

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

**FY22 Scale-Up of Integrated Biorefineries and Greenhouse Gas
Reduction in First Generation Ethanol Production (Scale-Up+)**

Funding Opportunity Announcement (FOA) Number: DE-FOA-0002638

FOA Type: Initial

CFDA Number: 81.087

FOA Issue Date:	06/01/2022
Informational Webinar:	06/15/2022 3:00pm ET
Submission Deadline for Concept Papers:	07/08/2022 5:00pm ET
Submission Deadline for Full Applications:	09/09/2022 5:00pm ET
Expected Submission Deadline for Replies to Reviewer Comments:	10/20/2022 5:00pm ET
Expected Date for EERE Selection Notifications:	November 2022
Expected Timeframe for Award Negotiations:	03/31/2023

- Applicants must submit a Concept Paper by 5:00pm ET on 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.

Modifications

All modifications to the FOA are [HIGHLIGHTED] in the body of the FOA.

Mod. No.	Date	Description of Modification
000001	6/28/22	<p>Section I.D: Applications Specifically Not of Interest</p> <p>Clarifying the intent of Topic Area 4's allowable product.</p> <ul style="list-style-type: none">Applications whose primary fuel product is not intended for aviation, long-haul trucking, marine, or rail usage. Along with aviation, long-haul trucking, marine, and rail fuels, ethanol is an allowable product for Topic Area 4 applications only.

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I. Funding Opportunity Description

A. Background and Context

i. Background and Purpose

Building a clean and equitable energy economy and addressing the climate crisis is a top priority of the Biden Administration. This FOA will advance the Biden Administration's goals to deliver an equitable, clean energy future, and put the United States on a path to achieve net-zero emissions, economy-wide, by no later than 2050¹ to the benefit of all Americans. The Department of Energy is committed to pushing the frontiers of science and engineering, catalyzing clean energy jobs through research, development, demonstration, and deployment (RDD&D), and ensuring environmental justice and inclusion of underserved communities. Additionally, this FOA will support the Biden Administration's new action items to produce 3 billion gallons of sustainable aviation fuel (SAF) per year and reduce aviation emissions by 20% by 2030 towards unlocking the potential for a fully zero-carbon aviation sector by 2050.

In support of these Administration priorities, the Bioenergy Technologies Office (BETO) focuses on developing technologies that convert domestic lignocellulosic biomass (e.g., agricultural residues, forestry residues, dedicated energy crops) and waste resources (e.g., municipal solid wastes, animal manure, biosolids) into affordable low-carbon biofuels and bioproducts that significantly reduce carbon emissions on a life-cycle basis as compared to equivalent petroleum-based products. These bioenergy technologies can enable a transition to a clean energy economy, create high-quality jobs, and support rural economies. The research, development and demonstration (RD&D) activities to be funded under this FOA will support the government-wide approach to the climate crisis by driving the innovation that can accelerate the deployment of clean energy technologies, which are critical for climate protection. These activities will also mobilize public clean energy investment in the biofuels, chemical and agricultural sectors and support achieving economy-wide net-zero emissions by 2050.

This FOA supports high-impact technology RD&D to accelerate the bioeconomy and, in particular, the production of low-carbon fuels for the aviation, marine, rail, and long-haul trucking industries. BETO is focusing on applied RD&D to improve the performance and reduce cost of biofuel production technologies and scale-up production systems in partnership with industry. By reducing cost and technical risk, BETO can help pave the way for industry to deploy

¹ Executive Order 14008, "Tackling the Climate Crisis at Home and Abroad," January 27, 2021.

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commercial-scale integrated biorefineries and reduce greenhouse gas emissions from hard-to-decarbonize sectors, such as the aviation industry. Additionally, this FOA will strengthen current first generation (Gen-1) corn ethanol production facilities by reducing their overall carbon footprint. Under the current BETO vision, these biomass feedstocks will be developed for use in the production of sustainable aviation fuel through a variety of conversion technologies. BETO is focused on developing and demonstrating technologies that are capable of producing low-carbon, cost-effective biofuels and co-products by 2030, as well as biofuel production pathways that can deliver at least 70% lower lifecycle greenhouse gas emissions than petroleum. BETO further aims to support the demonstration of 4-5 fully integrated biorefineries, thereby increasing the number of proven pathways to produce sustainable aviation fuels, as well as sustainable marine, long-haul trucking, and rail fuels, by 2030.

The RD&D activities to be funded under this FOA will support BETO goals and the government-wide approach to the climate crisis by driving the innovation that can lead to the deployment of clean energy technologies, which are critical for climate protection. Specifically, this FOA will support high-impact RD&D focusing on the production of low-GHG fuels for the aviation industry, as well as the marine, long-haul trucking, and rail industries by soliciting proposals to scale-up biorefinery technologies, and the reduction of Gen-1 GHG emissions.

ii. Technology Space and Strategic Goals

BETO manages a diverse portfolio of technologies covering the full spectrum of bioenergy production, from the feedstock source to final products. These potential products include biofuels for commercial aviation, marine vessels, renewable diesel, off-road transportation, biogas, and bioproducts. Although BETO focuses on biofuel, it also pursues strategies to develop high-value bioproducts as byproducts that can lower the cost and accelerate the development of biofuel technologies.

Biofuels and bioproducts are produced via a variety of technology configurations that can be referred to as technology pathways. Each technology pathway includes a specific feedstock or feedstocks and conversion technology combination to produce a product slate of biofuels and/or bioproducts. BETO's programs focus on overcoming key technology barriers that affect technology pathways and the ability to economically scale-up these pathways to industrially-relevant volumes.

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Illustrative biofuel pathway progress is assessed annually by BETO using techno-economic analyses (TEA), which translate technology development into modeled gasoline gallon equivalent (GGE) price improvements. These results, along with life cycle analysis (LCA) of energy and emissions and supply chain sustainability analyses, which estimate the environmental impact of improvements, are referred to by BETO as the state of technology. Figure 1 illustrates the TEA impact of technology development progress representing a significant reduction in the modeled Minimum Fuel Selling Price (MFSP) and projections of future improvements for one example technology pathway.

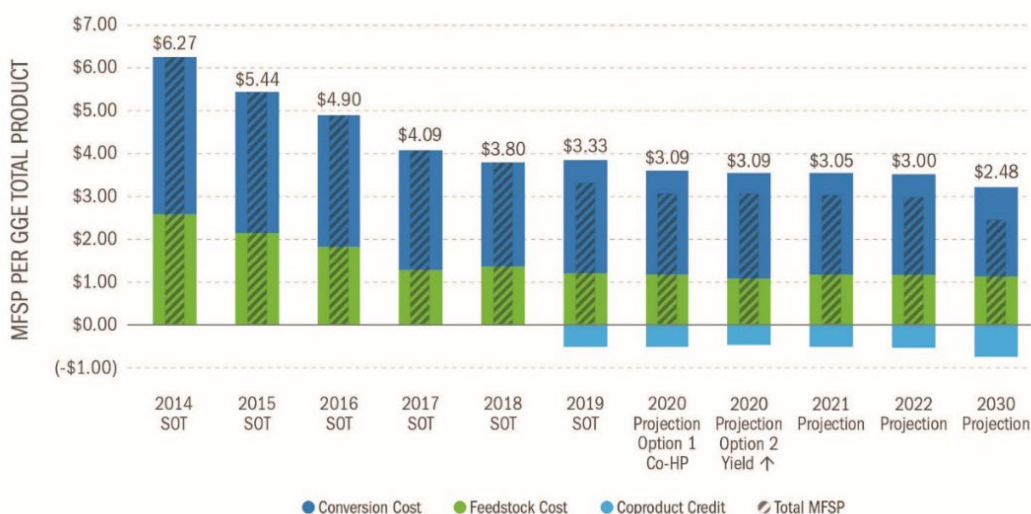


Figure 1: Illustrative biofuel pathway progress toward a cost competitive fuel (woody feedstocks via catalytic fast pyrolysis and upgrading pathway).²

² D. S. Hartley, D. N. Thompson, and H. Cai, Woody Feedstocks 2019 State of Technology Report (Idaho Falls, ID: Idaho National Laboratory, INL/EXT-20-57181, 2019), https://inldigitallibrary.inl.gov/sites/sti/sti/Sort_21882.pdf.

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Similarly, Figures 2A-2C show sustainability factors that must be kept in mind and worked on simultaneously as cost reduction occurs in order to fully realize the effect of design changes to lower cost.

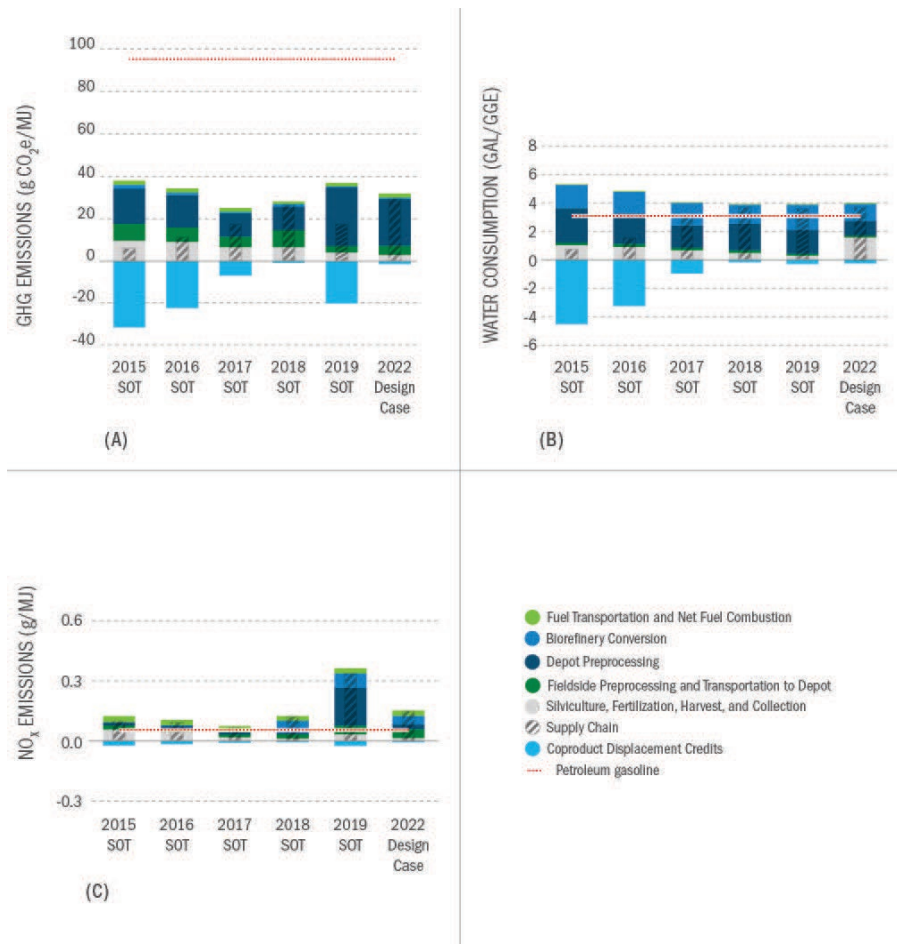


Figure 2A-2C: Supply chain for the catalytic fast pyrolysis design case for (A) GHG emissions, (B) water consumption, and (C) NO_x emissions^{3,4}

Significant RD&D is still required to reach the ultimate trajectory of a cost competitive MFSP and to achieve the desired 70% reduction in GHG emissions. The Topic Areas in this FOA directly seek to address the following RD&D needs:

- Development of integrated processes, tested and verified at engineering scale, to reduce technological uncertainties and enable industry deployment.

³ <https://www.energy.gov/sites/prod/files/2020/07/f76/beto-2019-state-of-technology-july-2020-r1.pdf>

⁴ 2019 SOT data assumes a feedstock of 50% clean pine and 50% forest residues. 2022 projects assume a feedstock of 25% clean pine and 75% forest residues.

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- The ability to use carbon dioxide captured directly from the ambient air in algal systems.
- The ability to reduce GHG emissions from first generation (Gen-1) ethanol facilities.

All work under EERE funding agreements, such as those awarded as a result of this FOA, must be performed in the United States.

iii. Diversity, Equity, and Inclusion

It is the policy of the Biden Administration that:

[T]he Federal Government should pursue a comprehensive approach to advancing equity⁵ for all, including people of color and others who have been historically underserved, marginalized, and adversely affected by persistent poverty and inequality. Affirmatively advancing equity, civil rights, racial justice, and equal opportunity is the responsibility of the whole of our Government. Because advancing equity requires a systematic approach to embedding fairness in decision-making processes, executive departments and agencies (agencies) must recognize and work to redress inequities in their policies and programs that serve as barriers to equal opportunity.

By advancing equity across the Federal Government, we can create opportunities for the improvement of communities that have been historically underserved, which benefits everyone.⁶

As part of this whole of government approach, this FOA seeks to encourage the participation of underserved communities⁷ and underrepresented groups.

⁵ The term “equity” means the consistent and systematic fair, just, and impartial treatment of all individuals, including individuals who belong to underserved communities that have been denied such treatment, such as Black, Latino, and Indigenous and Native American persons, Asian Americans and Pacific Islanders and other persons of color; members of religious minorities; lesbian, gay, bisexual, transgender, and queer (LGBTQ+) persons; persons with disabilities; persons who live in rural areas; and persons otherwise adversely affected by persistent poverty or inequality.

⁶ Executive Order 13985, “Advancing Racial Equity and Support for Underserved Communities Through the Federal Government” (Jan. 20, 2021).

⁷ The term “underserved communities” refers to populations sharing a particular characteristic, as well as geographic communities, that have been systematically denied a full opportunity to participate in aspects of economic, social, and civic life, as exemplified by the list of in the definition of “equity.” E.O. 13985. For purposes of this FOA, as applicable to geographic communities, applicants can refer to economically distressed communities identified by the Internal Revenue Service as Qualified Opportunity Zones; communities identified as

Applicants are highly encouraged to include individuals from groups historically underrepresented^{8,9} in STEM on their project teams. As part of the application, applicants are required to describe how diversity, equity, and inclusion objectives will be incorporated in the project. Specifically, applicants are required to submit a Diversity, Equity, and Inclusion Plan that describes the actions the applicant will take to foster a welcoming and inclusive environment, support people from underrepresented groups in STEM, advance equity, and encourage the inclusion of individuals from these groups in the project; and the extent the project activities will be located in or benefit underserved communities. (See Section IV.D.xv). The plan should include at least one SMART (Specific, Measurable, Assignable, Realistic and Time-Related) milestone per budget period supported by metrics to measure the success of the proposed actions. This plan will be evaluated as part of the technical review process, and incorporated into the award if selected.

Further, Minority Serving Institutions¹⁰, Minority Business Enterprises, Minority Owned Businesses, Woman Owned Businesses, Veteran Owned Businesses, or entities located in an underserved community that meet the eligibility requirements (See Section III.) are encouraged to apply as the prime applicant or

disadvantaged or underserved communities by their respective States; communities identified on the Index of Deep Disadvantage referenced at <https://news.umich.edu/new-index-ranks-americas-100-most-disadvantaged-communities/>, and communities that otherwise meet the definition of “underserved communities” stated above.

⁸ According to the National Science Foundation’s 2019 report titled, “Women, Minorities and Persons with Disabilities in Science and Engineering”, women, persons with disabilities, and underrepresented minority groups—black or African Americans, Hispanics or Latinos, and American Indians or Alaska Natives—are vastly underrepresented in the STEM (science, technology, engineering and math) fields that drive the energy sector. That is, their representation in STEM education and STEM employment is smaller than their representation in the U.S. population. <https://ncses.nsf.gov/pubs/nsf19304/digest/about-this-report> For example, in the U.S., Hispanics, African Americans and American Indians or Alaska Natives make up 24 percent of the overall workforce, yet only account for 9 percent of the country’s science and engineering workforce. DOE seeks to inspire underrepresented Americans to pursue careers in energy and support their advancement into leadership positions. <https://www.energy.gov/articles/introducing-minorities-energy-initiative>

⁹ See also. Note that Congress recognized in section 305 of the American Innovation and Competitiveness Act of 2017, Public Law 114-329:

(1) [I]t is critical to our Nation’s economic leadership and global competitiveness that the United States educate, train, and retain more scientists, engineers, and computer scientists; (2) there is currently a disconnect between the availability of and growing demand for STEM-skilled workers; (3) historically, underrepresented populations are the largest untapped STEM talent pools in the United States; and (4) given the shifting demographic landscape, the United States should encourage full participation of individuals from underrepresented populations in STEM fields.

¹⁰ Minority Serving Institutions (MSIs), including Historically Black Colleges and Universities/Other Minority Institutions as educational entities recognized by the Office of Civil Rights (OCR), U.S. Department of Education, and identified on the OCR’s Department of Education U.S. accredited postsecondary minorities’ institution list. See <https://www2.ed.gov/about/offices/list/ocr/edlite-minorityinst.html>.

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participate on an application as a proposed partner to the prime applicant. The Selection Official may consider the inclusion of these types of entities as part of the selection decision (See Section V.C.i).

B. Topic Areas

Table 1: Topic Area Breakdown

No.	Title
1	Pre-Pilot Scale-Up of Integrated Biorefineries
1a	Pre-Pilot Scale-Up of Integrated Biorefinery Technologies
1b	Pre-Pilot Scale-Up of Integrated Biorefineries: Use of Carbon Dioxide from Ambient Air in Algal Systems
2	Pilot Scale-Up of Integrated Biorefineries
2a	Pilot Scale-Up of Integrated Biorefineries: Preliminary Design and Phased Construction
2b	Pilot Scale-Up of Integrated Biorefineries: Final Design and Construction
3	Demonstration Scale-Up of Integrated Biorefineries
3a	Demonstration Scale-Up of Integrated Biorefineries: Preliminary Design and Phased Construction
3b	Demonstration Scale-Up of Integrated Biorefineries: Final Design and Construction
4	Gen-1 Corn Ethanol Emission Reduction
4a	Gen-1 Corn Ethanol Emission Reduction: Feasibility Study
4b	Gen-1 Corn Ethanol Emission Reduction: Pre-Pilot

i. Scale-up of Bioenergy Technologies Overview

Significant progress has been made on biofuels through both government and private sector RD&D over the last 10 years and some technologies are now ready for scaling-up to support their ultimate commercialization. BETO recognizes the availability of financing for first-of-a-kind process systems can be a barrier to commercializing advanced biofuels. Pilot and demonstration scale facilities are key to ensuring that commercial biorefineries are successful. BETO is looking for bioenergy companies that are ready to move their technologies from the laboratory to the pilot and demonstration stage and eventual commercialization.

Based on lessons learned from previous pilot, demonstration, and pioneer integrated biorefineries, BETO's scale-up strategy will:

- allow projects to be funded at either the pre-pilot, pilot, or demonstration scale.
- require projects have the data to show they have completed the previous stage successfully. This can be done through a previous BETO funded deployment or can be through one the company has done on its own.
- provide a consistent approach each year to provide industry with less uncertainty on BETO scale-up work.

