deemed necessary. **This step is required to apply to this FOA.**

The EERE Exchange registration does not have a delay; however, **the remaining registration requirements below could take several weeks to process and are necessary for a potential applicant to receive an award under this FOA.**

ii. DUNS Number

Obtain a Dun and Bradstreet Data Universal Numbering System (DUNS) number (including the plus 4 extension, if applicable) at <http://fedgov.dnb.com/webform>.

iii. System for Award Management

Register with the System for Award Management (SAM) at <https://www.sam.gov>. Designating an Electronic Business Point of Contact (EBiz POC) and obtaining a special password called an MPIN are important steps in SAM registration. Please update your SAM registration annually.

iv. FedConnect

Register in FedConnect at <https://www.fedconnect.net>. To create an organization account, your organization's SAM MPIN is required. For more information about the SAM MPIN or other registration requirements, review the FedConnect Ready, Set, Go! Guide at http://www.fedconnect.net/FedConnect/Marketing/Documents/FedConnect_Ready_Set_Go.pdf.

v. Grants.gov

Register in Grants.gov (<http://www.grants.gov>) to receive automatic updates when Amendments to this FOA are posted. However, please note that Concept Papers and Full Applications will not be accepted through Grants.gov.

vi. Electronic Authorization of Applications and Award Documents

Submission of an application and supplemental information under this FOA through electronic systems used by the Department of Energy, including EERE Exchange and FedConnect.net, constitutes the authorized representative's approval and electronic signature.

2) Award Administrative Requirements

The administrative requirements for DOE grants and cooperative agreements are contained in 2 CFR Part 200 as amended by 2 CFR Part 910.

3) Foreign National Access to DOE Sites

All applicants that ultimately enter into an award resulting from this FOA will be subject to the following requirement concerning foreign national involvement. Upon DOE's request, Prime Recipients must provide information to facilitate DOE's responsibilities associated with foreign national access to DOE sites, information, technologies, and equipment. A foreign national is defined as any person who was born outside the jurisdiction of the United States, is a citizen of a foreign government, and has not been naturalized under U.S. law. If the Prime Recipient or Subrecipients, contractors or vendors under the award, anticipate utilizing a foreign national person in the performance of an award, the Prime Recipient is responsible for providing to the

Contracting Officer specific information of the foreign national(s) to satisfy compliance with all of the requirements for access approval.

4) Subaward and Executive Reporting

Additional administrative requirements necessary for DOE grants and cooperative agreements to comply with the Federal Funding and Transparency Act of 2006 (FFATA) are contained in 2 CFR Part 170. Prime Recipients must register with the new FFATA Subaward Reporting System database and report the required data on their first tier Subrecipients. Prime Recipients must report the executive compensation for their own executives as part of their registration profile in SAM.

5) National Policy Requirements

The National Policy Assurances that are incorporated as a term and condition of award are located at: <http://www.nsf.gov/awards/managing/rtc.jsp>.

6) Environmental Review in Accordance with National Environmental Policy Act (NEPA)

EERE's decision whether and how to distribute federal funds under this FOA is subject to the National Environmental Policy Act (42 USC 4321, *et seq.*). NEPA requires Federal agencies to integrate environmental values into their decision-making processes by considering the potential environmental impacts of their proposed actions. For additional background on NEPA, please see DOE's NEPA website, at <http://nepa.energy.gov/>.

While NEPA compliance is a Federal agency responsibility and the ultimate decisions remain with the Federal agency, all recipients selected for an award will be required to assist in the timely and effective completion of the NEPA process in the manner most pertinent to their proposed project. If DOE determines certain records must be prepared to complete the NEPA review process (e.g., biological evaluations or environmental assessments), the costs to prepare the necessary records may be included as part of the project costs.

7) Applicant Representations and Certifications

i. Lobbying Restrictions

By accepting funds under this award, the Prime Recipient agrees that none of the funds obligated on the award shall be expended, directly or indirectly, to influence Congressional action on any legislation or appropriation matters pending before Congress, other than to communicate to Members of Congress as described in 18 U.S.C. §1913. This restriction is in addition to those prescribed elsewhere in statute and regulation.

ii. Corporate Felony Conviction and Federal Tax Liability Representations

In submitting an application in response to this FOA, the applicant represents that:

- a. It is **not** a corporation that has been convicted of a felony criminal violation under any Federal law within the preceding 24 months, and

- b. It is **not** a corporation that has any unpaid Federal tax liability that has been assessed, for which all judicial and administrative remedies have been exhausted or have lapsed, and that is not being paid in a timely manner pursuant to an agreement with the authority responsible for collecting the tax liability.

For purposes of these representations the following definitions apply:

A Corporation includes any entity that has filed articles of incorporation in any of the 50 states, the District of Columbia, or the various territories of the United States [but not foreign corporations]. It includes both for-profit and non-profit organizations.

iii. Nondisclosure and Confidentiality Agreements Representations

In submitting an application in response to this FOA the applicant represents that:

- a. It **does not and will not** require its employees or contractors to sign internal nondisclosure or confidentiality agreements or statements prohibiting or otherwise restricting its employees or contractors from lawfully reporting waste, fraud, or abuse to a designated investigative or law enforcement representative of a Federal department or agency authorized to receive such information.
- b. It **does not and will not** use any Federal funds to implement or enforce any nondisclosure and/or confidentiality policy, form, or agreement it uses unless it contains the following provisions:

(1) *“These provisions are consistent with and do not supersede, conflict with, or otherwise alter the employee obligations, rights, or liabilities created by existing statute or Executive order relating to (1) classified information, (2) communications to Congress, (3) the reporting to an Inspector General of a violation of any law, rule, or regulation, or mismanagement, a gross waste of funds, an abuse of authority, or a substantial and specific danger to public health or safety, or (4) any other whistleblower protection. The definitions, requirements, obligations, rights, sanctions, and liabilities created by controlling Executive orders and statutory provisions are incorporated into this agreement and are controlling.”*

(2) The limitation above shall not contravene requirements applicable to Standard Form 312, Form 4414, or any other form issued by a Federal department or agency governing the nondisclosure of classified information.

(3) Notwithstanding the provision listed in paragraph (a), a nondisclosure or confidentiality policy form or agreement that is to be executed by a person connected with the conduct of an intelligence or intelligence-related activity, other than an employee or officer of the United States Government, may contain provisions appropriate to the particular activity for which such document is to be used. Such form or agreement shall, at a minimum, require that the person will not disclose any classified information received in the course

of such activity unless specifically authorized to do so by the United States Government. Such nondisclosure or confidentiality forms shall also make it clear that they do not bar disclosures to Congress, or to an authorized official of an executive agency or the Department of Justice, that are essential to reporting a substantial violation of law.