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This continuing strategy includes a multi-faceted approach in partnership with the private sector, the DOE national laboratories, and academia, which brings together the following elements:

- Focus on the RD&D of sustainable aviation fuel¹¹, renewable diesel¹², sustainable marine fuel¹³, or sustainable rail fuel¹⁴;
- Provide opportunities for pre-pilot, pilot, and demonstration scale projects;
- Allow opportunities for a variety of feedstocks including traditional agricultural and forestry wastes, other lignocellulosic feedstocks, algae, organic wet waste, sorted municipal solid waste, food waste, biogas, grain starch, oilseed crops, waste carbon dioxide (CO₂), and CO₂ by direct air capture. Reference Appendix G for a full list of acceptable feedstocks for each Topic Area. **Any application or project proposing the use of any feedstock source not included in Appendix G is not of interest under this FOA and will not be considered;**
- Leverage the existing infrastructure, supply chains, and resources from adjacent industries, including but not limited to first-generation biorefineries, petrochemical production, and pulp and paper production; and
- Encourage the development and use of predictive models and high-performance computing as tools to lower risk and accelerate scale-up of biotechnologies.

The goal for this work is to help speed the uptake and commercialization of these technologies by the private sector.

To reach that goal, the FOA will fund projects at various levels of technology readiness including pre-pilot, pilot, and demonstration scale, jointly ranging from Technology Readiness Level (TRL) 4 to 7. However, to provide a path to 4-5 demonstration scale sustainable aviation fuel producing biorefineries by 2030 BETO intends to more heavily focus on the funding of pilot and demonstration scale applications for this FOA. BETO will identify, evaluate, and select applications proposing the scale-up of key process steps from laboratory scale unit operations to industrially-relevant piece(s) of equipment, as well as applications proposing project definition, development and execution plans for the scaling of pre-pilot technologies to pilot scale and/or demonstration scale. Of particular interest are those proposing technologies that support sustainable

¹¹ See Glossary (Appendix D) for sustainable aviation fuel (SAF) definition as it pertains to this FOA.

¹² See Glossary (Appendix D) for renewable diesel definition as it pertains to this FOA.

¹³ See Glossary (Appendix D) for sustainable marine fuel definition as it pertains to this FOA.

¹⁴ See Glossary (Appendix D) for Sustainable rail fuel definition as it pertains to this FOA.

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aviation, marine, rail, and long-haul trucking fuels, CO₂ conversion, waste and underutilized carbon feedstocks¹⁵, and novel process technologies at the pilot and demonstration scales that leverage existing first generation biorefinery assets and infrastructure.

As a means to achieve the aforementioned 4-5 demonstration scale biofuel producing facilities, non-fuel bioproducts are not allowable as the primary product for an Applicant's proposed technology under this FOA. Production of bioproducts is allowable as coproducts if essential for the overall economics of biofuel production. However, of all the carbon contained in the biofuels and coproducts, at least 50% of the total carbon must be contained within the biofuel(s). In addition, carbon found in waste streams, or streams consumed as a part of the production process, is not included in this calculation. For instance, CO₂ from a fermentation, light gases produced from biomass feedstock used for process heat, or char from a catalytic fast pyrolysis process would be considered traditional waste streams, even though there are technologies that can utilize these streams to further reduce the Carbon Index (CI) score and benefit the overall economics of a process. This will be different among technologies and the Applicant is responsible for fully explaining and establishing the applicability of their process streams under this requirement.

\$49,000,000 is anticipated to be available to fund Scale-Up Topic Areas 1, 2 and 3. This includes pre-pilots (Subtopic Area 1a and 1b), the design phase (Phase 1) of pilots and demonstrations (Subtopic Areas 2a and 3a), as well as the construction and operation (Phase 2) of pilots and demonstrations (Subtopic Areas 2b and 3b). Selections can be a combination of the three Topic Areas depending on the Applicant pool and the outcome of the evaluation process.

¹⁵ <https://www.energy.gov/eere/bioenergy/waste-energy>

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Table 2: Scale-Up Topic Areas Summary

Subtopic Area(s)	1a: Pre-pilot Scale	1b: Pre-pilot Scale (Ambient CO ₂ via Algal Systems)	2a and 2b: Pilot Scale	3a and 3b: Demonstration Scale
Allowable Feedstocks (see Appendix G)	Lignocellulosic Feedstocks, Algae, Organic Wet Waste, Sorted Municipal Solid Waste, Food Waste, Biogas, Grain Starch, Oilseed Crops, Construction and Demolition (C&D) Waste, and Waste CO ₂	CO ₂ by Direct Air Capture	Lignocellulosic Feedstocks, Algae, Organic Wet Waste, Sorted Municipal Solid Waste, Food Waste, Biogas, Grain Starch, Oilseed Crops, C&D Waste, Waste CO ₂ , and CO ₂ by Direct Air Capture	
Allowable Primary Products	Sustainable aviation fuel ¹⁶ , renewable diesel ¹⁷ , sustainable marine fuel ¹⁸ , or sustainable rail fuel ¹⁹			
Minimum Throughput	0.5 Dry Tons Per Day (DTPD) equivalent; or 8 MMBTU/day of biogas equivalent; or 35 gallons/day of final fuel equivalent for processes that utilize CO ₂ as a feedstock	35 gallons/day or 12,500 gallons/year of biofuel intermediate (e.g., extracted lipid suitable for upgrading to SAF)	20,000 gallons of biofuel per year equivalent	1,000,000 gallons of biofuel per year equivalent
Full Integration	No	No	Yes	Yes
Minimum GHG Reduction	70% reduction when compared to the fossil derived alternative			50% reduction
Fuel Selling Price	Cost competitive with petroleum-based fuels (model TEA for n th plant)			
Cumulative Time on Stream	500 hours	500 hours	1,000 hours	1,000 hours
Continuous Time on Stream	100 hours	100 hours	500 hours	1000 hours
Phased Project	No	No	2a: Yes 2b: No	3a: Yes 3b: No
Max Federal Funding Per Project	\$2,000,000	\$9,000,000	\$2,000,000 (TA 2a) \$15,000,000 (TA 2b)	\$2,000,000 (TA 3a) \$100,000,000* (TA 3b)
Min Cost Share	20%	20%	50%	50%

*\$100,000,000 is the absolute maximum federal funding for a demonstration facility under Topic Area 3b; however, applicants are highly encouraged to be judicious when budgeting their demonstration scale projects, as funding for these projects is subject to future Congressional appropriations.

¹⁶ See Glossary (Appendix D) for sustainable aviation fuel (SAF) definition as it pertains to this FOA.

¹⁷ See Glossary (Appendix D) for renewable diesel definition as it pertains to this FOA.

¹⁸ See Glossary (Appendix D) for sustainable marine fuel definition as it pertains to this FOA.

¹⁹ See Glossary (Appendix D) for Sustainable rail fuel definition as it pertains to this FOA.

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ii. Topic Area 1: Pre-Pilot Scale-Up of Integrated Biorefineries Overview

Many technologies developed at the bench scale, both externally and within the other BETO programs, require further development prior to full system scaling. Topic Area 1 will scale up key process steps that are ready to move out of the laboratory scale (TRL 3 or 4) and into industrially-relevant piece(s) of equipment (TRL 5). The proposed unit operation(s) within an application do not have to comprise a fully integrated pilot scale unit (TRL 6) by the end of the project, but rather can be utilized to support future integration of the entire process at pilot or demonstration scale. Applicants to Topic Area 1 will be required to demonstrate proof of technology success at the laboratory scale and provide a market justification for further system scaling. Lowering scale-up risk for these processes will contribute to the BETO 2030 goal of at least 70% reduction in greenhouse gas emissions relative to petroleum-derived fuels. Topic Area 1 is broken out into two distinct Subtopic Areas. Subtopic Area 1a focuses on technologies using conventional bio-based feedstocks and Subtopic Area 1b focuses on technologies that use CO₂ from ambient air in algal systems.

iii. Subtopic Area 1a: Pre-Pilot Scale-Up of Integrated Biorefinery Technologies

Subtopic Area 1a focuses on technologies scaling key process steps that are ready to move out of the laboratory scale (TRL 3 or 4) and into industrially-relevant piece(s) of equipment (TRL 5) utilizing lignocellulosic feedstocks, algae, organic wet waste, sorted municipal solid waste, food waste, biogas, grain starch, oilseed crops, construction and demolition (C&D) waste, and/or waste CO₂. Engineering solutions for the key process steps can include a single or multiple unit operations moving from batch to continuous operation, utilizing real-world feed and recycle streams, as well as specialized engineering scale equipment. Projects should further the development of technologies for biofuels and bioproducts that address BETO's goals for reductions in greenhouse gas emissions with an eye toward mitigating project risk and enabling future industrial deployment. Partnering with technology end users such as first generation corn ethanol facilities, sustainable aviation fuel producers, municipalities, and waste facilities is a good way to demonstrate industry interest in the proposed technology. Projects are encouraged to utilize predictive modeling and high-performance computing to accelerate and optimize their unit operation(s) design(s). The following metrics will be required for award:

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Table 3: Subtopic Area 1a – Pre-pilot Requirements

Metric:	Minimum:
Fuel Type	sustainable aviation fuel ²⁰ , renewable diesel ²¹ , sustainable marine fuel ²² , and/or sustainable rail fuel ²³
Fuel Selling Price	Cost competitive with petroleum-based fuels (model TEA for envisioned mature commercial facility (n th plant))
Cumulative Time on Stream	500 hours
Continuous Time on Stream	100 hours
Throughput Equivalent	0.5 DTPD equivalent; or 8 MMBTU/day of biogas equivalent; or 35 gallons/day of final fuel equivalent for processes that utilize CO ₂ as a feed
Greenhouse Gas (GHG) Reductions ^{24,25,26}	70%
Allowable Feedstocks (see Appendix G)	Lignocellulosic Feedstocks, Algae, Organic Wet Waste, Sorted Municipal Solid Waste, Food Waste, Biogas, Grain Starch, Oilseed Crops, C&D Waste, and Waste CO ₂

Anticipated Approaches for Subtopic Area 1a Include, but are Not Limited To

- Applications that use waste and underutilized carbon feedstocks²⁷;
- Biorefinery technologies taking advantage of existing assets and infrastructure, such as bolt-on and retrofit technologies;
- Applications that include industrial collaboration and partnerships for all aspects of the proposed process from farm to fuel;
- Applications that include safety consideration in design and operation as a first priority;
- Applicants that work closely with equipment/technology manufacturers, catalyst manufacturers, enzyme suppliers, and/or downstream and upstream process owners to ensure the feedstocks, processes, equipment, and catalyst employed in the proposed project are available and that assumptions within the application are reasonable;

²⁰ See Glossary (Appendix D) for sustainable aviation fuel (SAF) definition as it pertains to this FOA.

²¹ See Glossary (Appendix D) for renewable diesel definition as it pertains to this FOA.

²² See Glossary (Appendix D) for sustainable marine fuel definition as it pertains to this FOA.

²³ See Glossary (Appendix D) for Sustainable rail fuel definition as it pertains to this FOA.

²⁴ Applicants may use any standardized approach to calculating life cycle GHG emissions e.g. Argonne National Laboratory GREET (Greenhouse Gases, Regulated Emissions, and Energy Use in Technologies) model⁹ or provide schemes developed through the CORSIA (Carbon Offsetting and Reduction Scheme for International Aviation) methodology¹⁰ for calculating life cycle emissions

²⁵ <https://greet.es.anl.gov/>

²⁶ <https://www.icao.int/environmental-protection/CORSIA/Pages/CORSIA-Eligible-Fuels.aspx>

²⁷ <https://www.energy.gov/eere/bioenergy/waste-energy>

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- Development of predictive models and high-performance computing as tools to accelerate scale-up; and
- Biofuels (and bioproducts) must be produced domestically in the U.S.

Subtopic Area 1a Specific Requirements

The following requirements must be addressed in the application and the strength of the Applicant's discussion will be evaluated by the independent technical review panel for engineering and scientific merit (see evaluation criteria in Section V.A.ii.):

- Projects must meet or exceed all minimum metrics listed above in Table 3: Subtopic Area 1a – Pre-pilot Requirements.
- Applications must contain techno-economic and life cycle analyses (TEA and LCA) that relate the key technical parameters of the proposed technology described in the proposal application to achieving a cost competitive MFSP (minimum fuel selling price) and GHG (greenhouse gas) reduction targets. Previously achieved values, scales, and durations should be delineated from the values necessary to meet the targeted MFSP so that the level of technology advancement needed is clear.
- The biofuels being produced by the proposed technology must be a sustainable aviation fuel²⁸, renewable diesel²⁹, sustainable marine fuel³⁰, and/or sustainable rail fuel³¹.
- Projects selected for negotiation of award will be subject to verification immediately after award approval, within budget period 1.
- A Block Flow Diagram and Supplemental Data template are required as part of the application.
- Production of bioproducts is allowable as coproducts if essential for the overall economics of biofuel production. However, of all the carbon contained in the biofuels and coproducts, at least 50% must be in the biofuel(s). Higher percentages of utilizable carbon found in the biofuels may be prioritized using Program Policy Factors (see section V.C.i).
- Biofuels must demonstrate a reasonable chance of receiving ASTM International (ASTM) or other regulatory approvals, as evidenced by substantial discussion in the narrative and inclusion of necessary tasks in the Statement of Project Objectives (SOPO).

²⁸ See Glossary (Appendix D) for sustainable aviation fuel (SAF) definition as it pertains to this FOA.

²⁹ See Glossary (Appendix D) for renewable diesel definition as it pertains to this FOA.

³⁰ See Glossary (Appendix D) for sustainable marine fuel definition as it pertains to this FOA.

³¹ See Glossary (Appendix D) for Sustainable rail fuel definition as it pertains to this FOA.

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- Applications proposing co-processing with an existing petroleum refinery must address how at least 50% of the biogenic carbon would be converted to a biofuel and how this would be measured.
- Applications cannot include greater than 10% of the total project budget for earlier stage research and development (R&D) (<TRL 4), including expenses for equipment, salaries, and supplies.

Subtopic Area 1a Special Deliverables

In addition to the deliverables required in the Federal Assistance Reporting Checklist, the following deliverables are required for awards made under Subtopic Area 1a:

- Applications submitted under Subtopic Area 1a are required to participate in the Verification Process as described in Section I.C.
- A publicly releasable final technical report describing how the technology would contribute to the BETO 2030 goal being cost competitive with petroleum-based fuels (model TEA for nth plant) with at least 70% reduction in greenhouse gas emissions relative to petroleum derived fuels.
- Recipients will be required to provide input for DOE's design cases (link to our latest State of Technology Report that discusses these design cases can be found at the link provided below) to refine the various program models (such as TEA and LCA) in an anonymous manner (permitting the data to be made publicly available).
 - (<https://www.energy.gov/sites/prod/files/2020/07/f76/beto-2019-state-of-technology-july-2020-r1.pdf>)

Subtopic Area 1a Applications Specifically Not of Interest

- Those identified in Section I.D. of the FOA.

All work under EERE funding agreements must be performed in the United States. See Section IV.J.iii. and Appendix C.

iv. Subtopic Area 1b: Pre-Pilot Scale-Up of Integrated Biorefineries: Use of Carbon Dioxide from Ambient Air in Algal Systems

The use of carbon dioxide captured directly from the ambient air in algal systems has been developed at the bench scale, both externally and within the other BETO programs and requires further development to reduce scale-up risks prior to full system scaling. Subtopic Area 1b will scale up key process steps that are ready to move out of the laboratory scale (TRL 3 or 4) and into industrially-relevant piece(s) of equipment (TRL 5). Engineering solutions for the key process steps can include a single unit operation or multiple unit operations moving from batch to continuous

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operation, utilizing real-world feed and recycle streams, as well as specialized engineering scale equipment. The proposed unit operation(s) within an application do not have to comprise a fully integrated pilot scale algal system that produces biofuels (TRL 6) by the end of the project, but rather can be utilized to support future integration of the entire process at pilot or demonstration scale. However, even in pre-pilot projects of algal systems, clear hand-offs and system boundary limits for the future envisioned scale-up must be identified, such as technology and development partner(s) for production of sustainable aviation fuels from algal feedstocks. In addition, projects are encouraged to utilize predictive modeling and high-performance computing to accelerate and optimize their unit operation(s) design(s). As such, the following metrics will be required for award:

Table 4: Subtopic Area 1b – Pre-pilot Requirements

Metric:	Minimum:
Fuel Type	sustainable aviation fuel ³² , renewable diesel ³³ , sustainable marine fuel ³⁴ , and/or sustainable rail fuel ³⁵
Fuel Selling Price	Cost competitive with petroleum-based fuels (model TEA for n th plant)
Cumulative Time on Stream	500 hours of CO ₂ delivery to algal systems
Continuous Time on Stream	100 hours of CO ₂ delivery to algal systems
Throughput Equivalent	35 gallons/day or 12,500 gallons/year of biofuel intermediate (e.g., extracted lipid suitable for upgrading to SAF)
Greenhouse Gas (GHG) Reductions ^{36,37,38}	70% reduction in gCO ₂ e/MJ of the biofuel as compared to petroleum baseline
Allowable Feedstocks ³⁹	CO ₂ from the ambient air, either: <ul style="list-style-type: none">• captured via operation of Direct Air Capture (DAC) systems and supplied directly to co-located algal systems; or• captured through chemically, biologically, or mechanically-assisted accelerated diffusion of air into algal system growth media.

³² See Glossary (Appendix D) for sustainable aviation fuel (SAF) definition as it pertains to this FOA.

³³ See Glossary (Appendix D) for renewable diesel definition as it pertains to this FOA.

³⁴ See Glossary (Appendix D) for sustainable marine fuel definition as it pertains to this FOA.

³⁵ See Glossary (Appendix D) for Sustainable rail fuel definition as it pertains to this FOA.

³⁶ Applicants may use any standardized approach to calculating life cycle GHG emissions e.g. Argonne National Laboratory GREET (Greenhouse Gases, Regulated Emissions, and Energy Use in Technologies) model⁹ or provide schemes developed through the CORSIA (Carbon Offsetting and Reduction Scheme for International Aviation) methodology¹⁰ for calculating life cycle emissions

³⁷ <https://greet.es.anl.gov/>

³⁸ <https://www.icao.int/environmental-protection/CORSIA/Pages/CORSIA-Eligible-Fuels.aspx>

³⁹ see Appendix G for feedstock definitions

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Anticipated Technology Approaches for Subtopic Area 1b Include, but are Not Limited To

- Integration of a Direct Air Capture (DAC) technology with an algae growth system that enables highly productive algae biomass growth;
- Cultivation of highly productive algae strains in cultivation configurations suitable for accelerated diffusion of carbon dioxide from the atmosphere into the growth media; and/or
- Bioproducts that can be co-produced with biofuels and be shown to lower the accompanied biofuel selling price to be competitive with petroleum-based fuels.

Subtopic Area 1b Specific Requirements

The following requirements must be addressed in the application and the strength of the Applicant's discussion will be evaluated by the independent technical review panel for engineering and scientific merit (see evaluation criteria in Section V.A.ii.):

- Projects must meet or exceed all minimum metrics listed above in Table 4: Subtopic Area 1b – Pre-pilot Requirements.
- Subtopic Area 1b will only allow the use of carbon from the ambient air, either: captured via operation of Direct Air Capture (DAC) systems and supplied directly to co-located algal systems; or captured through chemically, biologically, or mechanically-assisted accelerated diffusion of air into algal system growth media.
- Applications must contain techno-economic and life cycle analyses (TEA and LCA) that relate the key technical parameters of the proposed technology described in the application to achieving the MFSP and GHG targets. Previously achieved values, scales, and durations should be delineated from the values necessary to meet the targeted MFSP so that the level of technology advancement needed is clear.
- The biofuels being produced by the proposed technology must be a sustainable aviation fuel⁴⁰, renewable diesel⁴¹, sustainable marine fuel⁴², and/or sustainable rail fuel⁴³.
- Projects selected for negotiation of award will be subject to verification immediately after award approval, within budget period 1.