8) Statement of Federal Stewardship

EERE will exercise normal Federal stewardship in overseeing the project activities performed under EERE Awards. Stewardship Activities include, but are not limited to, conducting site visits; reviewing performance and financial reports, providing assistance and/or temporary intervention in usual circumstances to correct deficiencies that develop during the project; assuring compliance with terms and conditions; and reviewing technical performance after project completion to ensure that the project objectives have been accomplished.

9) Statement of Substantial Involvement

EERE has substantial involvement in work performed under Awards made as a result of this FOA. EERE does not limit its involvement to the administrative requirements of the Award. Instead, EERE has substantial involvement in the direction and redirection of the technical aspects of the project as a whole. Substantial involvement includes, but is not limited to, the following:

1. EERE shares responsibility with the recipient for the management, control, direction, and performance of the Project.
2. EERE may intervene in the conduct or performance of work under this Award for programmatic reasons. Intervention includes the interruption or modification of the conduct or performance of project activities.
3. EERE may redirect or discontinue funding the Project based on the outcome of EERE's evaluation of the Project at that the Go/No Go decision point(s).
4. EERE participates in major project decision-making processes.
5. In order to adequately monitor project progress and provide technical direction and/or redirection to the Recipient, DOE must be provided an adequate level of insight into various Recipient activities. Government insight activities include but are not limited to access for DOE's consultants to perform independent evaluations of Recipient's plans and processes. (Consultants to DOE may not provide technical direction and/or redirection to the Recipient.)
6. DOE will be actively involved with the Recipient in verifying the current technology readiness level of the project (and specific unit operations) as well as establishing the project technology baseline and interim and concluding performance metrics. This includes

working with the Recipient to generate the baseline technical and financial data sheet that will then be updated periodically throughout the project.

10) Intellectual Property Management Plan

Within 30 days of selection, applicants must submit an executed IP Management Plan between the members of the consortia or team.

The award will set forth the treatment of and obligations related to intellectual property rights between EERE and the individual members. The IP Management Plan should describe how the members will handle intellectual property rights and issues between themselves while ensuring compliance with Federal IP laws, regulations, and policies (see Sections VIII.L-VIII.O of this FOA for more details on applicable Federal IP laws and regulations). Guidance regarding the contents of IP Management Plans is available from EERE upon request.

The following is a non-exhaustive list of examples of items that the IP Management Plan may cover:

- The treatment of confidential information between members (i.e., the use of non-disclosure agreements);
- The treatment of background IP (e.g., any requirements for identifying it or making it available);
- The treatment of inventions made under the project (e.g., any requirements for disclosing to the other members, filing patent applications, paying for patent prosecution, and cross-licensing or other licensing arrangements between the members);
- The treatment of data produced, including software, under the project (e.g., any publication process or other dissemination strategies, copyrighting strategy or arrangement between members);
- Any technology transfer and commercialization requirements or arrangements between the members;
- The treatment of any intellectual property issues that may arise due to a change in membership of the consortia or team; and
- The handling of disputes related to intellectual property between the members.

11) Subject Invention Utilization Reporting

In order to ensure that Prime Recipients and Subrecipients holding title to subject inventions are taking the appropriate steps to commercialize subject inventions, EERE may require that each Prime Recipient holding title to a subject invention submit annual reports for 10 years from the date the subject invention was disclosed to EERE on the utilization of the subject invention and efforts made by Prime Recipient or their licensees or assignees to stimulate such utilization. The reports must include information regarding the status of development, date of first commercial sale or use, gross royalties received by the Prime Recipient, and such other data and information as EERE may specify.

12) Intellectual Property Provisions

The standard DOE financial assistance intellectual property provisions applicable to the various types of recipients are located at <http://www1.eere.energy.gov/financing/resources.html>.

13) Reporting

Reporting requirements are identified on the Federal Assistance Reporting Checklist, attached to the award agreement. The checklist can be accessed at <http://www1.eere.energy.gov/financing/resources.html>.

The information requested in the technical/financial template at the time of application as well as during the validation task for selected and awarded projects, must be updated annually at a minimum and at Go/No-Go decision points throughout the project.

As a steward of taxpayer funds, BETO recognizes the importance of tracking, documenting and analyzing the outcomes of Federally funded awards. Investments in bioenergy applied R&D often do not immediately translate into impactful commercial products and processes. BETO is interested in evaluating both the short-term progress and the long-term impact of its investments. If a project is selected for award negotiations, a letter of commitment from selectees to reporting beyond the end of the period of performance for at least five years will be required. Receipt of the required information during award negotiations enables BETO to improve future funding opportunities to achieve better outcomes for the high-risk, high-reward technologies it seeks to support. Therefore, Prime Recipients must agree to provide annual updates (consisting of no more than 600 words) for at least five years following the conclusion of the award, describing technical and economic updates to the technology developed under the BETO award. This may include but is not limited to the following: how the results from the project have been leveraged and have led to commercialization efforts; creation of jobs; subsequent awards; formation of new partnerships; building of new facilities; testing at increased scales; patents and licenses awarded; purchase of technologies and/or companies; and if the awardee sells technologies or the company itself.

14) Go/No-Go Review

Each project selected under this FOA will be subject to a periodic project evaluation referred to as a Go/No-Go Review. Federal funding beyond the Go/No Go decision point (continuation funding), is contingent on (1) the availability of funds appropriated by Congress for the purpose of this program and the availability of future-year budget authority; (2) meeting the objectives, milestones, deliverables, and decision point criteria of recipient's approved project and obtaining approval from EERE to continue work on the project; and (3) the submittal of required reports in accordance with the Statement of Project Objectives.

As a result of the Go/No Go Review, DOE may, at its discretion, authorize the following actions: (1) continue to fund the project, contingent upon the availability of funds appropriated by Congress for the purpose of this program and the availability of future-year budget authority; (2) recommend redirection of work under the project; (3) place a hold on federal funding for the project, pending further supporting data or funding; or (4) discontinue funding the project because of insufficient progress, change in strategic direction, or lack of funding.

The Go/No-Go decision is distinct from a non-compliance determination. In the event a recipient fails to comply with the requirements of an award, EERE may take appropriate action, including but not limited to, redirecting, suspending or terminating the award.

15) Conference Spending

The recipient shall not expend any funds on a conference not directly and programmatically related to the purpose for which the grant or cooperative agreement was awarded that would defray the cost to the United States Government of a conference held by any Executive branch department, agency, board, commission, or office for which the cost to the United States Government would otherwise exceed \$20,000, thereby circumventing the required notification by the head of any such Executive Branch department, agency, board, commission, or office to the Inspector General (or senior ethics official for any entity without an Inspector General), of the date, location, and number of employees attending such conference.

16) BETO Program Requirements

1. Applicants that receive awards through this FOA will, in coordination with BETO, issue press releases at award and at successful completion of the project to highlight the positive aspects of the work.
2. Applicants that receive awards through this FOA will submit to DOE during the award and for 5 years after the award an annual report on the utilization and impact of the work in the project (such as: papers; presentations; additional awards; investment; joint ventures; additional construction; and advancement towards the market) that is affiliated with the FOA award. This report will be for DOE internal use only. Please also refer to section VI.B.12 for specific administrative reporting requirements regarding subject inventions that are in no way diminished or replaced.
3. All selected projects that receive awards will also be required to participate in DOE's Peer Review Process. Currently this is a bi-annual process that includes preparation of a presentation and participation/presentation at the Peer Review Meeting. This activity must be accounted for within each applicant's scope, schedule, and budget.

VII. Questions/Agency Contacts

Upon the issuance of a FOA, EERE personnel are prohibited from communicating (in writing or otherwise) with applicants regarding the FOA except through the established question and

answer process as described below. Specifically, questions regarding the content of this FOA must be submitted to: PEAKFOA@ee.doe.gov. Questions must be submitted not later than 3 business days prior to the application due date and time.

All questions and answers related to this FOA will be posted on EERE Exchange at: <https://eere-exchange.energy.gov>. **Please note that you must first select this specific FOA Number in order to view the questions and answers specific to this FOA.** EERE will attempt to respond to a question within 3 business days, unless a similar question and answer has already been posted on the website.

Questions related to the registration process and use of the EERE Exchange website should be submitted to: EERE-ExchangeSupport@hq.doe.gov.

VIII. Other Information

A. FOA Modifications

Amendments to this FOA will be posted on the EERE Exchange website and the Grants.gov system. However, you will only receive an email when an amendment or a FOA is posted on these sites if you register for email notifications for this FOA in Grants.gov. EERE recommends that you register as soon after the release of the FOA as possible to ensure you receive timely notice of any amendments or other FOAs.

B. Informational Webinar

EERE will conduct one informational webinar during the FOA process. It will be held after the initial FOA release but before the due date for Concept Papers.

Attendance is not mandatory and will not positively or negatively impact the overall review of any applicant submissions. As the webinar will be open to all applicants who wish to participate, applicants should refrain from asking questions or communicating information that would reveal confidential and/or proprietary information specific to their project. Specific dates for the webinar can be found on the cover page of the FOA.

C. Government Right to Reject or Negotiate

EERE reserves the right, without qualification, to reject any or all applications received in response to this FOA and to select any application, in whole or in part, as a basis for negotiation and/or award.

D. Commitment of Public Funds

The Contracting Officer is the only individual who can make awards or commit the Government to the expenditure of public funds. A commitment by anyone other than the Contracting Officer, either express or implied, is invalid.

E. Treatment of Application Information

In general, EERE will only use data and other information contained in applications for evaluation purposes, unless such information is generally available to the public or is already the property of the Government.

Applicants should not include trade secrets or commercial or financial information that is privileged or confidential in their application unless such information is necessary to convey an understanding of the proposed project or to comply with a requirement in the FOA.

The use of protective markings such as “Do Not Publicly Release – Trade Secret” or “Do Not Publicly Release – Confidential Business Information” is encouraged. However, applicants should be aware that the use of protective markings is not dispositive as to whether information will be publicly released pursuant to the Freedom of Information Act, 5 U.S.C. §552, et. seq., as amended by the OPEN Government Act of 2007, Pub. L. No. 110-175. (See Section I of this document, “Notice of Potential Disclosure Under the Freedom of Information Act (FOIA)” for additional information regarding the public release of information under the Freedom of Information Act.

Applicants are encouraged to employ protective markings in the following manner:

The cover sheet of the application must be marked as follows and identify the specific pages containing trade secrets or commercial or financial information that is privileged or confidential:

Notice of Restriction on Disclosure and Use of Data:

Pages [list applicable pages] of this document may contain trade secrets or commercial or financial information that is privileged or confidential, and is exempt from public disclosure. Such information shall be used or disclosed only for evaluation purposes or in accordance with a financial assistance or loan agreement between the submitter and the Government. The Government may use or disclose any information that is not appropriately marked or otherwise restricted, regardless of source. [End of Notice]

The header and footer of every page that contains trade secrets or commercial or financial information that is privileged must be marked as follows: “May contain trade secrets or commercial or financial information that is privileged or confidential and exempt from public disclosure.”

In addition, each line or paragraph containing trade secrets or commercial or financial information that is privileged or confidential must be enclosed in brackets.

F. Evaluation and Administration by Non-Federal Personnel

In conducting the merit review evaluation, the Go/No-Go Review and Peer Review, the Government may seek the advice of qualified non Federal personnel as reviewers. The Government may also use non-Federal personnel to conduct routine, nondiscretionary administrative activities. The applicant, by submitting its application, consents to the use of non-Federal reviewers/administrators. Non-Federal reviewers must sign conflict of interest and non-disclosure agreements prior to reviewing an application. Non-Federal personnel conducting administrative activities must sign a non-disclosure agreement.

G. Notice Regarding Eligible/Ineligible Activities

Eligible activities under this FOA include those which describe and promote the understanding of scientific and technical aspects of specific energy technologies, but not those which encourage or support political activities such as the collection and dissemination of information related to potential, planned or pending legislation.

H. Notice of Right to Conduct a Review of Financial Capability

EERE reserves the right to conduct an independent third party review of financial capability for applicants that are selected for negotiation of award (including personal credit information of principal(s) of a small business if there is insufficient information to determine financial capability of the organization).