⁴⁰ See Glossary (Appendix D) for sustainable aviation fuel (SAF) definition as it pertains to this FOA.

⁴¹ See Glossary (Appendix D) for renewable diesel definition as it pertains to this FOA.

⁴² See Glossary (Appendix D) for sustainable marine fuel definition as it pertains to this FOA.

⁴³ See Glossary (Appendix D) for sustainable rail fuel definition as it pertains to this FOA.

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- A Block Flow Diagram and Supplemental Data template are required as part of the application.
- Production of bioproducts is allowable as coproducts if essential for the overall economics of biofuel production. However, of all the carbon contained in the biofuels and coproducts, at least 50% must be in the biofuel(s). Higher percentages of utilizable carbon found in the biofuels may be prioritized by use of Program Policy Factors (section V.C.i).
- Biofuels must demonstrate a reasonable chance of receiving ASTM or other regulatory approvals, as evidenced by substantial discussion in the narrative and inclusion of necessary tasks in the SOPO.
- Applications cannot include greater than 10% of the total project budget for earlier stage R&D (<TRL 4), including expenses for equipment, salaries, and supplies.
- Biofuels (and bioproducts) must be produced domestically in the U.S.
- Clear hand-offs and system boundary limits for the future envisioned scale-up must be identified; such as technology and development partner(s) for production of sustainable aviation fuels from algal feedstocks.

Subtopic Area 1b Special Deliverables

In addition to the deliverables required in the Federal Assistance Reporting Checklist, the following deliverables are required for awards made under Subtopic Area 1b:

- Applications submitted under Subtopic Area 1b are required to participate in the Verification Process as described in Section I.C.
- Applications must propose to deliver final TEA and LCA that incorporate the time on stream data generated in the conduct of the proposed project.
- Recipients will be required to provide input for DOE's design cases (link to our latest State of Technology Report that discusses these design cases can be found at the link provided below) to refine the various program models (such as TEA and LCA) in an anonymous manner (permitting the data to be made publicly available).
 - (<https://www.energy.gov/sites/prod/files/2020/07/f76/beto-2019-state-of-technology-july-2020-r1.pdf>)
- A publicly releasable final technical report describing how the technology would contribute to the reduction of feedstock carbon intensity.

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Subtopic Area 1b Applications Specifically Not of Interest

- Those identified in Section I.D. of the FOA.

All work under EERE funding agreements must be performed in the United States. See Section IV.J.iii. and Appendix C.

v. Topic Area 2: Pilot Scale-Up of Integrated Biorefineries

Topic Area 2 will identify, evaluate, and select applications proposing project definition, development, and execution plans for the scaling of pre-pilot biofuel and bioproduct technologies to pilot scale including for:

- the manufacturing of sustainable aviation fuel⁴⁴, renewable diesel⁴⁵, sustainable marine fuel⁴⁶, and/or sustainable rail fuel⁴⁷;
- novel process technologies that leverage existing first generation, grain starch, biorefinery assets and infrastructure; and/or
- novel process technologies that leverage US-produced, oilseed crops (see Appendix G) that meet all other metrics of the topic area, including achieving at least 70% GHG reductions. This can include the utilization of oil-seed cover crops, the co-processing of intermediates and oilseed oils, blending of SAFs from various feedstocks, among other innovative concepts.

Topic Area 2 is broken into two separate Subtopic Areas. The first, Subtopic Area 2a: Pilot Scale – Preliminary Design and Phased Construction, is intended for projects that have all prior scale data and are ready to design a pilot facility. Projects selected under Subtopic Area 2a will have an opportunity to construct and operate their designed pilot facility based on the down-select process described below in Subtopic Area 2a. The second, Subtopic Area 2b: Pilot Scale – Final Design and Construction, is intended for projects that have completed the design of the pilot scale facility, whether that design was funded through past DOE funding or not. Selected Subtopic Area 2b projects will be subject to an initial verification and DOE review to approve start of construction, also known as Critical Decision 3 per DOE Order 413.3b⁴⁸.

⁴⁴ See Glossary (Appendix D) for sustainable aviation fuel (SAF) definition as it pertains to this FOA.

⁴⁵ See Glossary (Appendix D) for renewable diesel definition as it pertains to this FOA.

⁴⁶ See Glossary (Appendix D) for sustainable marine fuel definition as it pertains to this FOA.

⁴⁷ See Glossary (Appendix D) for sustainable rail fuel definition as it pertains to this FOA.

⁴⁸ <https://www.directives.doe.gov/directives-documents/400-series/0413.3-BOrder-b/@images/file>

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Topic Area 2 will provide the ability for pre-pilot technologies to scale to pilot scale. Pilot scale facilities developed under Topic Area 2 must produce at the plant's rated capacity, a minimum quantity of 20,000 gallons per year of liquid biobased hydrocarbon fuel for aviation, marine, rail, or long-haul trucking applications.

Scale-up and integrated operations of these process technologies is essential to enable the industry to build future demonstration, pioneer, and commercial scale facilities. Successfully scaling and operating process technology is critical for biotechnologies to remain a significant near-term decarbonization pathway.

Applications submitted under Topic Area 2 must meet a minimum neat biofuel throughput of 20,000 gallons per year equivalent. Proposed technologies must meet 70% GHG reduction relative to the petroleum-derived alternative. **Although 70% GHG reduction is the minimum allowable, applications with greater GHG reductions are highly encouraged and may receive preference by way of a Program Policy Factor (section V.C.i).** The minimum baseline technology readiness level for projects submitted under this topic is TRL 4 with a maximum of TRL 6 at the conclusion of the project. As such, the following metrics will be required for award:

Table 5: Topic Area 2 Minimum Requirements

Metric:	Minimum:
Fuel Type	sustainable aviation fuel ⁴⁹ , renewable diesel ⁵⁰ , sustainable marine fuel ⁵¹ , and/or sustainable rail fuel ⁵²
Fuel Selling Price	Cost competitive with petroleum-based fuels (model TEA for n th plant)
Cumulative Time on Stream	1,000 hours
Continuous Time on Stream	500 hours
Throughput Equivalent	20,000 gallons of biofuel per year equivalent
GHG Reductions	70%
Allowable Feedstocks ⁵³	Lignocellulosic Feedstocks, Algae, Organic Wet Waste, Sorted Municipal Solid Waste, Food Waste, Biogas, Grain Starch, Oilseed Crops, C&D Waste, Waste CO ₂ , and CO ₂ by Direct Air Capture

⁴⁹ See Glossary (Appendix D) for sustainable aviation fuel (SAF) definition as it pertains to this FOA.

⁵⁰ See Glossary (Appendix D) for renewable diesel definition as it pertains to this FOA.

⁵¹ See Glossary (Appendix D) for sustainable marine fuel definition as it pertains to this FOA.

⁵² See Glossary (Appendix D) for sustainable rail fuel definition as it pertains to this FOA.

⁵³ see Appendix G for feedstock definitions

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vi. Subtopic Area 2a: Pilot Scale-Up of Integrated Biorefineries (Preliminary Design and Phased Construction)

Subtopic Area 2a is intended for projects that have all relevant prior scale data and are ready to design a biofuels pilot facility. Projects selected under Subtopic Area 2a may have an opportunity to construct and operate their designed pilot facility subject to the down-select process described in detail below. Only projects selected following the down-select process will be eligible to proceed into a final design/construction/operation phase.

Subtopic Area 2a Project and Award Structure

Given the high cost and complexity of pilot scale projects, recipients in Subtopic Area 2a will undergo a phased approach as depicted in Table 6: Subtopic Area 2a Award Structure below. Phase 1 will consist of an extended 12 month Verification & Design Basis Definition phase to verify prior scale data and readiness to proceed. Up to \$2,000,000 of federal funds will be made available for each Phase 1 project. A minimum of 50% cost share is required for Phase 1. DOE will conduct a down-select review between Phase 1 and the final design/construction/operation phase (Phase 2), also referred to as Critical Decision (CD) 2⁵⁴. The down-select decision will be made by DOE at the completion of the 12 month Phase 1 period. Project performance in Phase 1, as well as portfolio balance, available of funds, and other factors, will be considered in the down-select process. Please see Appendix I – Preliminary Design Requirements for a list of the criteria upon which EERE will evaluate Phase 1 projects. Only projects selected by DOE as a result of the down-select process will be eligible to receive additional Phase 2 funding, subject to the availability of future year appropriations, and be permitted to proceed into the 42-48 month design/construction/operation phase (Phase 2). Applications should schedule at least 6-12 months for start-up and commissioning tasks within Phase 2.

⁵⁴ <https://www.directives.doe.gov/directives-documents/400-series/0413.3-BOrder-b/@@images/file>

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Table 6: Subtopic Area 2a Award Structure

Phases	Budget Periods	Scope
Phase 1 – Verification & Design Basis Definition (12 Months) Up to \$2M federal	BP1	Verification of baseline data presented in application
	Go/No-Go Review of Verification outcome	
	BP2	Design Basis Definition
Down-select (CD-2) Approve project scope and begin design (Subject to future appropriations)		
Phase 2 – Final Design, Construction, Operation (42-48 Months) Up to \$15M federal	BP3	Project Definition - preliminary planning and design
	Go/No-Go (CD-3) Review to approve start of construction	
	BP4	Project Execution - complete final design and construction
	Go/No-Go (CD-4) Performance test to verify readiness to begin operations	
	BP5	Operations

Applications should consider Phase 2 (Final Design, Construction, Operation) projects on the order of \$15,000,000 of federal funds plus a minimum of 50% Applicant cost-share when developing the Phase 1 proposal in their applications. Only Phase 1 funds will be obligated at time of initial award. **Selection for Phase 1 award does not guarantee a Phase 2 award. Phase 2 funds are subject to future appropriations and availability of funds, which may be obligated to successful Phase 2 awards once a down-select occurs (see section VI.C.).**

Subtopic Area 2a Phase 1 Deliverables

At the end of Phase 1, a full design package will be reviewed and verified by DOE and their Independent Engineer. The full design package includes items such as Process Design Basis Documents, Process Flow Diagrams, Mass and Energy Balances, budgetary estimates, and schedules. A more extensive list of design package elements is found in Appendix I.

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Subtopic Area 2a Initial Project Verification

All Phase 1 projects will be subject to an initial verification effort to review their baseline and proposed targets and will result in a Go/No-Go decision (see Section VI.B.xiv). The verification will require that the Recipient conduct a performance test of the process proposed in its application. The performance test will require that the Recipient reproduce data sets commensurate to the prior scale work presented in the application. The prior scale data sets must be available to DOE, (which may include delivery to DOE), or its representatives (such as an Independent Engineer), for review in support of the verification effort. The outcome of this performance test will be a primary component of the Go/No-Go decision. Applicants must include this task within their proposed scope, schedule, and budget. It is anticipated that the initial verification can take up to six months; Applicants must include this task in their schedule as Budget Period 1. Applicants will be required to execute the appropriate Conflict of Interest and Non-disclosure Agreements (COI/NDA) with DOE's representatives immediately after negotiation and execution of an award. Failure to execute the COI/NDAs in a reasonable amount of time to enable the verification review will result in a 'No-Go' decision. Projects that receive a 'Go' decision at the conclusion of the initial verification effort and proceed to Budget Period 2 will also be subject to a final verification review as part of the down-select process prior to Phase 2.

Subtopic Area 2a National Environmental Policy Act (NEPA) Considerations

All Subtopic Area 2a project activities will be subject to NEPA review. Applicants must account for NEPA related efforts in the project scope, schedule, and budget. Phase 1 of each award will be limited in scope, as it will focus only on project development and design activities related to future pilot and demonstration scale integrated biorefineries. Under Phase 1, limited modifications to existing facilities to complete the prior scale data set may be allowed; construction of new facilities will not be allowed.

Any construction activities will be restricted to Phase 2. DOE will complete additional NEPA review for Phase 2 activities. See Sections IV.J.ii.1 and VI.B.vi for additional information on NEPA requirements. It should be noted that new construction or significant modification of an existing facility will likely trigger an Environmental Assessment or Environmental Impact Statement. Proper budgeting and scheduling must be accounted for within the proposed project's application.

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Subtopic Area 2a Additional Financial Requirements

In addition to verifying the technical baseline at the beginning of Phase 1 and demonstrating completion of the key outcomes from Phase 1, recipients must demonstrate their financial readiness to proceed into Phase 2. This includes demonstrating the ability to provide all required cost share and contingency reserve (see below) prior to entering into Phase 2 of the project. Recipients are required to secure all cost share and contingency prior to proceeding into Phase 2. Throughout the award life cycle, DOE will review and monitor the financial capability of the Recipient and other key organizations within the project team, such as parent companies or cost share providers. DOE may also conduct pre-award accounting system audits, financial capability reviews, or reviews of financial or compliance audits.

A contingency reserve is required for all Phase 2 activities. DOE experience and industry best practice show that a minimum of 25% of Total Project Cost (federal share and cost share) for Phase 2 Costs is necessary to allow the project to continue when unexpected expenses are encountered. Recipients must demonstrate that they can meet the financial needs of Phase 2 of their project when submitting a continuation application. The continuation application (see Section VI.B.xiv) for Phase 2 must include documentation showing that the Recipient has access to this minimum 25% required contingency. Contingency funds must be: (a) liquid, (b) immediately available, and (c) unrestricted funds dedicated exclusively to the project for the purpose of mitigating project performance baseline risk. The contingency reserve is in addition to Total Project Costs and cannot count towards cost share, until expended. If expended, the contingency will not result in reimbursement by DOE above the total federal share approved in the award. DOE discourages Recipients from reducing scope to comply with the contingency reserve requirement.

Subtopic Area 2a Specific Requirements

The following requirements must be addressed in the application and the strength of the Applicant's discussion will be evaluated by the independent technical review panel for engineering and scientific merit (see evaluation criteria in Section V.A.ii.):

- Projects must meet or exceed all minimum metrics listed above in Table 5: Topic Area 2 Minimum Requirements.
- Applications submitted under Subtopic Area 2a are required to participate in the Verification Process as described in Section I.C.

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- Applications must contain techno-economic and life cycle analyses (TEA and LCA) that relate the key technical parameters of the proposed technology described in the proposal application to achieving a cost competitive MFSP and GHG reduction targets. Previously achieved values, scales, and durations should be delineated from the values necessary to meet the targeted MFSP so that the level of technology advancement needed is clear.
- A Block Flow Diagram and Supplemental Data template are required as part of the application.
- Scale-up factors⁵⁵ per unit operation⁵⁶ can be no greater than 50x.
- All major equipment being utilized in the pilot must be based on the equipment that will be used in the eventual commercial facility. For example, if a fluidized bed will be utilized in the commercial scale a fluidized bed must be utilized in the pilot facility.
- Subtopic Area 2a allows for production of bioproducts as coproducts if essential for the overall economics of biofuel production. However, of all the carbon contained in the biofuels and coproducts, at least 50% must be in the biofuel(s). Higher percentages of utilizable carbon⁵⁷ found in the biofuels may be prioritized. Higher percentages of utilizable carbon found in the biofuels may be prioritized by use of a Program Policy Factor (section V.C.i).
- Biofuels must demonstrate a reasonable chance of receiving ASTM or other regulatory approvals as evidenced by substantial discussion in the narrative and inclusion of necessary tasks in the SOPO.
- Applications proposing co-processing with an existing petroleum refinery must address how at least 50% of the biogenic carbon would be converted to a biofuel and how this would be measured, as evidenced by substantial discussion in the narrative and inclusion of necessary tasks in the SOPO.
- Applications cannot include greater than 10% of the total project budget for earlier stage R&D (<TRL 4), including expenses for equipment, salaries, and supplies.
- Biofuels (and bioproducts) must be produced in the U.S.

Subtopic Area 2a Applications Specifically Not of Interest

- Those identified in Section I.D. of the FOA.

All work under EERE funding agreements must be performed in the United States. See Section IV.J.iii. and Appendix C.

⁵⁵ See Glossary (Appendix D) for scale-up factor definition as it pertains to this FOA.

⁵⁶ See Glossary (Appendix D) for unit operation definition as it pertains to this FOA.

⁵⁷ See Glossary (Appendix D) for utilizable carbon definition as it pertains to this FOA.

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Subtopic Area 2a Special Deliverables

In addition to the deliverables required in the Federal Assistance Reporting Checklist, the following deliverables are required for awards made under Subtopic Area 2a:

- Attendance and participation at the BETO Biennial Peer Review is required so that external subject matter experts can review project accomplishments and provide feedback to ensure optimal use of BETO funds.
- A publicly releasable final technical report describing how the technology would contribute to the BETO 2030 goal being cost competitive with petroleum-based fuels (model TEA for nth plant) with at least 70% reduction in greenhouse gas emissions relative to petroleum derived fuels.
- Recipients will be required to provide input for DOE's design cases (link to our latest State of Technology Report that discusses these design cases can be found at the link provided below) to refine the various program models (such as TEA and LCA) in an anonymous manner (permitting the data to be made publicly available).
 - (<https://www.energy.gov/sites/prod/files/2020/07/f76/beto-2019-state-of-technology-july-2020-r1.pdf>)

vii. Subtopic Area 2b: Pilot Scale-Up of Integrated Biorefineries (Final Design and Construction)

Subtopic Area 2b is intended for projects that are fully ready to build and operate a pilot scale biorefinery. Eligible Applicants must have a completed full design package, whether that design was funded through past DOE funding or not. A full design package includes items like Process Design Basis Documents, Process Flow Diagrams, Mass and Energy Balances, budgetary estimates, and schedules. A more extensive list may be found in Appendix I. Unlike Subtopic Area 2a, recipients under Subtopic Area 2b will not be subject to the down-select process. The full federal share of the award will be obligated at the time of initial award, up to \$15,000,000.

Subtopic Area 2b Project and Award Structure

Subtopic Area 2b Applicants must have already completed a full design package for their pilot plant and are ready to move past Critical Decision 3 (CD-3 per DOE Order 413.3b⁵⁸). The design package will be reviewed and verified by a DOE

⁵⁸ https://www.directives.doe.gov/terms_definitions/cd-3-approve-start-of-construction

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Independent Engineer (Budget Period 1) and will culminate in the Go/No-Go Critical Decision 3 (CD-3) review to approve/disapprove the start of construction. Upon successful passage through CD-3, Subtopic Area 2b recipients will be allowed to move into the project execution stage (Budget Period 2). Budget Period 3 should include a start-up and commissioning step. In DOE's experience, this step can take anywhere from 6-12 months for pilot scale projects. This award structure is shown in Table 7: Subtopic Area 2b Award Structure below.

Table 7: Subtopic Area 2b Award Structure

Title	Budget Periods	Scope
Construction and Operation (42-48 Months) Up to \$15M federal	BP1	Verification of Design Package and Readiness to Proceed
	Go/No-Go (CD-3) Review to approve start of construction	
	BP2	Project Execution - complete final design and construction
	Go/No-Go (CD-4) Performance test to verify readiness to begin operations	
	BP3	Operations

Subtopic Area 2b Initial Project Verification

All Subtopic Area 2b projects will be subject to an initial verification effort to review their full design package and will result in a Go/No-Go decision (see Section VI.B.xiv). The verification will require that the Recipient conduct a performance test of the process proposed in its application at prior scale. The verification test will require that the Recipient reproduce data sets commensurate to the prior scale work presented in the application and full data package. The prior scale data sets must be available to DOE, (which may include delivery to DOE), or its representatives (such as an Independent Engineer), for review in support of the verification effort. The outcome of this performance test will be a primary component of the CD-3 Go/No-Go decision. Applicants should include this task within their proposed scope, schedule, and budget. It is anticipated that the initial verification can take up to six months; Applicants must include this task in their schedule as Budget Period 1. Applicants will be required to execute the appropriate Conflict of Interest and Non-disclosure Agreements (COI/NDA) with DOE's representatives immediately after negotiation and execution of an award. Failure to execute the COI/NDAs in a reasonable amount of time to enable the verification review will result in a 'No-Go' decision. Projects that receive a 'Go' decision at the conclusion of the initial verification effort and proceed to Budget Period 2 may also be subject to a final verification review.