I. Notice of Potential Disclosure Under Freedom of Information Act (FOIA)

Under the Freedom of Information Act, (FOIA), 5 U.S.C. §552, et. seq., as amended by the OPEN Government Act of 2007, Pub. L. No. 110-175, any information received from the Applicant is considered to be an agency record, and as such, subject to public release under FOIA. The purpose of the FOIA is to afford the public the right to request and receive agency records unless those agency records are protected from disclosure under one or more of the nine FOIA exemptions. Decisions to disclose or withhold information received from the Applicant are based upon the applicability of one or more of the nine FOIA exemptions, not on the existence or nonexistence of protective markings or designations. Only the agency's designated FOIA Officer may determine if information received from the Applicant may be withheld pursuant to one of the nine FOIA exemptions. All FOIA requests received by DOE are processed in accordance with 10 C.F.R. Part 1004.

J. Requirement for Full and Complete Disclosure

Applicants are required to make a full and complete disclosure of all information requested. Any failure to make a full and complete disclosure of the requested information may result in:

- The termination of award negotiations;
- The modification, suspension, and/or termination of a funding agreement;

- The initiation of debarment proceedings, debarment, and/or a declaration of ineligibility for receipt of Federal contracts, subcontracts, and financial assistance and benefits; and
- Civil and/or criminal penalties.

K. Retention of Submissions

EERE expects to retain copies of all Concept Papers, Full Applications, Replies to Reviewer Comments, and other submissions. No submissions will be returned. By applying to EERE for funding, applicants consent to EERE's retention of their submissions.

L. Title to Subject Inventions

Ownership of subject inventions is governed pursuant to the authorities listed below.

- Domestic Small Businesses, Educational Institutions, and Nonprofits: Under the Bayh-Dole Act (35 U.S.C. § 200 et seq.), domestic small businesses, educational institutions, and nonprofits may elect to retain title to their subject inventions.
- All other parties: The Federal Non-Nuclear Energy Act of 1974, 42 U.S.C. 5908, provides that the Government obtains title to new inventions unless a waiver is granted (see below).
- Class Patent Waiver: DOE has issued a class waiver that applies to this FOA. Under this class waiver, domestic large businesses may elect title to their subject inventions similar to the right provided to the domestic small businesses, educational institutions, and nonprofits by law. In order to avail itself of the class waiver, a domestic large business must agree that any products embodying or produced through the use of a subject invention first created or reduced to practice under this program will be substantially manufactured in the United States, unless DOE agrees that the commitments proposed in the U.S. Manufacturing Plan are sufficient.
- Advance and Identified Waivers: Applicants may request a patent waiver that will cover subject inventions that may be invented under the award, in advance of or within 30 days after the effective date of the award. Even if an advance waiver is not requested or the request is denied, the recipient will have a continuing right under the award to request a waiver for identified inventions, i.e., individual subject inventions that are disclosed to EERE within the timeframes set forth in the award's intellectual property terms and conditions. Any patent waiver that may be granted is subject to certain terms and conditions in 10 CFR 784.
- Determination of Exceptional Circumstances (DEC): Each applicant is required to submit a U.S. Manufacturing Plan as part of its application. If selected, the U.S. Manufacturing Plan shall be incorporated into the award terms and conditions for domestic small businesses and nonprofit organizations. DOE has determined that exceptional circumstances exist that warrants the modification of the standard patent rights clause for small businesses and non-profit awardees under Bayh-Dole to the extent necessary to implement and enforce the U.S. Manufacturing Plan. For example, the commitments and enforcement of a U.S. Manufacturing Plan may be tied to subject inventions. Any Bayh-Dole entity (domestic small business or nonprofit organization) affected by this DEC has the right to appeal it.

M. Government Rights in Subject Inventions

Where Prime Recipients and Subrecipients retain title to subject inventions, the U.S. Government retains certain rights.

1) Government Use License

The U.S. Government retains a nonexclusive, nontransferable, irrevocable, paid-up license to practice or have practiced for or on behalf of the United States any subject invention throughout the world. This license extends to contractors doing work on behalf of the Government.

2) March-In Rights

The U.S. Government retains march-in rights with respect to all subject inventions. Through “march-in rights,” the Government may require a Prime Recipient or Subrecipient who has elected to retain title to a subject invention (or their assignees or exclusive licensees), to grant a license for use of the invention to a third party. In addition, the Government may grant licenses for use of the subject invention when a Prime Recipient, Subrecipient, or their assignees and exclusive licensees refuse to do so.

DOE may exercise its march-in rights only if it determines that such action is necessary under any of the four following conditions:

- The owner or licensee has not taken or is not expected to take effective steps to achieve practical application of the invention within a reasonable time;
- The owner or licensee has not taken action to alleviate health or safety needs in a reasonably satisfied manner;
- The owner has not met public use requirements specified by Federal statutes in a reasonably satisfied manner; or
- The U.S. Manufacturing requirement has not been met.

Any determination that march-in rights are warranted must follow a fact-finding process in which the recipient has certain rights to present evidence and witnesses, confront witnesses and appear with counsel and appeal any adverse decision. To date, DOE has never exercised its march-in rights to any subject inventions.

N. Rights in Technical Data

Data rights differ based on whether data is first produced under an award or instead was developed at private expense outside the award.

“Limited Rights Data”: The U.S. Government will not normally require delivery of confidential or trade secret-type technical data developed solely at private expense prior to issuance of an award, except as necessary to monitor technical progress and evaluate the potential of proposed technologies to reach specific technical and cost metrics.

Government rights in Technical Data Produced Under Awards: The U.S. Government normally retains unlimited rights in technical data produced under Government financial assistance awards, including the right to distribute to the public. However, pursuant to special statutory authority, certain categories of sterdata generated under EERE awards may be protected from public disclosure for up to five years after the data is generated (“Protected Data”). For awards permitting Protected Data, the protected data must be marked as set forth in the awards intellectual property terms and conditions and a listing of unlimited rights data (i.e., non-protected data) must be inserted into the data clause in the award. In addition, invention disclosures may be protected from public disclosure for a reasonable time in order to allow for filing a patent application.

O. Copyright

The Prime Recipient and Subrecipients may assert copyright in copyrightable works, such as software, first produced under the award without EERE approval. When copyright is asserted, the Government retains a paid-up nonexclusive, irrevocable worldwide license to reproduce, prepare derivative works, distribute copies to the public, and to perform publicly and display publicly the copyrighted work. This license extends to contractors and others doing work on behalf of the Government.