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Subtopic Area 2b National Environmental Policy Act (NEPA) Considerations

All Subtopic Area 2b project activities will be subject to NEPA review. Applicants should account for NEPA related efforts in the project scope, schedule, and budget. Budget Period 1 of each award will be limited in scope, as it will focus only on the initial verification and potential NEPA requirements for subsequent budget periods. Construction of new facilities will not be allowed in Budget Period 1. Any construction activities will be restricted to Budget Period 2. DOE will complete additional NEPA review for Budget Period 2 activities. See Sections IV.J.ii.1 and VI.B.vi for additional information on NEPA requirements. It should be noted that new construction or significant modification of an existing facility will likely trigger an Environmental Assessment or Environmental Impact Statement. Proper budgeting and scheduling should be accounted for within the proposed project's application.

Subtopic Area 2b Additional Financial Requirements

In addition to verifying the full design package in Budget Period 1, recipients must demonstrate their financial readiness to proceed into Budget Period 2. This includes demonstrating the ability to provide all required cost share and contingency prior to entering each phase of the project. Recipients are required to secure all cost share and contingency prior to proceeding into the next budget period. Throughout the award life cycle, DOE will review and monitor the financial capability of the Recipient and other key organizations within the project team, such as parent companies or cost share providers. DOE may also conduct pre-award accounting system audits, financial capability reviews, or reviews of financial or compliance audits.

A contingency reserve is required for all Budget Period 2 and 3 activities. DOE experience and industry best practice show that a minimum of 25% of Total Project Cost (federal share and cost share) of Budget Period 2 and 3 costs is necessary to allow the project to continue when unexpected expenses are encountered. Recipients must demonstrate that they can meet the financial needs of the project. The full design package for Budget Period 2 must also include documentation showing that the Recipient has access to this minimum 25% required contingency. Contingency funds must be: (a) liquid, (b) immediately available, and (c) unrestricted funds dedicated exclusively to the project for the purpose of mitigating project performance baseline risk. The contingency reserve is in addition to Total Project Costs and cannot count towards cost share, until expended. If expended, the contingency will not result in reimbursement by DOE above the total federal share approved in the award. DOE discourages Recipients from reducing scope to comply with the contingency reserve requirement.

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Subtopic Area 2b Specific Requirements

The following requirements must be addressed in the application and the strength of the Applicant's discussion will be evaluated by the independent technical review panel for engineering and scientific merit (see evaluation criteria in Section V.A.ii.):

- Projects must meet or exceed all minimum metrics listed above in Table 5: Topic Area 2 Minimum Requirements.
- Applications submitted under Subtopic Area 2b are required to participate in the Verification Process as described in Section I.C.
- A Block Flow Diagram and Supplemental Data template are required as part of the application.
- Applications must contain techno-economic and life cycle analyses (TEA and LCA) that relate the key technical parameters of the proposed technology described in the proposal application to achieving a cost competitive MFSP and GHG reduction targets. Previously achieved values, scales, and durations should be delineated from the values necessary to meet the targeted MFSP so that the level of technology advancement needed is clear.
- Eligible applications must have a completed design of a pilot scale biorefinery as described in Appendix I. This design should be discussed in the application but should not be submitted as part of the application. The design will be fully verified prior to the release of Federal funds.
- Scale-up factors⁵⁹ per unit operation⁶⁰ can be no greater than 50x.
- All major equipment being utilized in the pilot must be based on the equipment that will be used in the eventual commercial facility. For example, if a fluidized bed will be utilized in the commercial scale a fluidized bed must be utilized in the pilot facility.
- Subtopic Area 2b allows for production of bioproducts as coproducts if essential for the overall economics of biofuel production. However, of all the carbon contained in the biofuels and coproducts, at least 50% must be in the biofuel(s). Higher percentages of utilizable carbon⁶¹ found in the biofuels may be prioritized. Higher percentages of utilizable carbon found in the biofuels may be prioritized by use of a Program Policy Factor (section V.C.i).

⁵⁹ See Glossary (Appendix D) for scale-up factor definition as it pertains to this FOA.

⁶⁰ See Glossary (Appendix D) for unit operation definition as it pertains to this FOA.

⁶¹ See Glossary (Appendix D) for utilizable carbon definition as it pertains to this FOA.

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- Biofuels must demonstrate a reasonable chance of receiving ASTM or other regulatory approvals as evidenced by substantial discussion in the narrative and inclusion of necessary tasks in the SOPO.
- Applications proposing co-processing with an existing petroleum refinery must address how at least 50% of the biogenic carbon would be converted to a biofuel and how this would be measured, as evidenced by substantial discussion in the narrative and inclusion of necessary tasks in the SOPO.
- Applications cannot include greater than 10% of the total project budget for earlier stage R&D (<TRL 4), including expenses for equipment, salaries, and supplies.
- Biofuels (and bioproducts) must be produced in the U.S.
- Unlike Subtopic Area 2a, recipients under Subtopic Area 2b will not be subject to the down-select process since their projects should be near or ready for CD-3 at selection.

Subtopic Area 2b Special Deliverables

In addition to the deliverables required in the Federal Assistance Reporting Checklist, the following deliverables are required for awards made under Subtopic Area 2b:

- Attendance and participation at the BETO Biennial Peer Review is required so that external subject matter experts can review project accomplishments and provide feedback to ensure optimal use of BETO funds.
- A publicly releasable final technical report describing how the technology would contribute to the BETO 2030 goal being cost competitive with petroleum-based fuels (model TEA for nth plant) with at least 70% reduction in greenhouse gas emissions relative to petroleum derived fuels.
- Recipients will be required to provide input for DOE's design cases (link to our latest State of Technology Report that discusses these design cases can be found at the link provided below) to refine the various program models (such as TEA and LCA) in an anonymous manner (permitting the data to be made publicly available).
 - (<https://www.energy.gov/sites/prod/files/2020/07/f76/beto-2019-state-of-technology-july-2020-r1.pdf>)

Subtopic Area 2b Applications Specifically Not of Interest

- Those identified in Section I.D. of the FOA; and
- Applications that do not demonstrate the Applicants have performed design safety review, process hazard analysis, risk assessment and management.

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All work under EERE funding agreements must be performed in the United States. See Section IV.J.iii. and Appendix C.

viii. Topic Area 3: Demonstration Scale-Up of Integrated Biorefineries

Topic Area 3 will identify, evaluate, and select applications proposing project definition, development, and execution plans for the scaling of pilot biofuel and bioproduct technologies to demonstration scale including for:

- the manufacturing of sustainable aviation fuel⁶², renewable diesel⁶³, sustainable marine fuel⁶⁴, and/or sustainable rail fuel⁶⁵;
- novel process technologies that leverage existing first generation, grain starch, biorefinery assets and infrastructure; and/or
- novel process technologies that leverage US-produced, oilseed crops (see Appendix G) that meet all other metrics of the topic area, including achieving at least 50% GHG reductions. This can include the utilization of oil-seed cover crops, the co-processing of intermediates and oilseed oils, blending of SAFs from various feedstocks, among other innovative concepts.

Topic Area 3 is broken into two separate Subtopic Areas. The first, Subtopic Area 3a: Demonstration Scale – Preliminary Design and Phased Construction, is intended for projects that have all requisite prior scale data and are ready to design a demonstration facility. Projects selected under Subtopic Area 3a will have an opportunity to construct and operate their designed demonstration facility based on the down-select process described below in Subtopic Area 3a. The second, Subtopic Area 3b: Demonstration Scale – Final Design and Construction, is intended for projects that have completed the design of the demonstration scale facility, whether that design was funded through past DOE funding or not. Selected Subtopic Area 3b projects will be subject to an initial verification and DOE review to approve start of construction, also known as Critical Decision 3 per DOE Order 413.3b⁶⁶.

Topic Area 3 will provide the ability for piloted technologies to scale to demonstration scale. Demonstration scale facilities developed under Topic Area 3 must produce at the plant's rated capacity, a minimum quantity of 1,000,000

⁶² See Glossary (Appendix D) for sustainable aviation fuel (SAF) definition as it pertains to this FOA.

⁶³ See Glossary (Appendix D) for renewable diesel definition as it pertains to this FOA.

⁶⁴ See Glossary (Appendix D) for sustainable marine fuel definition as it pertains to this FOA.

⁶⁵ See Glossary (Appendix D) for sustainable rail fuel definition as it pertains to this FOA.

⁶⁶ <https://www.directives.doe.gov/directives-documents/400-series/0413.3-BOrder-b/@@images/file>

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gallons per year of liquid biobased hydrocarbon fuel for aviation, marine, rail, or long-haul trucking applications.

Scale-up and integrated operations of these process technologies is essential to enable the industry to build future demonstration, pioneer, and commercial scale facilities. Successfully scaling and operating process technology is critical for biotechnologies to remain a significant near-term decarbonization pathway. Applications submitted under Topic Area 3 must meet a minimum neat biofuel throughput of 1,000,000 gallons per year equivalent. Proposed technologies must meet 50% GHG reduction relative to the petroleum-derived alternative. **Although 50% GHG reduction is the minimum allowable, applications with greater GHG reductions are highly encouraged and may receive preference by way of a Program Policy Factor (section V.C.i).** The minimum baseline technology readiness level for projects submitted under this topic is TRL 5 with a maximum of TRL 7 at the conclusion of the project. As such, the following metrics will be required for award:

Table 8: Topic Area 3 Minimum Requirements

Metric:	Minimum:
Fuel Type	sustainable aviation fuel ⁶⁷ , renewable diesel ⁶⁸ , sustainable marine fuel ⁶⁹ , and/or sustainable rail fuel ⁷⁰
Fuel Selling Price	Cost competitive with petroleum-based fuels (model TEA for n th plant)
Cumulative Time on Stream	1,000 hours
Continuous Time on Stream	1,000 hours
Throughput Equivalent	1,000,000 gallons of biofuel per year equivalent
GHG Reductions	50%
Allowable Feedstocks ⁷¹	Lignocellulosic Feedstocks, Algae, Organic Wet Waste, Sorted Municipal Solid Waste, Food Waste, Biogas, Grain Starch, Oilseed Crops, C&D Waste, Waste CO ₂ , and CO ₂ by Direct Air Capture

⁶⁷ See Glossary (Appendix D) for sustainable aviation fuel (SAF) definition as it pertains to this FOA.

⁶⁸ See Glossary (Appendix D) for renewable diesel definition as it pertains to this FOA.

⁶⁹ See Glossary (Appendix D) for sustainable marine fuel definition as it pertains to this FOA.

⁷⁰ See Glossary (Appendix D) for sustainable rail fuel definition as it pertains to this FOA.

⁷¹ see Appendix G for feedstock definitions

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ix. Subtopic Area 3a: Demonstration Scale-Up of Integrated Biorefineries (Preliminary Design and Phased Construction)

Subtopic Area 3a is intended for projects that have all requisite prior scale data and are ready to design a biofuels demonstration facility. Projects selected under Subtopic Area 3a may have an opportunity to construct and operate their designed demonstration facility subject to the down-select process described in detail below. Only projects selected following the down-select process will be eligible to proceed into a final design/construction/operation phase.

Topic Area 3a Project and Award Structure

Given the high cost and complexity of demonstration scale projects, awards under Subtopic Area 3a will only be funded for design work as depicted in Table 9: Subtopic Area 3a Award Structure below. Subtopic Area 3a consists of an extended 12-18 month Verification & Design Basis Definition phase to verify prior scale data and readiness to proceed. Up to \$2,000,000 of federal funds will be made available for each Phase 1 project. A minimum of 50% cost share is required for Subtopic Area 3a.

Table 9: Subtopic Area 3a Award Structure

Phases	Budget Periods	Scope
Phase 1 – Verification & Design Basis Definition (12-18 Months) Up to \$2M federal	BP1	Verification of baseline data presented in application
	Go/No-Go Review of Verification outcome	
	BP2	Design Basis Definition
Down-select (CD-2) Approve project scope and begin design (Subject to future appropriations)		
Phase 2 – Final Design, Construction, Operation (42-48 Months) Up to \$100M federal	BP3	Project Definition - preliminary planning and design
	Go/No-Go (CD-3) Review to approve start of construction	
	BP4	Project Execution - complete final design and construction
	Go/No-Go (CD-4) Performance test to verify readiness to begin operations	
	BP5	Operations

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When developing Phase 1 of their applications, Subtopic Area 3a Applicants should consider and base Phase 1 on a Phase 2 (Final Design, Construction, Operation) project for up to \$100,000,000 of federal funds plus a minimum of 50% Applicant cost-share. Only Phase 1 funds will be obligated at time of initial award. **Selection for Phase 1 award does not guarantee a Phase 2 award. Phase 2 funds are subject to future appropriations and availability of funds, which may be obligated to successful Phase 2 awards once a down-select occurs (see section VI.C.).**

Subtopic Area 3a Phase 1 Deliverables

At the end of Phase 1, a full design package will be reviewed and verified by DOE and their Independent Engineer. The full design package includes items like Process Design Basis Documents, Process Flow Diagrams, Mass and Energy Balances, budgetary estimates, and schedules. A more extensive list may be found in Appendix I.

Subtopic Area 3a Initial Project Verification

All Phase 1 projects will be subject to an initial verification effort to review their baseline and proposed targets and will result in a Go/No-Go decision (see Section VI.B.xiv). The verification will require that the Recipient conduct a performance test of the process proposed in its application. The performance test will require that the Recipient reproduce data sets commensurate to the prior scale work presented in the application. The prior scale data sets must be available to DOE, (which may include delivery to DOE), or its representatives (such as an Independent Engineer), for review in support of the verification effort. The outcome of this performance test will be a primary component of the Go/No-Go decision. Applicants should include this task within their proposed scope, schedule, and budget. It is anticipated that the initial verification can take up to six months; Applicants must include this task in their schedule as Budget Period 1. Applicants will be required to execute the appropriate Conflict of Interest and Non-disclosure Agreements (COI/NDA) with DOE's representatives immediately after negotiation and execution of an award. Failure to execute the COI/NDAs in a reasonable amount of time to enable the verification review will result in a 'No-Go' decision.

Subtopic Area 3a National Environmental Policy Act (NEPA) Considerations

Subtopic Area 3a project activities will be subject to NEPA review. Applicants should account for NEPA related efforts in the project scope, schedule, and

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budget. Phase 1 of each award will be limited in scope, as it will focus only on project development and design activities related to future pilot and demonstration scale integrated biorefineries. Under Phase 1, limited modifications to existing facilities to complete the prior scale data set may be allowed; construction of new facilities will not be allowed.

Any construction activities are prohibited for Subtopic Area 3a. See Sections IV.J.ii.1 and VI.B.vi for additional information on NEPA requirements. It should be noted that new construction or significant modification of an existing facility will likely trigger an Environmental Assessment or Environmental Impact Statement. Proper budgeting and scheduling should be accounted for within the proposed project's application.

Subtopic Area 3a Specific Requirements

The following requirements must be addressed in the application and the strength of the Applicant's discussion will be evaluated by the independent technical review panel for engineering and scientific merit (see evaluation criteria in Section V.A.ii.):

- Projects must meet or exceed all minimum metrics listed above in Table 8: Subtopic Area 3a Minimum Requirements.
- Applications submitted under Subtopic Area 3a are required to participate in the Verification Process as described in Section I.C.
- A Block Flow Diagram and Supplemental Data template are required as part of the application.
- Applications must contain techno-economic and life cycle analyses (TEA and LCA) that relate the key technical parameters of the proposed technology described in the proposal application to achieving a cost competitive MFSP and GHG reduction targets. Previously achieved values, scales, and durations should be delineated from the values necessary to meet the targeted MFSP so that the level of technology advancement needed is clear.
- Eligible applications must have a completed design of a demonstration scale biorefinery as described in Appendix I. This design should be discussed in the application but should not be submitted as part of the application. The design will be fully verified prior to the release of Federal funds.
- Scale-up factors⁷² per unit operation⁷³ can be no greater than 20x.

⁷² See Glossary (Appendix D) for scale-up factor definition as it pertains to this FOA.

⁷³ See Glossary (Appendix D) for unit operation definition as it pertains to this FOA.

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- All major equipment being utilized in the demonstration facility must be based on the equipment that will be used in the eventual commercial facility. For example, if a fluidized bed will be utilized in the commercial scale a fluidized bed must be utilized in the demonstration facility.
- Production of bioproducts as coproducts if essential for the overall economics of biofuel production. However, of all the carbon contained in the biofuels and coproducts, at least 50% must be in the biofuel(s). Higher percentages of utilizable carbon⁷⁴ found in the biofuels may be prioritized. Higher percentages of utilizable carbon found in the biofuels may be prioritized by use of a Program Policy Factor (section V.C.i).
- Biofuels must demonstrate a reasonable chance of receiving ASTM or other regulatory approvals as evidenced by substantial discussion in the narrative and inclusion of necessary tasks in the SOPO.
- Applications proposing co-processing with an existing petroleum refinery must address how at least 50% of the biogenic carbon would be converted to a biofuel and how this would be measured.
- Biofuels (and bioproducts) must be produced in the U.S.

Subtopic Area 3a Special Deliverables

In addition to the deliverables required in the Federal Assistance Reporting Checklist, the following deliverables are required for awards made under Subtopic Area 3a:

- Attendance and participation at the BETO Biennial Peer Review is required so that external subject matter experts can review project accomplishments and provide feedback to ensure optimal use of BETO funds.
- A publicly releasable final technical report describing how the technology would contribute to the BETO 2030 goal being cost competitive with petroleum-based fuels (model TEA for nth plant) with at least 70% reduction in greenhouse gas emissions relative to petroleum derived fuels.
- Recipients will be required to provide input for DOE's design cases (link to our latest State of Technology Report that discusses these design cases can be found at the link provided below) to refine the various program models (such as TEA and LCA) in an anonymous manner (permitting the data to be made publicly available).
 - (<https://www.energy.gov/sites/prod/files/2020/07/f76/beto-2019-state-of-technology-july-2020-r1.pdf>)

⁷⁴ See Glossary (Appendix D) for utilizable carbon definition as it pertains to this FOA.

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Subtopic Area 3a Applications Specifically Not of Interest

- Those identified in Section I.D. of the FOA;
- Applications that include major equipment, processes, and/or feedstocks that have yet to be piloted under the proposed process's relevant conditions.

All work under EERE funding agreements must be performed in the United States. See Section IV.J.iii. and Appendix C.

x. Subtopic Area 3b: Demonstration Scale-Up of Integrated Biorefineries (Final Design and Construction)

Subtopic Area 3b is intended for projects that are fully ready to build and operate a demonstration scale biorefinery. Eligible Applicants must have a completed full design package, whether that design was funded through past DOE funding or not. A full design package includes items like Process Design Basis Documents, Process Flow Diagrams, Mass and Energy Balances, budgetary estimates, and schedules. A more extensive list may be found in Appendix I. Unlike Subtopic Area 3a, recipients under Subtopic Area 3b will not be subject to the down-select process. A partial or full federal share of the award will be obligated at the time of initial award, up to \$100,000,000.