P. Personally Identifiable Information (PII)

All information provided by the Applicant must to the greatest extent possible exclude Personally Identifiable Information (PII). The term “personally identifiable information” refers to information which can be used to distinguish or trace an individual's identity, such as their name, social security number, biometric records, etc. alone, or when combined with other personal or identifying information which is linked or linkable to a specific individual, such as date and place of birth, mother’s maiden name, etc. (See OMB Memorandum M-07-16 dated May 22, 2007, found at:

<https://www.whitehouse.gov/sites/default/files/omb/memoranda/fy2007/m07-16.pdf>

By way of example, Applicants must screen resumes to ensure that they do not contain PII such as personal addresses, phone/cell numbers, personal emails and/or SSNs. In short, if the PII is not essential to the application, it should not be in the application.

Q. Annual Compliance Audits

If a for-profit entity is a Prime Recipient and has expended \$750,000 or more of DOE funds during the entity's fiscal year, an annual compliance audit performed by an independent auditor is be required. For additional information, please refer to 2 C.F.R. § 910.501 and Subpart F.

If an educational institution, non-profit organization, or state/local government is a Prime Recipient or Subrecipient and has expended \$750,000 or more of Federal funds during the non-

Federal entity's fiscal year, then a single or program-specific audit is required. For additional information, please refer to 2 C.F.R. § 200.501 and Subpart F.

Applicants and sub-recipients (if applicable) should propose sufficient costs in the project budget to cover the costs associated with the audit. EERE will share in the cost of the audit at its applicable cost share ratio.

Appendix A – Cost Share Information

Cost Sharing or Cost Matching

The terms “cost sharing” and “cost matching” are often used synonymously. Even the DOE Financial Assistance Regulations, 2 CFR 200.306, use both of the terms in the titles specific to regulations applicable to cost sharing. EERE almost always uses the term “cost sharing,” as it conveys the concept that non-federal share is calculated as a percentage of the Total Project Cost. An exception is the State Energy Program Regulation, 10 CFR 420.12, State Matching Contribution. Here “cost matching” for the non-federal share is calculated as a percentage of the Federal funds only, rather than the Total Project Cost.

How Cost Sharing Is Calculated

As stated above, cost sharing is calculated as a percentage of the Total Project Cost. FFRDC costs must be included in Total Project Costs. Following is an example of how to calculate cost sharing amounts for a project with \$1,000,000 in federal funds with a minimum 20% non-federal cost sharing requirement:

- Formula: Federal share (\$) divided by Federal share (%) = Total Project Cost
Example: \$1,000,000 divided by 80% = \$1,250,000
- Formula: Total Project Cost (\$) minus Federal share (\$) = Non-federal share (\$)
Example: \$1,250,000 minus \$1,000,000 = \$250,000
- Formula: Non-federal share (\$) divided by Total Project Cost (\$) = Non-federal share (%)
Example: \$250,000 divided by \$1,250,000 = 20%

What Qualifies For Cost Sharing

While it is not possible to explain what specifically qualifies for cost sharing in one or even a couple of sentences, in general, if a cost is allowable under the cost principles applicable to the organization incurring the cost and is eligible for reimbursement under an EERE grant or cooperative agreement, then it is allowable as cost share. Conversely, if the cost is not allowable under the cost principles and not eligible for reimbursement, then it is not allowable as cost share. In addition, costs may not be counted as cost share if they are paid by the Federal Government under another award unless authorized by Federal statute to be used for cost sharing.

The rules associated with what is allowable as cost share are specific to the type of organization that is receiving funds under the grant or cooperative agreement, though are generally the same for all types of entities. The specific rules applicable to:

- FAR Part 31 for For-Profit entities, (48 CFR Part 31); and
- 2 CFR Part 200 Subpart E - Cost Principles for all other non-federal entities.

In addition to the regulations referenced above, other factors may also come into play such as timing of donations and length of the project period. For example, the value of ten years of donated maintenance on a project that has a project period of five years would not be fully allowable as cost share. Only the value for the five years of donated maintenance that corresponds to the project period is allowable and may be counted as cost share.

Additionally, EERE generally does not allow pre-award costs for either cost share or reimbursement when these costs precede the signing of the appropriation bill that funds the award. In the case of a competitive award, EERE generally does not allow pre-award costs prior to the signing of the Selection Statement by the EERE Selection Official.

DOE Financial Assistance Rules 2 CFR Part 200 as amended by 2 CFR Part 910

As stated above, the rules associated with what is allowable cost share are generally the same for all types of organizations. Following are the rules found to be common, but again, the specifics are contained in the regulations and cost principles specific to the type of entity:

- (A) Acceptable contributions. All contributions, including cash contributions and third party in-kind contributions, must be accepted as part of the Prime Recipient's cost sharing if such contributions meet all of the following criteria:
- (1) They are verifiable from the recipient's records.
 - (2) They are not included as contributions for any other federally-assisted project or program.
 - (3) They are necessary and reasonable for the proper and efficient accomplishment of project or program objectives.
 - (4) They are allowable under the cost principles applicable to the type of entity incurring the cost as follows:
 - a. For-profit organizations. Allowability of costs incurred by for-profit organizations and those nonprofit organizations listed in Attachment C to OMB Circular A-122 is determined in accordance with the for-profit cost principles in 48 CFR Part 31 in the Federal Acquisition Regulation, except that patent prosecution costs are not allowable unless specifically authorized in the award document. (v) Commercial Organizations. FAR Subpart 31.2—Contracts with Commercial Organizations

- b. Other types of organizations. For all other non-federal entities, allowability of costs is determined in accordance with 2 CFR Part 200 Subpart E.

- (5) They are not paid by the Federal Government under another award unless authorized by Federal statute to be used for cost sharing or matching.

- (6) They are provided for in the approved budget.

- (B) Valuing and documenting contributions
 - (1) Valuing recipient's property or services of recipient's employees. Values are established in accordance with the applicable cost principles, which mean that amounts chargeable to the project are determined on the basis of costs incurred. For real property or equipment used on the project, the cost principles authorize depreciation or use charges. The full value of the item may be applied when the item will be consumed in the performance of the award or fully depreciated by the end of the award. In cases where the full value of a donated capital asset is to be applied as cost sharing or matching, that full value must be the lesser or the following:
 - a. The certified value of the remaining life of the property recorded in the recipient's accounting records at the time of donation; or
 - b. The current fair market value. If there is sufficient justification, the Contracting Officer may approve the use of the current fair market value of the donated property, even if it exceeds the certified value at the time of donation to the project. The Contracting Officer may accept the use of any reasonable basis for determining the fair market value of the property.

 - (2) Valuing services of others' employees. If an employer other than the recipient furnishes the services of an employee, those services are valued at the employee's regular rate of pay, provided these services are for the same skill level for which the employee is normally paid.

 - (3) Valuing volunteer services. Volunteer services furnished by professional and technical personnel, consultants, and other skilled and unskilled labor may be counted as cost sharing or matching if the service is an integral and necessary part of an approved project or program. Rates for volunteer services must be consistent with those paid for similar work in the recipient's organization. In those markets in which the required skills are not found in the recipient organization, rates must be consistent with those paid for similar work in the labor market in which the recipient competes for the kind of services involved. In either case, paid fringe benefits that are reasonable, allowable, and allocable may be included in the valuation.

(4) Valuing property donated by third parties.

- a. Donated supplies may include such items as office supplies or laboratory supplies. Value assessed to donated supplies included in the cost sharing or matching share must be reasonable and must not exceed the fair market value of the property at the time of the donation.
- b. Normally only depreciation or use charges for equipment and buildings may be applied. However, the fair rental charges for land and the full value of equipment or other capital assets may be allowed, when they will be consumed in the performance of the award or fully depreciated by the end of the award, provided that the Contracting Officer has approved the charges. When use charges are applied, values must be determined in accordance with the usual accounting policies of the recipient, with the following qualifications:
 - i. The value of donated space must not exceed the fair rental value of comparable space as established by an independent appraisal of comparable space and facilities in a privately-owned building in the same locality.
 - ii. The value of loaned equipment must not exceed its fair rental value.

(5) Documentation. The following requirements pertain to the recipient's supporting records for in-kind contributions from third parties:

- a. Volunteer services must be documented and, to the extent feasible, supported by the same methods used by the recipient for its own employees.
- b. The basis for determining the valuation for personal services and property must be documented.

Appendix B – Sample Cost Share Calculation for Blended Cost Share Percentage

The following example shows the math for calculating required cost share for a project with \$2,000,000 in Federal funds with four tasks requiring different Non-federal cost share percentages:

Task	Proposed Federal Share	Federal Share %	Recipient Share %
Task 1 (R&D)	\$1,000,000	80%	20%
Task 2 (R&D)	\$500,000	80%	20%
Task 3 (Demonstration)	\$400,000	50%	50%
Task 4 (Outreach)	\$100,000	100%	0%

Federal share (\$) divided by Federal share (%) = Task Cost

Each task must be calculated individually as follows:

Task 1

\$1,000,000 divided by 80% = \$1,250,000 (Task 1 Cost)

Task 1 Cost minus federal share = Non-federal share

\$1,250,000 - \$1,000,000 = \$250,000 (Non-federal share)

Task 2

\$500,000 divided 80% = \$625,000 (Task 2 Cost)

Task 2 Cost minus federal share = Non-federal share

\$625,000 - \$500,000 = \$125,000 (Non-federal share)

Task 3

\$400,000 / 50% = \$800,000 (Task 3 Cost)

Task 3 Cost minus federal share = Non-federal share

\$800,000 - \$400,000 = \$400,000 (Non-federal share)

Task 4

Federal share = \$100,000

Non-federal cost share is not mandated for outreach = \$0 (Non-federal share)

The calculation may then be completed as follows:

Tasks	\$ Federal Share	% Federal Share	\$ Non-Federal Share	% Non-Federal Share	Total Project Cost
Task 1	\$1,000,000	80%	\$250,000	20%	\$1,250,000
Task 2	\$500,000	80%	\$125,000	20%	\$625,000
Task 3	\$400,000	50%	\$400,000	50%	\$800,000
Task 4	\$100,000	100%	\$0	0%	\$100,000
Totals	\$2,000,000		\$775,000		\$2,775,000

Blended Cost Share %

Non-federal share (\$775,000) divided by Total Project Cost (\$2,775,000) = 27.9% (Non-federal)

Federal share (\$2,000,000) divided by Total Project Cost (\$2,775,000) = 72.1% (Federal)

Appendix C – Foreign Entity Participation Waiver Requests

A. Waiver for Foreign Entity Participation as the Prime Recipient

As set forth in Section III.A.3, all Prime Recipients receiving funding under this FOA must be incorporated (or otherwise formed) under the laws of a State or territory of the United States. To request a waiver of this requirement, an applicant must submit an explicit waiver request in the Full Application.

Overall, the applicant must demonstrate to the satisfaction of EERE that it would further the purposes of this FOA and is otherwise in the economic interests of the United States to have a foreign entity serve as the Prime Recipient. A request to waive the *Foreign Entity Participation as the Prime Recipient* requirement must include the following:

- Entity name;
- The rationale for proposing a foreign entity to serve as the Prime Recipient;
- Country of incorporation;
- A description of the project’s anticipated contributions to the US economy;
- How the project will benefit U.S. research, development and manufacturing, including contributions to employment in the U.S. and growth in new markets and jobs in the U.S.;
- How the project will promote domestic American manufacturing of products and/or services;
- A description of how the foreign entity’s participation as the Prime Recipient is essential to the project;
- A description of the likelihood of Intellectual Property (IP) being created from the work and the treatment of any such IP;
- Countries where the work will be performed (Note: if any work is proposed to be conducted outside the U.S., the applicant must also complete a separate request for waiver of the Performance of Work in the United States requirement).

EERE may require additional information before considering the waiver request.

The applicant does not have the right to appeal EERE’s decision concerning a waiver request.

B. Waiver for Performance of Work in the United States

As set forth in Section IV.J.3, all work under EERE funding agreements must be performed in the United States. This requirement does not apply to the purchase of supplies and equipment, so a waiver is not required for foreign purchases of these items. However, the Prime Recipient should make every effort to purchase supplies and equipment within the United States. There may be limited circumstances where it is in the interest of the project to perform a portion of

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the work outside the United States. To seek a waiver of the Performance of Work in the United States requirement, the applicant must submit an explicit waiver request in the Full Application. A separate waiver request must be submitted for each entity proposing performance of work outside of the United States.