Subtopic Area 3b Project and Award Structure

Subtopic Area 3b Applicants must have already completed a full design package for their demonstration plant and are ready to move past Critical Decision 3 (CD-3 per DOE Order 413.3b⁷⁵). The design package will be reviewed and verified by a DOE Independent Engineer (Budget Period 1) and will culminate in the Go/No-Go Critical Decision 3 (CD-3) review to approve/disapprove the start of construction. Upon successful passage through CD-3, Subtopic Area 3b recipients will be allowed to move into the project execution stage (Budget Period 2). Budget Period 3 should include a start-up and commissioning step. In DOE's experience, this step can take anywhere from 6-18 months for demonstration scale projects. This award structure is shown in Table 10: Subtopic Area 3b Award Structure on the following page.

⁷⁵ https://www.directives.doe.gov/terms_definitions/cd-3-approve-start-of-construction

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Table 10: Subtopic Area 3b Award Structure

Title	Budget Periods	Scope
Construction and Operation (42-48 Months) Up to \$100M federal	BP1	Verification of Design Package and Readiness to Proceed
	Go/No-Go (CD-3) Review to approve start of construction	
	BP2	Project Execution - complete final design and construction
	Go/No-Go (CD-4) Performance test to verify readiness to begin operations	
	BP3	Operations

Subtopic Area 3b Initial Project Verification

All Subtopic Area 3b projects will be subject to an initial verification effort to review their full design package and will result in a Go/No-Go decision (see Section VI.B.xiv). The verification will require that the Recipient conduct a performance test of the process proposed in its application at prior scale. The verification test will require that the Recipient reproduce data sets commensurate to the prior scale work presented in the application and full data package. The prior scale data sets must be available to DOE, (which may include delivery to DOE), or its representatives (such as an Independent Engineer), for review in support of the verification effort. The outcome of this performance test will be a primary component of the CD-3 Go/No-Go decision. Applicants should include this task within their proposed scope, schedule, and budget. It is anticipated that the initial verification can take up to six months; Applicants must include this task in their schedule as Budget Period 1. Applicants will be required to execute the appropriate Conflict of Interest and Non-disclosure Agreements (COI/NDA) with DOE's representatives immediately after negotiation and execution of an award. Failure to execute the COI/NDAs in a reasonable amount of time to enable the verification review will result in a 'No-Go' decision. Projects that receive a 'Go' decision at the conclusion of the initial verification effort and proceed to Budget Period 2 may also be subject to a final verification review.

Subtopic Area 3b National Environmental Policy Act (NEPA) Considerations

All Subtopic Area 3b project activities will be subject to NEPA review. Applicants should account for NEPA related efforts in the project scope, schedule, and budget. Budget Period 1 of each award will be limited in scope, as it will focus only on the initial verification and potential NEPA requirements for subsequent budget

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periods. Construction of new facilities will not be allowed in Budget Period 1. Any construction activities will be restricted to Budget Period 2. DOE will complete additional NEPA review for Budget Period 2 activities. See Sections IV.J.ii.1 and VI.B.vi for additional information on NEPA requirements. It should be noted that new construction or significant modification of an existing facility will likely trigger an Environmental Assessment or Environmental Impact Statement. Proper budgeting and scheduling should be accounted for within the proposed project's application.

Subtopic Area 3b Additional Financial Requirements

In addition to verifying the full design package in Budget Period 1, recipients must demonstrate their financial readiness to proceed into Budget Period 2. This includes demonstrating the ability to provide all required cost share and contingency prior to entering each phase of the project. Recipients are required to secure all cost share and contingency prior to proceeding into the next budget period. Throughout the award life cycle, DOE will review and monitor the financial capability of the Recipient and other key organizations within the project team, such as parent companies or cost share providers. DOE may also conduct pre-award accounting system audits, financial capability reviews, or reviews of financial or compliance audits.

A contingency reserve is required for all Budget Period 2 and 3 activities. DOE experience and industry best practice show that a minimum of 25% of Total Project Cost (federal share and cost share) of Budget Period 2 and 3 costs is necessary to allow the project to continue when unexpected expenses are encountered. Recipients must demonstrate that they can meet the financial needs of the project. The full design package for Budget Period 2 must also include documentation showing that the Recipient has access to this minimum 25% required contingency. Contingency funds must be: (a) liquid, (b) immediately available, and (c) unrestricted funds dedicated exclusively to the project for the purpose of mitigating project performance baseline risk. The contingency reserve is in addition to Total Project Costs and cannot count towards cost share, until expended. If expended, the contingency will not result in reimbursement by DOE above the total federal share approved in the award. DOE discourages Recipients from reducing scope to comply with the contingency reserve requirement.

Subtopic Area 3b Specific Requirements

The following requirements must be addressed in the application and the strength of the Applicant's discussion will be evaluated by the independent technical review panel for engineering and scientific merit (see evaluation criteria in Section V.A.ii.):

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- Projects must meet or exceed all minimum metrics listed above in Table 8: Topic Area 3 Minimum Requirements.
- Applications submitted under Subtopic Area 3b are required to participate in the Verification Process as described in Section I.C.
- A Block Flow Diagram and Supplemental Data template are required as part of the application.
- Applications must contain techno-economic and life cycle analyses (TEA and LCA) that relate the key technical parameters of the proposed technology described in the proposal application to achieving a cost competitive MFSP and GHG reduction targets. Previously achieved values, scales, and durations should be delineated from the values necessary to meet the targeted MFSP so that the level of technology advancement needed is clear.
- Eligible applications must have a completed design of a demonstration scale biorefinery as described in Appendix I. This design should be discussed in the application but should not be submitted as part of the application. The design will be fully verified prior to the release of Federal funds.
- Scale-up factors⁷⁶ per unit operation⁷⁷ can be no greater than 20x.
- All major equipment being utilized in the demonstration must be based on the equipment that will be used in the eventual commercial facility. For example, if a fluidized bed will be utilized in the commercial scale a fluidized bed must be utilized in the demonstration facility.
- Subtopic Area 3b allows for production of bioproducts as coproducts if essential for the overall economics of biofuel production. However, of all the carbon contained in the biofuels and coproducts, at least 50% must be in the biofuel(s). Higher percentages of utilizable carbon⁷⁸ found in the biofuels may be prioritized. Higher percentages of utilizable carbon found in the biofuels may be prioritized by use of a Program Policy Factor (section V.C.i).
- Biofuels must demonstrate a reasonable chance of receiving ASTM or other regulatory approvals as evidenced by substantial discussion in the narrative and inclusion of necessary tasks in the SOPO.
- Applications proposing co-processing with an existing petroleum refinery must address how at least 50% of the biogenic carbon would be converted to a biofuel and how this would be measured, as evidenced by substantial discussion in the narrative and inclusion of necessary tasks in the SOPO.

⁷⁶ See Glossary (Appendix D) for scale-up factor definition as it pertains to this FOA.

⁷⁷ See Glossary (Appendix D) for unit operation definition as it pertains to this FOA.

⁷⁸ See Glossary (Appendix D) for utilizable carbon definition as it pertains to this FOA.

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- Applications cannot include greater than 10% of the total project budget for earlier stage R&D (<TRL 4), including expenses for equipment, salaries, and supplies.
- Biofuels (and bioproducts) must be produced in the U.S.
- Unlike Subtopic Area 3a, recipients under Subtopic Area 3b will not be subject to the down-select process since their projects should be near or ready for CD-3 at selection.

Subtopic Area 3b Special Deliverables

In addition to the deliverables required in the Federal Assistance Reporting Checklist, the following deliverables are required for awards made under Subtopic Area 3b:

- Attendance and participation at the BETO Biennial Peer Review is required so that external subject matter experts can review project accomplishments and provide feedback to ensure optimal use of BETO funds.
- A publicly releasable final technical report describing how the technology would contribute to the BETO 2030 goal being cost competitive with petroleum-based fuels (model TEA for nth plant) with at least 70% reduction in greenhouse gas emissions relative to petroleum derived fuels.
- Recipients will be required to provide input for DOE's design cases (link to our latest State of Technology Report that discusses these design cases can be found at the link provided below) to refine the various program models (such as TEA and LCA) in an anonymous manner (permitting the data to be made publicly available).
 - (<https://www.energy.gov/sites/prod/files/2020/07/f76/beto-2019-state-of-technology-july-2020-r1.pdf>)

Subtopic Area 3b Applications Specifically Not of Interest

- Those identified in Section I.D. of the FOA;
- Applications that do not demonstrate the Applicants have performed design safety review, process hazard analysis, risk assessment and management; and
- Applications that include major equipment, processes, and/or feedstocks that have yet to be piloted under the proposed process's relevant conditions

All work under EERE funding agreements must be performed in the United States. See Section IV.J.iii. and Appendix C.

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xi. Topic Area 4: First Generation (Gen-1) Corn Ethanol Emission Reduction

The existing U.S. ethanol industry has sufficient existing capacity to produce 17.6 billion gallons of ethanol and reduce GHG emissions by approximately over 42.7 million metric tons (CO₂-eq) per year – or approximately 2% of total U.S.⁷⁹ transportation emissions. The over 200 U.S. ethanol plants supported 68,600 jobs as recently as 2019⁸⁰—many in rural areas. Existing technologies and agricultural practices have the potential to make significant improvements in the reduction of lifecycle GHG of fuel ethanol from approximately 40% today to 71.6% as compared to petroleum baseline⁸¹. Topic Area 4 will analyze or demonstrate strategies to lower GHG emissions and Carbon Intensity (CI) within existing the Gen-1 corn ethanol industry such as low-carbon agricultural practices, switching to renewable process heat and power (i.e., renewable natural gas, or biomass), utilization of process produced CO₂, and new productivity or conversion efficiency measures in ethanol facilities. Projects should further the development of technologies that address BETO's goals for reductions in GHG emissions with an eye toward mitigating project risk and enabling future industrial deployment. Partnering with Gen-1 ethanol facilities will demonstrate industry interest in the proposed technology.

Topic Area 4 is broken out into two distinct Subtopic Areas. Subtopic Area 4a focuses on the development of feasibility studies to analyze the technoeconomic and lifecycle emissions benefits of proposed technologies. Subtopic Area 4b will scale technologies to reduce Gen-1 emissions to the pre-pilot level.

xii. Subtopic Area 4a: Gen-1 Corn Ethanol Emission Reduction: Feasibility Studies

Topic Area 4a seeks projects that create feasibility studies or models to assess the technical viability and costs associated with implementing a new GHG emission reduction technology into the corn-to-ethanol chain. Project teams must include an industry partner, either corn farming or ethanol production related, in order to utilize real world processes and data in their studies. However, teams must have a rigorous technoeconomic analysis (TEA) and verify the lifecycle GHG benefits allowing for sufficient geographical and technical diversity to provide a representative sample of replicable cases to catalyze widespread adoption. Projects are encouraged to utilize predictive modeling and high-performance

⁷⁹ Lewandrowski, J, J. Rosenfeld, D. Pape, T. Hendrickson, K. Jaglo, & K. Moffroid. 2020. The greenhouse gas benefits of corn ethanol – assessing recent evidence. *Biofuels*, 11:3, 361-375

⁸⁰ Focus Forward: 2020 Ethanol Industry Outlook. Renewable Fuels Association, 2020, 2020-Outlook-Final-for-Website.pdf (ethanolrfa.org)

⁸¹ Lewandrowski, J, J. Rosenfeld, D. Pape, T. Hendrickson, K. Jaglo, & K. Moffroid. 2020. The greenhouse gas benefits of corn ethanol – assessing recent evidence. *Biofuels*, 11:3, 361-375

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computing to accelerate and optimize their unit operation(s) design(s). Lowering scale-up risk for these processes will contribute to the BETO 2030 goal of at least 70% reduction in greenhouse gas emissions relative to petroleum-derived fuels.

Anticipated Approaches for Subtopic Area 4a Include, but are Not Limited To

- Feasibility studies using one or a cluster of industry specific corn farms;
- Feasibility studies using one or a cluster of ethanol facilities;
- Applications that use waste and underutilized carbon feedstocks⁸²;
- Carbon capture and utilization technologies;
- Biorefinery technologies taking advantage of existing assets and infrastructure, such as bolt-on and retrofit technologies;
- The inclusion of bioproducts is allowable;
- Applications that include industrial collaboration and partnerships for all aspects of the proposed process from farm to fuel;
- Applications that include safety consideration in design and operation as a first priority;
- Applicants are encouraged to work closely with equipment/technology manufacturers, catalyst manufacturers, enzyme suppliers, and/or downstream and upstream process owners to ensure the feedstocks, processes, equipment, and catalyst employed in the proposed project are available and that assumptions within the application are reasonable; and
- Development of predictive models and high-performance computing as tools to accelerate scale-up.

Subtopic Area 4a Specific Requirements

The following requirements must be addressed in the application and the strength of the Applicant's discussion will be evaluated by the independent technical review panel for engineering and scientific merit (see evaluation criteria in Section V.A.ii.):

- Project teams must include at least one Gen-1 Ethanol Producer.
- Applications must contain techno-economic and life cycle analyses (TEA and LCA) that relate the key technical parameters of the proposed technology described in the proposal application to achieving a cost competitive MFSP and GHG reduction targets. Previously achieved values, scales, and durations should be delineated from the values necessary to meet the targeted MFSP so that the level of technology advancement needed is clear.

⁸² <https://www.energy.gov/eere/bioenergy/waste-energy>

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- If a biofuel, other than the Gen-1 ethanol, is being produced as part of the application it must be a sustainable aviation fuel⁸³, renewable diesel⁸⁴, sustainable marine fuel⁸⁵, and/or sustainable rail fuel⁸⁶.
- Use of an allowable feedstock(s) as defined in Appendix G
- A Block Flow Diagram and Supplemental Data template are required as part of the application.

Subtopic Area 4a Special Deliverables

In addition to the deliverables required in the Federal Assistance Reporting Checklist, the following deliverables are required for awards made under Subtopic Area 4a:

- Attendance and participation at the BETO Biennial Peer Review is required so that external subject matter experts can review project accomplishments and provide feedback to ensure optimal use of BETO funds.
- A publicly releasable final technical report describing how the technology would contribute to the reduction of feedstock carbon intensity and to the BETO 2030 goal being cost competitive with petroleum-based fuels (model TEA for nth plant) with at least 70% reduction in greenhouse gas emissions relative to petroleum derived fuels.
- Recipients will be required to provide input for DOE's design cases (link to our latest State of Technology Report that discusses these design cases can be found at the link provided below) to refine the various program models (such as TEA and LCA) in an anonymous manner (permitting the data to be made publicly available).
 - (<https://www.energy.gov/sites/prod/files/2020/07/f76/beto-2019-state-of-technology-july-2020-r1.pdf>)

Subtopic Area 4a Applications Specifically Not of Interest

- Those identified in Section I.D. of the FOA;
- Proposals that include Carbon Capture and Sequestration (CCS) technologies. Carbon Capture and Utilization are allowable under this FOA.

All work under EERE funding agreements must be performed in the United States. See Section IV.J.iii. and Appendix C.

⁸³ See Glossary (Appendix D) for sustainable aviation fuel (SAF) definition as it pertains to this FOA.

⁸⁴ See Glossary (Appendix D) for renewable diesel definition as it pertains to this FOA.

⁸⁵ See Glossary (Appendix D) for sustainable marine fuel definition as it pertains to this FOA.

⁸⁶ See Glossary (Appendix D) for sustainable rail fuel definition as it pertains to this FOA.

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xiii. Subtopic Area 4b: Gen-1 Corn Ethanol Emission Reduction: Pre-Pilot

Subtopic Area 4b will scale up key process steps, within the corn-to-ethanol chain, that are ready to move out of the laboratory scale (TRL 3 or 4) and into industrially relevant environments (TRL 5). The proposed unit operation(s) within an application are not required to comprise a fully integrated pilot scale unit (TRL 6) by the end of the project, but rather can be utilized to support future integration of the entire process at pilot or demonstration scale. Engineering solutions for the key process steps may include single or multiple unit operations, moving from batch to continuous operation, utilizing real-world fertilizers, feed or recycle streams, as well as specialized engineering scale equipment all aimed at lowering emissions or carbon intensity. Applicants to Subtopic Area 4b will be required to demonstrate proof of technology success at the laboratory scale and provide a market justification for further system scaling. Partnering with first generation ethanol producers is mandatory to demonstrate industry interest in the proposed technology. Projects are encouraged to utilize predictive modeling and high-performance computing to accelerate and optimize their unit operation(s) design(s). Lowering scale-up risk for these processes will contribute to the BETO 2030 goal of at least 70% reduction in greenhouse gas emissions relative to petroleum-derived fuels. The following metrics will be required for award:

Table 11: Subtopic Area 4b – Gen-1 Corn EtOH Emission Reduction: Pre-pilot Requirements

Metric:	Minimum:
Carbon Intensity (CI) Reduction	3.58 gCO ₂ e/MJ, which equates to 5% CI reduction of a typical corn ethanol, preference may be shown for larger GHG reductions.
Applications Proposing Conversion Facility Processes	
Cumulative Time on Stream	500 hours
Continuous Time on Stream	100 hours
Throughput Equivalent	0.5 DTPD equivalent; or 8 MMBTU/day of biogas equivalent; or 35 gallons/day of final fuel equivalent for processes that utilize CO ₂ as a feed
Allowable Feedstocks (see Appendix G)	Lignocellulosic Feedstocks, Algae, Organic Wet Waste, Sorted Municipal Solid Waste, Food Waste, Biogas, Grain Starch, Oilseed Crops, and Waste CO ₂
Applications Proposing Field Studies	
Number of Plots	3 plots
Growing Seasons	3 seasons

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Anticipated Approaches for Subtopic Area 4b Include, but are Not Limited To

- Hardware testing in an ethanol facility;
- Farming practice study at the corn growing site;
- Applications that use waste streams and underutilized carbon feedstocks⁸⁷;
- Carbon capture and utilization technologies;
- Biorefinery technologies taking advantage of existing assets and infrastructure, such as bolt-on and retrofit technologies;
- Applications that include industrial collaboration and partnerships for all aspects of the proposed process from farm to fuel;
- Applications that include safety consideration in design and operation as a first priority;
- Applicants are encouraged to work closely with equipment/technology manufacturers, catalyst manufacturers, enzyme suppliers, and/or downstream and upstream process owners to ensure the feedstocks, processes, equipment, and catalyst employed in the proposed project are available and that assumptions within the application are reasonable; and
- Development of predictive models and high-performance computing as tools to accelerate scale-up.

Subtopic Area 4b Specific Requirements

The following requirements must be addressed in the application and the strength of the Applicant's discussion will be evaluated by the independent technical review panel for engineering and scientific merit (see evaluation criteria in Section V.A.ii.):

- Projects must meet or exceed all minimum metrics listed above in the Subtopic Area 4b – Gen-1 Corn Ethanol Emission Reduction: Pre-pilot Requirements Table 11.
- Biofuels (and bioproducts) must be produced domestically in the U.S.
- Project teams must include at least one Gen-1 Ethanol Producer.
- Applications must contain techno-economic and life cycle analyses (TEA and LCA) that relate the key technical parameters of the proposed technology described in the proposal application to achieving a cost competitive MFSP and GHG reduction targets. Previously achieved values, scales, and durations should be delineated from the values necessary to meet the targeted MFSP so that the level of technology advancement needed is clear.

⁸⁷ <https://www.energy.gov/eere/bioenergy/waste-energy>

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- Applications must propose to deliver final TEA and LCA that incorporate the time on stream data generated in the conduct of the proposed project.
- If there are biofuels being produced by the proposed technology other than ethanol, they must be a sustainable aviation fuel, renewable diesel, and/or sustainable marine or rail fuel.
- Projects selected for negotiation of award will be subject to verification immediately after award approval, within budget period 1.
- A Block Flow Diagram and Supplemental Data template are required as part of the application.
- Production of bioproducts is allowable as coproducts if essential for the overall economics of biofuel production. However, of all the carbon contained in the biofuels (including Gen-1 ethanol being produced) and coproducts, at least 50% must be in the biofuel(s). Higher percentages of utilizable carbon found in the biofuels may be prioritized through the use of Program Policy Factors (see section V.C.i).
- Proposed biofuels must demonstrate a reasonable chance of receiving ASTM or other regulatory approvals, as evidenced by substantial discussion in the narrative and inclusion of necessary tasks in the SOPO.
- Applications cannot include greater than 10% of the total project budget for earlier stage research and development (R&D) (<TRL 4), including expenses for equipment, salaries, and supplies.

Subtopic Area 4b Special Deliverables

In addition to the deliverables required in the Federal Assistance Reporting Checklist, the following deliverables are required for awards made under Subtopic Area 4b:

- Applications submitted under Subtopic Area 4b are required to participate in the Verification Process as described in Section I.C.
- Attendance and participation at the BETO Biennial Peer Review is required so that external subject matter experts can review project accomplishments and provide feedback to ensure optimal use of BETO funds.
- A publicly releasable final technical report describing how the technology would contribute to the reduction of feedstock carbon intensity and to the BETO 2030 goal being cost competitive with petroleum-based fuels (model TEA for nth plant) with at least 70% reduction in greenhouse gas emissions relative to petroleum derived fuels.
- Recipients will be required to provide input for DOE's design cases (link to our latest State of Technology Report that discusses these design cases can be found at the link provided below) to refine the various program models

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(such as TEA and LCA) in an anonymous manner (permitting the data to be made publicly available).

- (<https://www.energy.gov/sites/prod/files/2020/07/f76/beto-2019-state-of-technology-july-2020-r1.pdf>)

Subtopic Area 4b Applications Specifically Not of Interest

- Those identified in Section I.D. of the FOA;
- Proposals that include Carbon Capture and Sequestration (CCS) technologies. Carbon Capture and Utilization are allowable under this FOA.

All work under EERE funding agreements must be performed in the United States. See Section IV.J.iii. and Appendix C.

C. Verifications

All applications selected for award negotiations under this FOA are required to participate in a verification process led by DOE's identified external third-party non-conflicted verification team. This team may be led by the National Renewable Energy Laboratory's Systems Integration team, DOE BETO's independent engineering contractor, or another non-conflicted BETO contractor. Personnel involved in verifications sign project specific Non-Disclosure Agreements and Conflict of Interest statements. This verification process provides technical assistance to both the DOE BETO and the project by providing an in-depth analysis of key technical and economic metrics to ensure transparency and increase the likelihood of project success.

The objectives of the verification effort are to:

- Verify the Applicant's technical data/performance metrics/targets as described in the original application.
- Establish a framework to evaluate and track progress over time so that the milestones and Go/No-Go decision points separating budget periods may be tracked and evaluated.
- Update or provide data in the Supplemental Content Requirements (see Appendix H).
- Establish benchmark, baseline, and associated target values.
- Identify potential major showstoppers and discuss risk mitigation strategies.
- Identify and address potential safety concerns. This is not intended to replace an organization's own hazard and safety analysis but instead to add another layer of safety.
- Align project goals with BETO's expectations.

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There are three types of verification periods throughout the lifetime of the project: the “Initial Verification,” conducted at the beginning of the project (months 0-3); the “Intermediate Verification(s),” conducted as a part of Go/No-Go decisions separating budget periods; and the “Final Verification,” conducted at the end of the project (within 3 months of closeout). The verification team will perform some or all of these verifications at the Recipient’s facility to initially verify the data included in the application or in negotiated Technical Datasheet, and subsequently in conjunction with site visits to monitor progress. Please note that Topic Areas 2 and 3 will not have “Intermediate Verifications”.

The specific objectives of these verifications are set forth below:

- The initial verification is to confirm the benchmark data and assumptions provided in the application, which will establish the project baseline against which future performance and cost improvements will be evaluated. During the initial verification, the verification team will work closely with the project team to discuss the project effort in detail; initiate the review of application 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 (or virtual) meeting. The project baseline will be set in this period, either through revision of the application data or by submission of additional/new data. The verification results are used by DOE at its sole discretion, among other factors, in making the Go/No-Go decision to proceed with Budget Period 2 (BP2). See Section II.A.ii. for information on period of performance and Go/No-Go decisions.
- An intermediate verification (Topic Area 1 only) will be conducted toward the end of BP2. The intermediate verification assesses progress towards the project’s BP2 Go/No-Go decision point and any targets established in the application, the initial verification, the achievement of the Statement of Project Objectives (SOPO) milestones in support of the Go/No-Go decision point, and any other factors contributing to progress toward the project objectives. The verification results are used by DOE at its sole discretion, among other factors, in making the Go/No-Go decision to proceed with BP3. In projects with more than 3 budget periods, additional interim verifications may be conducted.
- The final verification will be held prior to the end of the project. The objective of this final verification is to assess whether the final targets were achieved, document the challenges overcome, and record the technical or economic challenges that remain.

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Supplemental Content Requirements:

The Supplemental Content Requirements included with the FOA (Appendix H), were designed to guide Applicants in providing information to assess the technical validity of the technology being developed within the selected project.

Applications submitted without the appropriate supplemental content as defined in the Topic Area and Subtopic Area will be deemed non-responsive and excluded from further review under this FOA. In addition, the data provided will be used as the basis for review and discussion during the initial verification and will be considered the project's baseline. As such, it is expected the project will be able to reproduce this data when/if the verification team travels to the site to perform the verification. It is also expected the data will have been experimentally produced by the Applicant in the Applicant's facilities. For pre-pilot projects only, if literature data needs to be used for parts of the process, those metrics based on literature data should be marked appropriately.

Verification Timeline:

The initial verification period, including on-site observation of experiments (if applicable) and report creation, can take up to three months. Applicants must include this time in their schedule. Selected projects that receive a 'Go' decision at the conclusion of the initial verification effort will be subject to both an intermediate and a final verification. The time required for the intermediate and final verifications will be considerably less than the initial verification. However, the Applicant must also consider that time should be allocated to collect data for these verifications.

Verification Task:

All Applicants must include the initial verification 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 a three-month duration for the verification effort. This task, Task 1, will also be within a separate budget period, Budget Period 1 (BP1), from the remainder of the project. By way of example, the inclusion of the verification in the scope could include something like the following:

'Task 1. Initial Verification. At the beginning of the project, the baseline data and project targets provided in the Technical Tables will be experimentally verified. Process information and data will be provided to DOE (when applicable) to support the process claims within the original application. Technical metrics for project progress will be tailored to the project as needed.

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These metrics may include additional Go/No-Go decision points that will be incorporated into the overall project and Statement of Project Objectives (SOPO). Experiments will be conducted at the on-site verification visit to replicate the benchmark data provided in the application as described in the Technical Datasheet.

There will be a Go/No-Go associated with Task 1.1 as follows: Process information and data supporting the technology readiness level of the overall process, the unit operations within the process, and the original application. Technical metrics are based on preliminary data and represent a meaningful baseline and set of targets.

Upon successful completion of the initial verification effort and Go/No-Go decision point, the project will commence with work on the Priority Areas as discussed.

Similar provisions must be included for the Intermediate Verification as a task that will occur mid-way through the project (~18 months) and the final verification that will occur at the end of the project (within 3 months of completion).

Verification Conflict of Interest/Proprietary Information:

All of the technical and economic information requested will be disclosed to non-conflicted DOE National Renewable Energy Laboratory Systems Integration (NREL-SI) personnel and/or external third-party non-conflicted validators performing the verifications (BETO's verification team) as well as non-conflicted third-party reviewers potentially participating in the Go/No-Go review process and/or interim review meetings. It is expected that developments and advancements in technical performance made during the course of the project will be shared with the public via technical publications in journals or conference proceedings. It is also anticipated that the initial verification may, if necessary, involve pre-existing intellectual property of which DOE will not require publication. Data access, deliverables and dissemination requirements will be negotiated and set forth in the Statement of Project Objectives and will be consistent with Section VIII.L. of this FOA. DOE and those working on DOE's behalf, such as support service contractors, NREL personnel, Independent Engineers, validators, and reviewers, must be able to have sufficient access to these data, including but not limited to raw technical and financial data, to assess the baseline performance of the technology – subject to appropriate non-disclosure agreements or other protections.

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Verification Process:

The verification effort generally includes three steps: pre-verification, on-site verification (when applicable), and post-verification. The verification effort will be adapted to be appropriate for the technology readiness level and funding available to the project. However, the details provided below establish the framework for the process.

All steps are performed in concert with BETO's verification team and the project management team. During the pre-verification step, the verification team will work closely with the project team to discuss the effort in detail, initiate the review of the data from the Technical Datasheet and metrics 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. During the on-site verification meeting, the two 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, both teams will have the information needed to proceed forward. The post-verification step includes the verification team reporting to DOE and the DOE personnel working through the Go/No-Go decision point.

At the conclusion of the verification effort and once a Go/No-Go decision has been made, the DOE Technology Manager and Contracting Officer will send a formal document to the Recipient regarding the Go/No-Go decision and activities will proceed from there (based on the decision). If a 'Go' decision is reached, the project team and DOE Technology Manager will proceed with the necessary steps to release the remaining scope and associated funding for the project. A 'No-Go' decision may result in termination of the project or re-direction of scope.

Key Verification Requirements:

- During the initial verification effort (i.e., BP1), no additional experimental or project work, beyond that associated with the verification, may commence within the proposed scope. Only work associated with the verification – typically project management and data gathering activities – is allowed during the verification. The budget associated with the verification effort should correspond only to these types of activities and is typically minimal compared to the remaining project scope and budget.
- It is anticipated that the intermediate and final verifications will include the Recipient presenting the project progress toward the targets established during the initial verification. Both the intermediate and final verifications must be noted and accounted for within the scope, schedule, and budget, so

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that if a project is selected and receives a 'Go' decision at the conclusion of the initial verification effort, the schedule and budget will already account for the intermediate and final verifications.

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 that fall outside the technical parameters specified in Section I.A. and I.B. of the FOA;
- Applications for proposed technologies that are not based on sound scientific principles (e.g., violates the laws of thermodynamics);
- Applications identified in each Topic Area or Subtopic Area as "Applications Specifically Not of Interest" for that Topic Area or Subtopic Area;
- Applications that fail to include the required data and information specified in the Topic Area or Subtopic Area and any supplemental content requirements as defined in Appendix H;
- Applications that do not use an acceptable feedstock for the specific Topic Area or Subtopic Area as defined in Appendix G;
- Applications proposing to use non-domestically produced feedstocks. (i.e., feedstocks produced outside the U.S.);
- Applications that propose projects employing solely commercially available technologies;
- Applications proposing mock or ideal feedstocks and process streams;
- Applications whose primary product is biopower or heat;
- Applications whose primary fuel product is not intended for aviation, long-haul trucking, marine, or rail usage. Along with aviation, long-haul trucking, marine, and rail fuels, ethanol is an allowable product for Topic Area 4 applications only;
- Applications that propose the production of biodiesel; or
- Applications whose primary biofuel stream(s) are not a liquid at standard temperature and pressure (STP).

E. Authorizing Statutes

The programmatic authorizing statute is EAct 2005, § 931 as codified at 42 U.S.C. § 16231; EAct 2005 § 932, as codified at 42 U.S.C § 16232.

Awards made under this announcement will fall under the purview of 2 Code of Federal Regulation (CFR) Part 200 as amended by 2 CFR Part 910.

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II. Award Information

A. Award Overview

i. Estimated Funding

EERE expects to make a total of approximately \$59,000,000 of federal funding available for new awards under this FOA, subject to the availability of appropriated funds. EERE anticipates making approximately 4 to 20 awards under this FOA. EERE may issue one, multiple, or no awards. Individual awards may vary between \$500,000 and \$100,000,000. EERE may issue awards in one, multiple, or none of the following topic areas:

Subtopic Area Number	Subtopic Area Title (short hand)	Anticipated Number of Awards	Anticipated Minimum Award Size for Any One Individual Award (Fed Share)	Anticipated Maximum Award Size for Any One Individual Award (Fed Share)	Approximate Total Federal Funding Available for All Awards
1a	Pre-Pilot	1-3	\$1,000,000	\$2,000,000	An estimated federal share of \$49,000,000 of FY22 funds will be split across all three Topic Areas, 1, 2, and 3. Depending on the strength of applications, none, some, or all funding may be directed to a single subtopic.
1b	Pre-Pilot (CO2)	1-3	\$3,300,000	\$9,000,000	
2a	Pilot (Phase 1)	1-4	\$500,000	\$2,000,000	
2b	Pilot (Phase 2)	0-3	\$5,000,000	\$15,000,000	
3a	Demonstration (Phase 1)	1-4	\$500,000	\$2,000,000	If a demonstration project is selected under Subtopic Area 3b that exceeds the available fiscal year balance of funds, future Congressionally appropriated funding may be utilized to fund the remainder.
3b	Demonstration (Phase 2)	0-1	\$10,000,000	\$100,000,000	
4a	Gen-1 (Feasibility study)	2-5	\$250,000	\$500,000	\$10,000,000

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4b	Gen-1 (Pre-pilot)	1-2	\$4,000,000	\$9,000,000	Funding will be split between 4a and 4b depending on strength of applications.
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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.

For Subtopic Area 2a, Applicants should consider Phase 2 (Final Design, Construction, Operation) projects on the order of \$15,000,000 of federal funds plus a minimum of 50% Applicant cost-share when developing the Phase 1 proposal in their applications. Only Phase 1 funds will be obligated at time of initial award. Selection for Phase 1 award does not guarantee a Phase 2 award. Phase 2 funds are subject to future appropriations and availability of funds, which may be obligated to successful Phase 2 awards once a down-select occurs (see section VI.C.).

For Subtopic Area 3b, Applicants should consider Phase 2 (Final Design, Construction, Operation) projects no more than \$100,000,000 of federal funds plus a minimum of 50% Applicant cost-share when developing the Phase 1 proposal in their applications. Only Phase 1 funds will be obligated at time of initial award. Selection for Phase 1 award does not guarantee a Phase 2 award. Phase 2 funds are subject to future appropriations and availability of funds, which may be obligated to successful Phase 2 awards once a down-select occurs (see section VI.C.).

If a demonstration project is selected that exceeds the available fiscal year balance of funds, then out year funds may be utilized to fund the remainder.

ii. Period of Performance

EERE anticipates making awards that will run from 12 months up to 60 months in length, comprised of one or more budget periods. Project continuation will be contingent upon several elements, including satisfactory performance and Go/No-Go decision review. For a complete list, see Section VI.B.xiv. At the Go/No-Go decision points, EERE will evaluate project performance, project schedule adherence, the extent milestone objectives are met, compliance with reporting requirements, and overall contribution to the program goals and objectives. As a result of this evaluation, EERE may, at its discretion, authorize the following actions: (1) continue to fund the project, contingent upon the

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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.

Subtopic Area Number	Subtopic Area Title	Estimated Duration of Award (months)
1a	Pre-Pilot Scale-Up of Integrated Biorefinery Technologies	24-36
1b	Pre-Pilot Scale-Up of Integrated Biorefineries: Use of Carbon Dioxide from Ambient Air in Algal Systems	36-48
2a	Pilot Scale-Up of Integrated Biorefineries: Preliminary Design and Phased Construction	12
2b	Pilot Scale-Up of Integrated Biorefineries: Final Design and Construction	48-60
3a	Demonstration Scale-Up of Integrated Biorefineries: Preliminary Design and Phased Construction	12
3b	Demonstration Scale-Up of Integrated Biorefineries: Final Design and Construction	48-60
4a	Gen-1 Corn Ethanol Emission Reduction	12-24
4b	Gen-1 Corn Ethanol Emission Reduction	24-36

iii. **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.

However, if EERE has previously provided funding for a Recipient to develop a design for pilot or demonstration scale facilities, under a prior FOA or otherwise, that Recipient is eligible to apply for funding to implement the design under this FOA so long as the proposed application activity does not duplicate costs previously funded by EERE. EERE will not provide funding for any project costs previously funded by EERE.

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.

i. **Cooperative Agreements**

EERE generally uses cooperative agreements to provide financial and other support to prime recipients.

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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.ix of the FOA for more information on what substantial involvement may involve.

ii. Funding Agreements with Federally Funded Research and Development Center (FFRDCs)

In most cases, FFRDCs 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 eligibility requirements, it will be considered ineligible and removed from further evaluation.

A. Eligible Applicants

i. Individuals

U.S. citizens and lawful permanent residents are eligible to apply for funding as a prime recipient or subrecipient.

ii. 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 and have a physical location for business operations in 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.

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DOE/NNSA FFRDCs are eligible to apply for funding as a subrecipient, but are not eligible to apply as a prime recipient.

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.

iii. 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 and have a physical location for business operations in 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.

iv. 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

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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.

v. 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

Subtopic Areas 1a, 1b, 4a, and 4b: 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.)

Subtopic Areas 2a, 2b, 3a and 3b: The cost share must be at least 50% of the total allowable costs for demonstration projects (i.e., the sum of the government share,

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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.)

Subtopic Area Number	Subtopic Area Title	Cost Share Requirement
1a	Pre-Pilot Scale-Up of Integrated Biorefinery Technologies	20%
1b	Pre-Pilot Scale-Up of Integrated Biorefineries: Use of Carbon Dioxide from Ambient Air in Algal Systems	20%
2a	Pilot Scale-Up of Integrated Biorefineries: Preliminary Design and Phased Construction	50%
2b	Pilot Scale-Up of Integrated Biorefineries: Final Design and Construction	50%
3a	Demonstration Scale-Up of Integrated Biorefineries: Preliminary Design and Phased Construction	50%
3b	Demonstration Scale-Up of Integrated Biorefineries: Final Design and Construction	50%
4a	Gen-1 Corn Ethanol Emission Reduction	20%
4b	Gen-1 Corn Ethanol Emission Reduction	20%

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

i. 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. 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.

ii. 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.

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iii. Cost Share Types and Allowability

Every cost share contribution must be allowable under the applicable federal cost principles, as described in Section IV.J.i. 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. Cost share may be provided by the prime recipient, subrecipients, or third parties (entities that do not have a role in performing the scope of work). Vendors/contractors may not provide cost share. Any partial donation of goods or services is considered a discount and is not allowable.

Cash contributions include, but are not limited to: personnel costs, fringe costs, supply and equipment costs, indirect costs and other direct costs.

In-kind contributions are those where a value of the contribution can be readily determined, verified and justified but where no actual cash is transacted in securing the good or service comprising the contribution. Allowable in-kind contributions include but are not limited to: the donation of volunteer time or the donation of space or use of equipment.

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

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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 for additional cost sharing requirements.

iv. 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.

v. 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.

vi. 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). As FFRDC funding will be provided directly to the FFRDC(s) by DOE, prime recipients will be required to provide project cost share at a percentage commensurate with the FFRDC costs, on a budget period basis, resulting in a higher interim invoicing cost share ratio than the total award ratio.

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

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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, Full Applications, and Replies to Reviewer Comments must meet all compliance criteria listed below or they will be considered noncompliant. EERE will not review or consider noncompliant submissions, including Letters of Intent, 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 by the applicable deadline due to server/connection congestion.

i. Compliance Criteria

i. *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.

ii. *Full Applications*

Full Applications are deemed compliant if:

- The applicant submitted a compliant 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.

iii. *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.