Overall, a waiver request must demonstrate to the satisfaction of EERE that it would further the purposes of this FOA and is otherwise in the economic interests of the United States to perform work outside of the United States. A request to waive the *Performance of Work in the United States* requirement must include the following:

- The rationale for performing the work outside the U.S. (“foreign work”);
- A description of the work proposed to be performed outside the U.S.;
- An explanation as to how the foreign work is essential to the project;
- A description of the anticipated benefits to be realized by the proposed foreign work and the anticipated contributions to the US economy;
- The associated benefits to be realized and the contribution to the project from the foreign work;
- How the foreign work will benefit U.S. research, development and manufacturing, including contributions to employment in the U.S. and growth in new markets and jobs in the U.S.;
- How the foreign work will promote domestic American manufacturing of products and/or services;
- A description of the likelihood of Intellectual Property (IP) being created from the foreign work and the treatment of any such IP;
- The total estimated cost (DOE and Recipient cost share) of the proposed foreign work;
- The countries in which the foreign work is proposed to be performed; and
- The name of the entity that would perform the foreign work.

EERE may require additional information before considering the waiver request.

The applicant does not have the right to appeal EERE’s decision concerning a waiver request.

Appendix D - Data Management Plan

A data management plan (“DMP”) explains how data generated in the course of the work performed under an EERE award will be shared and preserved or, when justified, explains why data sharing or preservation is not possible or scientifically appropriate.

DMP Requirements

In order for a DMP to be considered acceptable, the DMP must address the following:

At a minimum, the DMP must describe how data sharing and preservation will enable validation of the results from the proposed work, or how results could be validated if data are not shared or preserved.

The DMP must provide a plan for making all research data displayed in publications resulting from the proposed work digitally accessible at the time of publication. This includes data that are displayed in charts, figures, images, etc. In addition, the underlying digital research data used to generate the displayed data should be made as accessible as possible in accordance with the principles stated above. This requirement could be met by including the data as supplementary information to the published article, or through other means. The published article should indicate how these data can be accessed.

The DMP should consult and reference available information about data management resources to be used in the course of the proposed work. In particular, a DMP that explicitly or implicitly commits data management resources at a facility beyond what is conventionally made available to approved users should be accompanied by written approval from that facility. In determining the resources available for data management at DOE User Facilities, researchers should consult the published description of data management resources and practices at that facility and reference it in the DMP. Information about other DOE facilities can be found in the additional guidance from the sponsoring program.

The DMP must protect confidentiality, personal privacy, Personally Identifiable Information, and U.S. national, homeland, and economic security; recognize proprietary interests, business confidential information, and intellectual property rights; avoid significant negative impact on innovation, and U.S. competitiveness; and otherwise be consistent with all laws (i.e., export control laws), and DOE regulations, orders, and policies.

Data Determination for a DMP

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The Principal Investigator should determine which data should be the subject of the DMP and, in the DMP, propose which data should be shared and/or preserved in accordance with the DMP Requirements noted above.

For data that will be generated through the course of the proposed work, the Principal Investigator should indicate what types of data should be protected from immediate public disclosure by DOE (referred to as “protected data”) and what types of data that DOE should be able to release immediately. Similarly, for data developed outside of the proposed work at private expense that will be used in the course of the proposed work, the Principal Investigator should indicate whether that type of data will be subject to public release or kept confidential (referred to as “limited rights data”). Any use of limited rights data or labeling of data as “protected data” must be consistent with the DMP Requirements noted above.

Suggested Elements for a DMP

The following list of elements for a DMP provides suggestions regarding the data management planning process and the structure of the DMP:

Data Types and Sources: A brief, high-level description of the data to be generated or used through the course of the proposed work and which of these are considered digital research data necessary to validate the research findings or results.

Content and Format: A statement of plans for data and metadata content and format including, where applicable, a description of documentation plans, annotation of relevant software, and the rationale for the selection of appropriate standards. Existing, accepted community standards should be used where possible. Where community standards are missing or inadequate, the DMP could propose alternate strategies for facilitating sharing, and should advise the sponsoring program of any need to develop or generalize standards.

Sharing and Preservation: A description of the plans for data sharing and preservation. This should include, when appropriate: the anticipated means for sharing and the rationale for any restrictions on who may access the data and under what conditions; a timeline for sharing and preservation that addresses both the minimum length of time the data will be available and any anticipated delay to data access after research findings are published; any special requirements for data sharing, for example, proprietary software needed to access or interpret data, applicable policies, provisions, and licenses for re-use and re-distribution, and for the production of derivatives, including guidance for how data and data products should be cited; any resources and capabilities (equipment, connections, systems, software, expertise, etc.) requested in the research proposal that are needed to meet the stated goals for sharing and preservation (this could reference the relevant section of the associated research proposal and budget request); and whether/where the data will be preserved after

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direct project funding ends and any plans for the transfer of responsibilities for sharing and preservation.

Protection: A statement of plans, where appropriate and necessary, to protect confidentiality, personal privacy, Personally Identifiable Information, and U.S. national, homeland, and economic security; recognize proprietary interests, business confidential information, and intellectual property rights; and avoid significant negative impact on innovation, and U.S. competitiveness.

Rationale: A discussion of the rationale or justification for the proposed data management plan including, for example, the potential impact of the data within the immediate field and in other fields, and any broader societal impact.

Additional Guidance

In determining which data should be shared and preserved, researchers must consider the data needed to validate research findings as described in the Requirements, and are encouraged to consider the potential benefits of their data to their own fields of research, fields other than their own, and society at large.

DMPs should reflect relevant standards and community best practices and make use of community accepted repositories whenever practicable.

Costs associated with the scope of work and resources articulated in a DMP may be included in the proposed research budget as permitted by the applicable cost principles.

To improve the discoverability of and attribution for datasets created and used in the course of research, EERE encourages the citation of publicly available datasets within the reference section of publications, and the identification of datasets with persistent identifiers such as Digital Object Identifiers (DOIs). In most cases, EERE can provide DOIs free of charge for data resulting from DOE-funded research through its Office of Scientific and Technical Information (OSTI) DataID Service.

EERE's Digital Data Management principles can be found at: [EERE Digital Data Management | Department of Energy](#)

Definitions:

Data Preservation: Data preservation means providing for the usability of data beyond the lifetime of the research activity that generated them.

Data Sharing: Data sharing means making data available to people other than those who have generated them. Examples of data sharing range from bilateral communications with colleagues, to providing free, unrestricted access to anyone through, for example, a web-based platform.

Digital Research Data: The term digital data encompasses a wide variety of information stored in digital form including: experimental, observational, and simulation data; codes, software and algorithms; text; numeric information; images; video; audio; and associated metadata. It also encompasses information in a variety of different forms including raw, processed, and analyzed data, published and archived data.