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D. Responsiveness Criteria

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

E. Other Eligibility Requirements

i. 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 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 (WP) 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, the subrecipient’s, and the FFRDC’s portions of the project.

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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 scope of work to be performed by the FFRDC may not be more significant than the scope of work to be performed by the applicant.

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

Subtopic Areas 1a, 1b, 4a, and 4b:

An entity may submit more than one Concept Paper and Full Application to this FOA, provided that each application describes a unique, scientifically distinct project and provided that an eligible Concept Paper was submitted for each Full Application.

Subtopic Areas 2a, 2b, 3a and 3b:

An entity may only submit one Concept Paper and one Full Application to this FOA. The Concept Paper and Full Application must address no more than one topic area identified in Section I.B. of the FOA. If an entity submits more than one Concept Paper and Full Application, EERE will request a determination from the applicant's authorizing representative as to which application should be reviewed. Any other submissions received listing the same entity as the applicant will not be eligible for further consideration. This limitation does not prohibit an applicant from collaborating on other applications (e.g., as a potential subrecipient or partner) so long as the entity is only listed as the applicant on one Concept Paper and one Full Application submitted under this FOA.

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.

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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, or 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 EERE 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 Calibri 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;

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- 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; and
- 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, Full Applications, and Replies to Reviewer Comments 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, 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 to any of these documents, 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, Full Applications, and Replies to Reviewer Comments 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.ii. of the FOA.

i. 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 EERE 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 applicant should contact the EERE Exchange helpdesk for assistance (EERE-ExchangeSupport@hq.doe.gov). The EERE Exchange helpdesk and/or the EERE Exchange system administrators will assist applicants in resolving issues.

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Problems with EERE Exchange? Email EERE-ExchangeSupport@hq.doe.gov Include FOA name and number in subject line.

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:

TechnicalVolume_Part_1

TechnicalVolume_Part_2

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.

i. 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 announcement Topic Area being addressed (if applicable), both the technical and business points of contact, names of all team member organizations, and any statements regarding confidentiality.
Technology Description	4 pages maximum	Applicants are required to describe succinctly: <ul style="list-style-type: none"> The proposed technology, including its basic operating principles and how it is unique and innovative; 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);

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		<ul style="list-style-type: none">• 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• The impact that EERE funding would have on the proposed project.
Addendum	2 pages maximum	<p>Applicants are required to describe succinctly the qualifications, experience, and capabilities of the proposed Project Team, including:</p> <ul style="list-style-type: none">• Whether the Principal Investigator (PI) and Project Team have the skill and expertise needed to successfully execute the project plan;• Whether the applicant has prior experience which demonstrates an ability to perform tasks of similar risk and complexity;• Whether the applicant has worked together with its teaming partners on prior projects or programs; and• Whether the applicant has adequate access to equipment and facilities necessary to accomplish the effort and/or clearly explain how it intends to obtain access to the necessary equipment and facilities.• Applicants may provide graphs, charts, or other data to supplement their Technology Description.

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 posted on EERE Exchange at the close of that phase.

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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 on EERE Exchange 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 clicking the “Create Concept Paper” button in EERE Exchange, and should include that control number in the file name of their Full Application submission (i.e., *Control number_Applicant Name_TopicArea_Full Application*).

i. 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:

Topic Areas 1a, 1b, and 4b:

Component	File Format	Page Limit	File Name
Technical Volume	PDF	25	ControlNumber_LeadOrganization_TopicArea_TechnicalVolume
Resumes	PDF	1 page each	ControlNumber_LeadOrganization_TopicArea_Resumes
Letters of Commitment	PDF	1 page each	ControlNumber_LeadOrganization_TopicArea_LOCs
Statement of Project Objectives	MS Word	10	ControlNumber_LeadOrganization_TopicArea_SOPO
SF-424	PDF		ControlNumber_LeadOrganization_TopicArea_App424
Budget Justification Workbook	MS Excel		ControlNumber_LeadOrganization_TopicArea_Budget_Justification
Summary/Abstract for Public Release	PDF	1	ControlNumber_LeadOrganization_TopicArea_Summary
Summary Slide	MS Powerpoint	1	ControlNumber_LeadOrganization_TopicArea_Slide
Subrecipient Budget Justification	MS Excel		ControlNumber_LeadOrganization_TopicArea_Subrecipient_Budget_Justification
DOE Work Proposal for FFRDC, if applicable (see DOE O 412.1A, Attachment 3)	PDF		ControlNumber_LeadOrganization_TopicArea_WP
Authorization from cognizant Contracting Officer for FFRDC	PDF		ControlNumber_LeadOrganization_TopicArea_FFRDCAuth
SF-LLL Disclosure of Lobbying Activities	PDF		ControlNumber_LeadOrganization_TopicArea_SF-LLL
Foreign Entities and Foreign Work	PDF		ControlNumber_LeadOrganization_TopicArea_Waiver
Diversity, Equity, and Inclusion Plan	PDF	5	ControlNumber_LeadOrganization_TopicArea_DEIP
Current and Pending Support	PDF		ControlNumber_LeadOrganization_TopicArea_CPS
Block Flow Diagram and Supplemental Data*	MS Word, PDF	15	ControlNumber_LeadOrganization_TopicArea_BFD

*Reference Appendix H

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Topic Areas 2a and 2b:

Component	File Format	Page Limit	File Name
Technical Volume	PDF	40	ControlNumber_LeadOrganization_TopicArea_TechnicalVolume
Resumes	PDF	1 page each	ControlNumber_LeadOrganization_TopicArea_Resumes
Letters of Commitment	PDF	1 page each	ControlNumber_LeadOrganization_TopicArea_LOCs
Statement of Project Objectives	MS Word	10	ControlNumber_LeadOrganization_TopicArea_SOPO
SF-424	PDF		ControlNumber_LeadOrganization_TopicArea_App424
Budget Justification Workbook	MS Excel		ControlNumber_LeadOrganization_TopicArea_Budget_Justification
Summary/Abstract for Public Release	PDF	1	ControlNumber_LeadOrganization_TopicArea_Summary
Summary Slide	MS Powerpoint	1	ControlNumber_LeadOrganization_TopicArea_Slide
Subrecipient Budget Justification	MS Excel		ControlNumber_LeadOrganization_TopicArea_Subrecipient_Budget_Justification
DOE Work Proposal for FFRDC, if applicable (see DOE O 412.1A, Attachment 3)	PDF		ControlNumber_LeadOrganization_TopicArea_WP
Authorization from cognizant Contracting Officer for FFRDC	PDF		ControlNumber_LeadOrganization_TopicArea_FFRDCAuth
SF-LLL Disclosure of Lobbying Activities	PDF		ControlNumber_LeadOrganization_TopicArea_SF-LLL
Foreign Entities and Foreign Work	PDF		ControlNumber_LeadOrganization_TopicArea_Waiver
Diversity, Equity, and Inclusion Plan	PDF	5	ControlNumber_LeadOrganization_TopicArea_DEIP
Current and Pending Support	PDF		ControlNumber_LeadOrganization_TopicArea_CPS
Block Flow Diagram and Supplemental Data*	MS Word, PDF	25	ControlNumber_LeadOrganization_TopicArea_BFD
Proforma Cash Flow Analysis*	MS Excel, MS Word, PDF	5	ControlNumber_LeadOrganization_TopicArea_Proforma
Life Cycle Assessment*	MS Word, PDF	5	ControlNumber_LeadOrganization_TopicArea_LCA

**Reference Appendix H*

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Topic Areas 3a and 3b:

Component	File Format	Page Limit	File Name
Technical Volume	PDF	60	ControlNumber_LeadOrganization_TopicArea_TechnicalVolume
Resumes	PDF	1 page each	ControlNumber_LeadOrganization_TopicArea_Resumes
Letters of Commitment	PDF	1 page each	ControlNumber_LeadOrganization_TopicArea_LOCs
Statement of Project Objectives	MS Word	10	ControlNumber_LeadOrganization_TopicArea_SOPO
SF-424	PDF		ControlNumber_LeadOrganization_TopicArea_App424
Budget Justification Workbook	MS Excel		ControlNumber_LeadOrganization_TopicArea_Budget_Justification
Summary/Abstract for Public Release	PDF	1	ControlNumber_LeadOrganization_TopicArea_Summary
Summary Slide	MS Powerpoint	1	ControlNumber_LeadOrganization_TopicArea_Slide
Subrecipient Budget Justification	MS Excel		ControlNumber_LeadOrganization_TopicArea_Subrecipient_Budget_Justification
DOE Work Proposal for FFRDC, if applicable (see DOE O 412.1A, Attachment 3)	PDF		ControlNumber_LeadOrganization_TopicArea_WP
Authorization from cognizant Contracting Officer for FFRDC	PDF		ControlNumber_LeadOrganization_TopicArea_FFRDCAuth
SF-LLL Disclosure of Lobbying Activities	PDF		ControlNumber_LeadOrganization_TopicArea_SF-LLL
Foreign Entities and Foreign Work	PDF		ControlNumber_LeadOrganization_TopicArea_Waiver
Diversity, Equity, and Inclusion Plan	PDF	5	ControlNumber_LeadOrganization_TopicArea_DEIP
Current and Pending Support	PDF		ControlNumber_LeadOrganization_TopicArea_CPS
Block Flow Diagram and Supplemental Data*	MS Word, PDF	25	ControlNumber_LeadOrganization_TopicArea_BFD
Proforma Cash Flow Analysis*	MS Excel, MS Word, PDF	5	ControlNumber_LeadOrganization_TopicArea_Proforma
Life Cycle Assessment*	MS Word, PDF	5	ControlNumber_LeadOrganization_TopicArea_LCA

**Reference Appendix H*

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Topic Area 4a:

Component	File Format	Page Limit	File Name
Technical Volume	PDF	25	ControlNumber_LeadOrganization_TopicArea_TechnicalVolume
Resumes	PDF	1 page each	ControlNumber_LeadOrganization_TopicArea_Resumes
Letters of Commitment	PDF	1 page each	ControlNumber_LeadOrganization_TopicArea_LOCs
Statement of Project Objectives	MS Word	10	ControlNumber_LeadOrganization_TopicArea_SOPO
SF-424	PDF		ControlNumber_LeadOrganization_TopicArea_App424
Budget Justification Workbook	MS Excel		ControlNumber_LeadOrganization_TopicArea_Budget_Justification
Summary/Abstract for Public Release	PDF	1	ControlNumber_LeadOrganization_TopicArea_Summary
Summary Slide	MS Powerpoint	1	ControlNumber_LeadOrganization_TopicArea_Slide
Subrecipient Budget Justification	MS Excel		ControlNumber_LeadOrganization_TopicArea_Subrecipient_Budget_Justification
DOE Work Proposal for FFRDC, if applicable (see DOE O 412.1A, Attachment 3)	PDF		ControlNumber_LeadOrganization_TopicArea_WP
Authorization from cognizant Contracting Officer for FFRDC	PDF		ControlNumber_LeadOrganization_TopicArea_FFRDCAuth
SF-LLL Disclosure of Lobbying Activities	PDF		ControlNumber_LeadOrganization_TopicArea_SF-LLL
Foreign Entities and Foreign Work	PDF		ControlNumber_LeadOrganization_TopicArea_Waiver
Diversity, Equity, and Inclusion Plan	PDF	5	ControlNumber_LeadOrganization_TopicArea_DEIP
Current and Pending Support	PDF		ControlNumber_LeadOrganization_TopicArea_CPS

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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:

TechnicalVolume_Part_1

TechnicalVolume_Part_2

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.

ii. Technical Volume

The Technical Volume must be submitted in 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.ii. of the FOA. Save the Technical Volume in a single PDF file using the following convention for the title “ControlNumber_LeadOrganization_TopicArea_TechnicalVolume”.

Applicants must provide sufficient citations and references to the primary research literature to justify the claims and approaches made in the Technical Volume. However, EERE and reviewers are under no obligation to review cited sources.

The Technical Volume to the Full Application may not be more than the number of pages specified in the above section IV.D.i: Full Application Content Requirements, including the cover page, table of contents, and all citations, 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.ii. of the FOA) when preparing the Technical Volume.

The Technical Volume should clearly describe and expand upon information provided in the Concept Paper. The Technical Volume must conform to the following content requirements:

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SECTION/PAGE LIMIT	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, names of the senior/key personnel and their organizations, and any statements regarding confidentiality.
Project Overview (Approximately 10% of the Technical Volume)	The Project Overview should contain the following information: <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.
Technical Description, Innovation, and Impact (Approximately 30% of the Technical Volume)	The Technical Description should contain the following information: <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 results.• 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.
Workplan and Market Transformation Plan (Approximately 40% of the Technical Volume)	The Workplan should include a summary of the Project Objectives, Technical Scope, Work Breakdown Structure (WBS), Milestones, Go/No-Go Decision Points, and Project Schedule. A detailed SOPO is separately requested. The Workplan should contain the following information:

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	<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 performance periods that are separated by discrete, approximately annual decision points (see below for more information on Go/No-Go decision points). The applicant should describe the specific expected end result of each performance period. • 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 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). 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. • 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
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	<p>in future phases or periods of performance is evaluated, prior to actually beginning the execution of future phases. At a minimum, each project must have at least one project-wide Go/No-Go decision point for each budget period (12 to 18-month period) of the project. See Section VI.B.xiv. The applicant should also provide the specific technical criteria to be used to evaluate the project at the Go/No-Go decision point. 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.</p> <ul style="list-style-type: none">• End of Project Goal: The applicant should provide a summary of the end of project goal(s). At a minimum, 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○ 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○ The approach to project risk management○ A description of how project changes will be handled○ If applicable, the approach to Quality Assurance/Control○ How communications will be maintained among project team members• Market Transformation Plan: The applicant should provide a market transformation plan, including the following:<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
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	intellectual property, infrastructure requirements, data dissemination, and product distribution.
Technical Qualifications and Resources (Approximately 20% of the Technical Volume)	<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. • 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 senior/key personnel; ○ Business agreements between the applicant and each PI and senior/key personnel; ○ How the various efforts will be integrated and managed; ○ Process for making decisions on scientific/technical direction; ○ Publication arrangements; ○ Intellectual Property issues; and ○ Communication plans

iii. Resumes

A resume provides information that can be used by reviewers to evaluate the individual’s skills, experience, and potential for leadership within the scientific community. Applicants are required to submit one-page resumes for the Principal Investigator and all Senior/Key Personnel that include the following:

1. Contact Information;
2. Education and training: Provide institution, major/area, degree, and year for undergraduate, graduate, and postdoctoral training;
3. Research and Professional Experience: Beginning with the current position, list professional/academic positions in chronological order with

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a brief description. List all current academic, professional, or institutional appointments, foreign or domestic, at the applicant institution or elsewhere, whether or not remuneration is received, and, whether full-time, part-time, or voluntary;

4. Awards and honors;
5. A list of up to 10 publications most closely related to the proposed project. For each publication, identify the names of all authors (in the same sequence in which they appear in the publication), the article title, book or journal title, volume number, page numbers, year of publication, and website address if available electronically. Patents, copyrights, and software systems developed may be provided in addition to or substituted for publications. An abbreviated style such as the Physical Review Letters (PRL) convention for citations (list only the first author) may be used for publications with more than 10 authors; and
6. Synergistic Activities: List up to five professional and scholarly activities related to the proposed effort.

Save the resumes in a single PDF file using the following convention for the title "ControlNumber_LeadOrganization_TopicArea_Resumes".

In future FOAs, EERE may require a biographical sketch for the PI and senior/key personnel. In the meantime, in lieu of a resume, it is acceptable to use the biographical sketch format approved by the National Science Foundation (NSF). The biographical sketch format may be generated by the Science Experts Network Curriculum Vita (SciENcv), a cooperative venture maintained at <https://www.ncbi.nlm.nih.gov/sciencv/>, and is also available at <https://nsf.gov/bfa/dias/policy/nsfapprovedformats/biosketch.pdf>. The use of a format required by another agency is intended to reduce the administrative burden to researchers by promoting the use of common formats.

iv. Letters of Commitment

Submit letters of commitment from all subrecipient and third-party cost share providers. If applicable, also include any letters of commitment from partners/end users (one-page maximum per letter). Save the letters of commitment in a single PDF file using the following convention for the title "ControlNumber_LeadOrganization_TopicArea_LOCs".

v. Statement of Project Objectives (SOPO)

Applicants are required to complete a SOPO. A SOPO template is available on EERE Exchange at <https://eere-Exchange.energy.gov/>. The SOPO, including the Milestone Table, must not exceed pages listed in appropriate Full Application Content Requirements table above when printed using standard 8.5 x 11 paper

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with 1" margins (top, bottom, left, and right) with font not smaller than 12 point (except in figures or tables, which may be 10 point font). Save the SOPO in a single Microsoft Word file using the following convention for the title "ControlNumber_LeadOrganization_TopicArea_SOPO".

vi. 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_424".

vii. Budget Justification Workbook

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. 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_TopicArea_Budget_Justification".

viii. 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

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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_TopicArea_Summary”.

ix. Summary Slide

Applicants are required to provide a single slide summarizing the proposed project. This slide is used during the evaluation process.

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 senior/key personnel information; and
- Requested EERE funds and proposed applicant cost share.

Save the Summary Slide in a single Microsoft Powerpoint file using the following convention for the title “ControlNumber_LeadOrganization_TopicArea_Slide”.

x. Subrecipient Budget Justification (if applicable)

Applicants must provide a separate budget justification for each subrecipient 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 subrecipient budget justification in a Microsoft Excel file using the following convention for the title
“ControlNumber_LeadOrganization_Subrecipient_Budget_Justification”.

xi. 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 WP in accordance with the requirements in DOE Order 412.1A, Work Authorization System, Attachment 3, available at:
<https://www.directives.doe.gov/directives-documents/400-series/0412.1-BOrder-a-chg1-AdmChg> Save the WP in a single PDF file using the following convention for the title “ControlNumber_LeadOrganization_TopicArea_WP”.

xii. 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

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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_TopicArea_FFRDCAuth".

xiii. SF-LLL: Disclosure of Lobbying Activities (required)

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"

(<https://www.grants.gov/web/grants/forms/sf-424-individual-family.html>) to ensure that non-federal funds have not been paid and will not be paid to any person for influencing or attempting to influence any of the following in connection with the 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_TopicArea_SF-LLL".

xiv. Waiver Requests: Foreign Entity and Foreign Work (if applicable)

i. Foreign Entity Participation:

As set forth in Section III.A., 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 (Foreign Work Waiver)

As set forth in Section IV.J.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.

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Appendix C lists the necessary information that must be included in a foreign work waiver request.

Save the Waivers in a single PDF file using the following convention for the title "ControlNumber_LeadOrganization_TopicArea_Waiver".

xv. Diversity, Equity and Inclusion Plan

As part of the application, applicants are required to describe how diversity, equity, and inclusion objectives will be incorporated in the project. Specifically, applicants are required to submit a Diversity, Equity, and Inclusion Plan that describes the actions the applicant will take to foster a welcoming and inclusive environment, support people from groups underrepresented in STEM, advance equity, and encourage the inclusion of individuals from these groups in the project; and the extent the project activities will be located in or benefit underserved communities (also see Section I.A.iii.). The plan should include at least one SMART milestone per Budget Period supported by metrics to measure the success of the proposed actions, and will be incorporated into the award if selected. The Diversity, Equity, and Inclusion Plan should contain the following information:

- Equity Impacts: the impacts of the proposed project on underserved communities, including social and environmental impacts.
- Benefits: The overall benefits of the proposed project, if funded, to underserved communities; and
- How diversity, equity, and inclusion objectives will be incorporated in the project.