Research Data: The recorded factual material commonly accepted in the scientific community as necessary to validate research findings, but not any of the following: preliminary analyses, drafts of scientific papers, plans for future research, peer reviews, or communications with colleagues. This 'recorded' material excludes physical objects (e.g., laboratory samples). Research data also do not include:

(A) Trade secrets, commercial information, materials necessary to be held confidential by a researcher until they are published, or similar information which is protected under law; and

(B) Personnel and medical information and similar information the disclosure of which would constitute a clearly unwarranted invasion of personal privacy, such as information that could be used to identify a particular person in a research study.”

Validate: In the context of DMPs, validate means to support, corroborate, verify, or otherwise determine the legitimacy of the research findings. Validation of research findings could be accomplished by reproducing the original experiment or analyses; comparing and contrasting the results against those of a new experiment or analyses; or by some other means.

Appendix E – PEAK Challenge Evaluation Criteria

The PEAK Challenge performance evaluation criteria outlined below support cultivation- and commercialization-enabling biological innovation. The evaluation criteria were informed by subject matter experts during the BETO sponsored [Algal Biology Toolbox Workshop](#).

Note that these criteria may be subject to change between the publication of this FOA and the PEAK Challenge. Any updates to these criteria will be distributed to selected projects ahead of the Challenge.

Table 1: Strain & Consortia Attributes		
Biological Stressors		
Was culture exposed to pests?		Species composition and effect on culture performance:
Was culture exposed to predators?		Species composition and effect on culture performance:
Water Chemistry		
What was the salinity of the cultivation water?		Effect on culture performance and sustainability:
What water source was used for cultivation?		Effect on culture performance and sustainability:
What was the pH of the cultivation water?		Effect on culture performance and sustainability:
Abiotic Stressors		
Was culture exposed to extremes in water temperature or temperature fluctuation?		Effect on culture performance:

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Was culture exposed to extremes in light intensity or light intensity fluctuation?		Effect on culture performance:
Was culture exposed to precipitation?		Effect on culture performance:
Was culture exposed to oxygen tolerance stress?		Effect on culture performance:

Table 2: Cultivation Attributes		
Nutrient Source		
What media was used?		Would this recipe be used in commercialization? (include cost as a consideration)
What was the inorganic carbon source?		Effect on culture performance and sustainability:
Was organic carbon used? If so, what was the source?		Effect on culture performance and sustainability:
What was the nitrogen source?		Effect on culture performance and sustainability:
What was the phosphorous source?		Effect on culture performance and sustainability:
What additional macronutrients, micronutrients, or trace elements were used?		Effect on culture performance and sustainability:
Cultivation Process Management		

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Describe the cultivation system used.	What was the modification?	Would this system be used in commercialization?
What was the culture inoculation density?	What was the modification?	Effect on culture performance and sustainability:
Was a crop protection application used? If so, what was the strategy?	What was the modification?	Effect on culture performance and sustainability:
How frequently were cultures harvested?	What was the modification?	Effect on culture performance and sustainability:

Table 3: PEAK Project Performance		
Biological Performance		
Describe the genetic and/or ecological stability of the strain/consortium of interest, if measured.		Factors contributing to stability:
What was the number and frequency of culture crashes per cultivation trial?		Expected cause of crash:*
Process Performance		
What was the mean time between failure of cultures?*		Description of culture restart strategy:
Describe the ease of harvest (settling rate or equivalent metric).		Would this system be used in commercialization?
Yield Performance		

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<p>What was the growth rate?</p>		<p>Comparison of interim and final validation results. Include description of common or deviating independent variables between validations:</p>
<p>What was the total biomass yield?</p>		<p>Comparison of interim and final validation results. Include description of common or deviating independent variables between validations:</p>
<p>What was the biomass composition at harvest?</p>		<p>Description of biomass composition, how was composition determined, consistency of composition between final validation runs and to interim validation:</p>
<p>*Indicate human error if it was a contributing factor</p>		

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subject line.*

Appendix F – DOE Technology Readiness Levels

Technology Readiness Levels (TRLs): Identify the readiness level of the technology associated with the project as well as the planned progression during the course of project execution. A detailed explanation of the rationale for the estimated technology readiness level should be provided. Specific entry criteria for the next higher technology readiness level should be identified. The following definitions apply:

TRL-1. Basic principles observed and reported: Scientific problem or phenomenon identified. Essential characteristics and behaviors of systems and architectures are identified using mathematical formulations or algorithms. The observation of basic scientific principles or phenomena has been validated through peer-reviewed research. Technology is ready to transition from scientific research to applied research.

TRL-2. Technology concept and/or application formulated: Applied research activity. Theory and scientific principles are focused on specific application areas to define the concept. Characteristics of the application are described. Analytical tools are developed for simulation or analysis of the application.

TRL-3. Analytical and experimental critical function and/or characteristic proof of concept: Proof of concept validation has been achieved at this level. Experimental research and development is initiated with analytical and laboratory studies. System/integrated process requirements for the overall system application are well known. Demonstration of technical feasibility using immature prototype implementations are exercised with representative interface inputs to include electrical, mechanical, or controlling elements to validate predictions.

TRL-4. Component and/or process validation in laboratory environment- Alpha prototype (component) Standalone prototyping implementation and testing in laboratory environment demonstrates the concept. Integration and testing of component technology elements are sufficient to validate feasibility.

TRL-5. Component and/or process validation in relevant environment- Beta prototype (component): Thorough prototype testing of the component/process in relevant environment to the end user is performed. Basic technology elements are integrated with reasonably realistic supporting elements based on available technologies. Prototyping implementations conform to the target environment and interfaces.

TRL-6. System/process model or prototype demonstration in a relevant environment- Beta prototype (system): Prototyping implementations are partially integrated with existing systems. Engineering feasibility fully demonstrated in actual or high fidelity system applications in an environment relevant to the end user.

TRL-7. System/process prototype demonstration in an operational environment- Integrated pilot (system): System prototyping demonstration in operational environment. System is at or near full scale (pilot or engineering scale) of the operational system, with most functions

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available for demonstration and test. The system, component, or process is integrated with collateral and ancillary systems in a near production quality prototype.

TRL-8. Actual system/process completed and qualified through test and demonstration- Pre-commercial demonstration: End of system development. Full-scale system is fully integrated into operational environment with fully operational hardware and software systems. All functionality is tested in simulated and operational scenarios with demonstrated achievement of end-user specifications. Technology is ready to move from development to commercialization.