The following is a non-exhaustive list of actions that can serve as examples of ways the proposed project could incorporate diversity, equity, and inclusion elements. These examples should not be considered either comprehensive or prescriptive. Applicants may include appropriate actions not covered by these examples.

- a. Include persons from groups underrepresented in STEM as PI, co-PI, and/or other senior personnel;
- b. Include persons from groups underrepresented in STEM as student researchers or post-doctoral researchers;
- c. Include faculty or students from Minority Serving Institutions as PI/co-PI, senior personnel, and/or student researchers, as applicable;
- d. Enhance or collaborate with existing diversity programs at your home organization and/or nearby organizations;
- e. Collaborate with students, researchers, and staff in Minority Serving Institutions;

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-
- f. Disseminate results of research and development in Minority Serving Institutions or other appropriate institutions serving underserved communities;
 - g. Implement evidence-based, diversity-focused education programs (such as implicit bias training for staff) in your organization;
 - h. Identify Minority Business Enterprises, Minority Owned Businesses, Woman Owned Businesses and Veteran Owned Businesses to solicit as vendors and sub-contractors for bids on supplies, services and equipment.

The Diversity, Equity, and Inclusion Plan must not exceed 5 pages. Save the Diversity, Equity and Inclusion Plan in a single PDF file using the following convention for the title "ControlNumber_LeadOrganization_TopicArea_DEIP".

xvi. Current and Pending Support

Current and pending support is intended to allow the identification of potential duplication, overcommitment, potential conflicts of interest or commitment, and all other sources of support. As part of the application, the principal investigator and senior/key personnel at the applicant and subrecipient level must provide a list of all sponsored activities, awards, and appointments, whether paid or unpaid; provided as a gift with terms or conditions or provided as a gift without terms or conditions; full-time, part-time, or voluntary; faculty, visiting, adjunct, or honorary; cash or in-kind; foreign or domestic; governmental or private-sector; directly supporting the individual's research or indirectly supporting the individual by supporting students, research staff, space, equipment, or other research expenses. All foreign government-sponsored talent recruitment programs must be identified in current and pending support.

For every activity, list the following items:

- The sponsor of the activity or the source of funding
- The award or other identifying number
- The title of the award or activity. If the title of the award or activity is not descriptive, add a brief description of the research being performed that would identify any overlaps or synergies with the proposed research
- The total cost or value of the award or activity, including direct and indirect costs and cost share. For pending proposals, provide the total amount of requested funding
- The award period (start date – end date)
- The person-months of effort per year being dedicated to the award or activity

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If required to identify overlap, duplication of effort, or synergistic efforts, append a description of the other award or activity to the current and pending support.

Details of any obligations, contractual or otherwise, to any program, entity, or organization sponsored by a foreign government must be provided on request to either the applicant institution or DOE.

PIs and senior/key personnel must provide a separate disclosure statement listing the required information above regarding current and pending support. Each individual must sign and date their respective disclosure statement and include the following certification statement:

I, [Full Name and Title], certify to the best of my knowledge and belief that the information contained in this Current and Pending Support Disclosure Statement is true, complete and accurate. I understand that any false, fictitious, or fraudulent information, misrepresentations, half-truths, or omissions of any material fact, may subject me to criminal, civil or administrative penalties for fraud, false statements, false claims or otherwise. (18 U.S.C. §§ 1001 and 287, and 31 U.S.C. 3729-3730 and 3801-3812). I further understand and agree that (1) the statements and representations made herein are material to DOE's funding decision, and (2) I have a responsibility to update the disclosures during the period of performance of the award should circumstances change which impact the responses provided above.

The information may be provided in the format approved by the National Science Foundation (NSF), which may be generated by the Science Experts Network Curriculum Vita (SciENCv), a cooperative venture maintained at <https://www.ncbi.nlm.nih.gov/sciencv/>, and is also available at <https://www.nsf.gov/bfa/dias/policy/nsfapprovedformats/cps.pdf>. The use of a format required by another agency is intended to reduce the administrative burden to researchers by promoting the use of common formats. If the NSF format is used, the individual must still include a signature, date, and a certification statement using the language included in the paragraph above.

Save the Current and Pending Support in a single PDF file using the following convention for the title "ControlNumber_LeadOrganization_TopicArea_CPS".

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E. Content and Form of Replies to Reviewer Comments

If replies to reviewer comments are applicable, EERE will provide applicants with reviewer comments following the 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 the comments however they desire or supplementing their Full Application. The Reply to Reviewer Comments is an optional submission; applicants are not required to submit a Reply to Reviewer Comments. EERE will post the Reviewer Comments in EERE Exchange. The expected submission deadline is on the cover page of the FOA; however, it is the applicant's responsibility to monitor EERE Exchange 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 EERE Exchange 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. 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 (3) pages in length, EERE will review only the first three (3) pages and disregard any additional pages.

SECTION	PAGE LIMIT	DESCRIPTION
Text	2 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.

F. Post Selection Information Requests

If selected for award, EERE reserves the right to request additional or clarifying information regarding the following (non-exhaustive list):

- Personnel proposed to work on the project and collaborating organizations (See Section VI.B.xviii. Participants and Collaborating Organizations);
- Current and Pending Support (See Sections IV.E.xvii and VI.B.xix. Current and Pending Support);

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- An Intellectual Property Management Plan (if applicable) describing how the project team/consortia members will handle intellectual property rights and issues between themselves while ensuring compliance with federal intellectual property laws, regulations, and policies in accordance with VI.B.x Intellectual Property Management Plan;
- A Data Management Plan (if applicable) describing how all research data displayed in publications resulting from the proposed work will be digitally accessible at the time of publications, in accordance with Section VI.B.xxi.;
- 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; and
- Environmental Questionnaire.

G. Unique Entity Identifier (UEI) and System for Award Management (SAM)

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 SAM at <https://www.sam.gov> before submitting its application; (2) provide a valid UEI 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 UEI 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 will 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

All required submissions must be submitted in EERE Exchange no later than 5 p.m. Eastern Time on the dates provided on the cover page of this FOA.

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I. Intergovernmental Review

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

J. Funding Restrictions

i. 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:

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

ii. 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 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.

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

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

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limit the choice of reasonable alternatives prior to EERE completing the NEPA review process.

EERE does not guarantee or assume any obligation to reimburse pre-award costs incurred prior to receiving written authorization from the Contracting Officer. If the applicant elects to undertake activities that DOE determines 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 for their project 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. Likewise, if an application 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.

iii. Performance of Work in the United States (Foreign Work Waiver)

1. 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.

2. 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 whether the work is performed by the prime recipient, subrecipients, contractors or other project partners.

3. 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 foreign work waiver, the applicant must submit a written waiver request to EERE.

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Appendix C lists the necessary information that must be included in a request for a foreign work waiver.

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

iv. Construction

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

v. Foreign Travel

Topic Areas 1, 2, 3 and 4:

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.

vi. 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. For-profit entity disposition requirements are set forth at 2 CFR 910.360. Property disposition requirements for other non-federal entities are set forth in 2 CFR 200.310 – 200.316.

vii. Domestic Preference—Infrastructure Projects

As appropriate and to the extent consistent with law, Applicants shall ensure that, to the greatest extent practicable, iron and aluminum as well as steel, cement, and other manufactured products (items and construction materials

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composed in whole or in part of non-ferrous metals such as aluminum; plastics and polymer-based products such as polyvinyl chloride pipe; aggregates such as concrete; glass, including optical fiber; and lumber) used in the proposed project shall be produced in the United States. This requirement shall flow down to all sub-awards including all contracts, subcontracts and purchase orders for work performed under the proposed project.

viii. 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" (<https://www.grants.gov/web/grants/forms/sf-424-individual-family.html>) to ensure that non-federal funds have not been paid and will not be paid to any person for influencing or attempting to influence any of the following in connection with the 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.

ix. 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 Office of Management and Budget (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,

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suspended or otherwise excluded from or ineligible for participation in federal programs or activities.

x. 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; and
- Other items as required by DOE.

V. Application Review Information

A. Technical Review Criteria

i. Concept Papers

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

Concept Paper Criterion: Overall FOA Responsiveness and Viability of the Project (Weight: 100%)

This criterion involves consideration of the following factors:

- 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;
- The applicant has identified 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 applicant has the qualifications, experience, capabilities and other resources necessary to complete the proposed project; and
- The proposed work, if successfully accomplished, would clearly meet the objectives as stated in the FOA.

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ii. Full Applications

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

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

This criterion involves consideration of the following factors:

Technical Merit and Innovation

- Extent to which the proposed technology or process is innovative;
- Degree to which the current state of the technology and the proposed advancement are clearly described;
- Extent to which the application specifically and convincingly demonstrates how the applicant will move the state-of-the-art to the proposed advancement; and
- Sufficiency of technical detail in the application to assess whether the proposed work is scientifically meritorious and revolutionary, including relevant data, calculations and discussion of prior work in the literature with analyses that support the viability of the proposed work.

Impact of Technology Advancement

- How the project supports the topic area objectives and target specifications and metrics; and
- The potential impact of the project on advancing the state-of-the-art.

Criterion 2: Project Research and Market Transformation Plan (25%)

This criterion involves consideration of the following factors:

Research Approach, Workplan and SOPO

- Degree to which the approach and critical path have been clearly described and thoughtfully considered; and
- Degree to which the task descriptions are clear, detailed, timely, and reasonable, resulting in a high likelihood that the proposed Workplan and SOPO will succeed in meeting the project goals.

Identification of Technical Risks

- Discussion and demonstrated understanding of the key technical risk areas involved in the proposed work and the quality of the mitigation strategies to address them.

Baseline, Metrics, and Deliverables

- The level of clarity in the definition of the baseline, metrics, and milestones; and
- Relative to a clearly defined experimental baseline, the strength of the quantifiable metrics, milestones, and a mid-point deliverables defined in the application, such that meaningful interim progress will be made.

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Market Transformation Plan

- Identification of target market, competitors, and distribution channels for proposed technology along with known or perceived barriers to market penetration, including mitigation plan; and
- Comprehensiveness of market transformation 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, and product distribution.

Criterion 3: Team and Resources (15%)

This criterion involves consideration of the following factors:

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

Criterion 4: Diversity, Equity, and Inclusion (10%)

This criterion involves consideration of the following factors:

- The quality and manner in which the measures incorporate diversity, equity and inclusion goals in the project; and
- Extent to which the project benefits underserved communities.

iii. 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 "DOE Merit Review Guide for Financial Assistance," effective

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September 2020, which is available at:

<https://energy.gov/management/downloads/merit-review-guide-financial-assistance-and-unsolicited-proposals-current>.

C. Other Selection Factors

i. 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; and
- The degree to which the proposed project, or group of projects, represent a desired geographic distribution (considering past awards and current applications);
- The degree to which the proposed project incorporates diversity, equity, and inclusion elements, including but not limited to team members from Minority Serving Institutions (e.g. Historically Black Colleges and Universities (HBCUs)/Other Minority Institutions), Minority Business Enterprises, Minority Owned Businesses, Woman Owned Businesses, Veteran Owned Businesses, or members within underserved communities.
- The degree to which the proposed project's primary biofuel stream(s) contains the proposed process(es)'s utilizable biogenic carbon; and
- The degree to which the proposed project reduces Greenhouse Gas emissions when compared to the petroleum derived equivalent.

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D. Evaluation and Selection Process

i. 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.

ii. 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.iii. 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.

iii. 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

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already provided in the application documentation. The pre-selection clarifications may occur before, during or after the merit 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.

iv. 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 CFR 200.206.

v. 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.

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E. Anticipated Notice of Selection and Award Negotiation Dates

EERE anticipates notifying applicants selected for negotiation of award and negotiating awards by the dates provided on the cover page of this FOA.

VI. Award Administration Information

A. Award Notices

i. 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.

ii. Concept Paper Notifications

EERE will notify applicants of its determination to encourage or discourage the submission of a Full Application. EERE will post these notifications to 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 encouraging the submission of a Full Application does not authorize the applicant to commence performance of the project. Please refer to Section IV.J.ii. of the FOA for guidance on pre-award costs.

iii. 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

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Full Applications will be made at a later date, subject to the availability of funds or other factors.

iv. 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.ii. of the FOA for guidance on pre-award costs.

v. 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.

vi. 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

i. 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

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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:

1. 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.**

2. System for Award Management

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

3. 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 https://www.fedconnect.net/FedConnect/Marketing/Documents/FedConnect_Ready_Set_Go.pdf.

4. 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 Letters of Intent, Concept Papers, and Full Applications will not be accepted through Grants.gov.

5. Electronic Authorization of Applications and Award Documents

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

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ii. 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.

iii. Foreign National Access

All applicants selected for an award under this FOA may be required to provide information to DOE in order to satisfy requirements for foreign nationals' access to DOE sites, information, technologies, equipment, programs or personnel. A foreign national is defined as any person who is not a U.S. citizen by birth or naturalization. If a selected applicant (including any of its subrecipients, contractors or vendors) anticipates involving foreign nationals in the performance of its award, the selected applicant may be required to provide DOE with specific information about each foreign national to ensure compliance with the requirements for access approval. National laboratory personnel already cleared for site access may be excluded.

iv. 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.

v. 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>.

vi. 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 NEPA (42 U.S.C. 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 <https://www.energy.gov/nepa>.

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

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certain records must be prepared to complete the NEPA review process (e.g., biological evaluations or environmental assessments), the recipient may be required to prepare the records and the costs to prepare the necessary records may be included as part of the project costs.

vii. Applicant Representations and Certifications

1. 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.

2. 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.

3. 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

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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 Classified Information Nondisclosure Agreement (<https://fas.org/sgp/othergov/sf312.pdf>), Form 4414 Sensitive Compartmented Information Disclosure Agreement (<https://fas.org/sgp/othergov/intel/sf4414.pdf>), 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.

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viii. 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 unusual 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.

ix. 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 the Go/No-Go decision point(s).
4. EERE participates in major project decision-making processes.

x. Intellectual Property Management Plan (IPMP)

Selectees must submit an executed IPMP between the members of the consortia or team, if required by the Contracting Officer in consultation with the cognizant DOE Patent Counsel. If required, executed IPMPs are due within 30 days of selection.

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

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

- The treatment of confidential information between members (e.g., the use of NDAs);
- The treatment of background intellectual property (e.g., any requirements for identifying it or making it available);
- The treatment of inventions made under the award (e.g., any requirements for disclosing to the other members on an application, 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 award (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.

xi. 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 ten (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.

xii. Intellectual Property Provisions

The standard DOE financial assistance intellectual property provisions applicable to the various types of recipients are located at <http://energy.gov/gc/standard-intellectual-property-ip-provisions-financial-assistance-awards>.

xiii. Reporting

Reporting requirements are identified on the Federal Assistance Reporting Checklist, attached to the award agreement. This helpful EERE checklist can be accessed at <https://www.energy.gov/eere/funding/eere-funding-application-and-management-forms>. See Attachment 2 Federal Assistance Reporting

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Checklist, after clicking on “Model Cooperative Agreement” under the Award Package section.

In addition to the Federal Assistance Reporting Checklist, please see the specific “**Special Deliverables**” descriptions for each Topic Area and each Subtopic Area in Section I.B.

xiv. 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. 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 EERE program goals and objectives. Federal funding beyond the Go/No-Go decision point (continuation funding) is contingent upon (1) availability of federal funds appropriated by Congress for the purpose of this program; (2) the availability of future-year budget authority; (3) recipient’s technical progress compared to the Milestone Summary Table stated in Attachment 1 of the award; (4) recipient’s submittal of required reports; (5) recipient’s compliance with the terms and conditions of the award; (6) EERE’s Go/No-Go decision; (7) the recipient’s submission of a continuation application; and (8) written approval of the continuation application by the Contracting Officer.

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.

xv. 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,

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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.

xvi. Uniform Commercial Code (UCC) Financing Statements

Per 2 CFR 910.360 (Real Property and Equipment) when a piece of equipment is purchased by a for-profit recipient or subrecipient with federal funds, and when the federal share of the financial assistance agreement is more than \$1,000,000, the recipient or subrecipient must:

Properly record, and consent to the Department's ability to properly record if the recipient fails to do so, UCC financing statement(s) for all equipment in excess of \$5,000 purchased with project funds. These financing statement(s) must be approved in writing by the Contracting Officer prior to the recording, and they shall provide notice that the recipient's title to all equipment (not real property) purchased with federal funds under the financial assistance agreement is conditional pursuant to the terms of this section, and that the government retains an undivided reversionary interest in the equipment. The UCC financing statement(s) must be filed before the Contracting Officer may reimburse the recipient for the federal share of the equipment unless otherwise provided for in the relevant financial assistance agreement. The recipient shall further make any amendments to the financing statements or additional recordings, including appropriate continuation statements, as necessary or as the Contracting Officer may direct.

xvii. Implementation of Executive Order 13798, Promoting Free Speech and Religious Liberty

States, local governments, or other public entities may not condition sub-awards in a manner that would discriminate, or disadvantage sub-recipients based on their religious character.

xviii. Participants and Collaborating Organizations

If selected for award negotiations, the selected applicant must submit a list of personnel who are proposed to work on the project, both at the recipient and subrecipient level and a list of collaborating organizations within 30 days after the applicant is notified of the selection. Recipients will have an ongoing responsibility to notify DOE of changes to the personnel and collaborating organizations, and submit updated information during the life of the award.

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xix. Current and Pending Support

If selected for award negotiations, within 30 days of the selection notice, the selectee must submit 1) current and pending support disclosures and resumes for any new PIs or senior/key personnel and 2) updated disclosures if there have been any changes to the current and pending support submitted with the application. Throughout the life of the award, the Recipient has an ongoing responsibility to submit 1) current and pending support disclosure statements and resumes for any new PI and senior/key personnel and 2) updated disclosures if there are changes to the current and pending support previously submitted to DOE. Also See. Section IV.E.xvii.

xx. U.S. Manufacturing Commitments

A primary objective of DOE's multi-billion dollar research, development and demonstration investments is to cultivate new research and development ecosystems, manufacturing capabilities, and supply chains for and by U.S. industry and labor. Therefore, in exchange for receiving taxpayer dollars to support an applicant's project, the applicant must agree to the following U.S. Competitiveness Provision as part of an award under this FOA.

U.S. Competitiveness

The Recipient agrees that any products embodying any subject invention or produced through the use of any subject invention will be manufactured substantially in the United States unless the Recipient can show to the satisfaction of DOE that it is not commercially feasible. In the event DOE agrees to foreign manufacture, there will be a requirement that the Government's support of the technology be recognized in some appropriate manner, e.g., alternative binding commitments to provide an overall net benefit to the U.S. economy. The Recipient agrees that it will not license, assign or otherwise transfer any subject invention to any entity, at any tier, unless that entity agrees to these same requirements. Should the Recipient or other such entity receiving rights in the invention(s): (1) undergo a change in ownership amounting to a controlling interest, or (2) sell, assign, or otherwise transfer title or exclusive rights in the invention(s), then the assignment, license, or other transfer of rights in the subject invention(s) is/are suspended until approved in writing by DOE. The Recipient and any successor assignee will convey to DOE, upon written request from DOE, title to any subject invention, upon a breach of this paragraph. The Recipient will

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include this paragraph in all subawards/contracts, regardless of tier, for experimental, developmental or research work.

A subject invention is any invention conceived or first actually reduced in performance of work under an award. An invention is any invention or discovery which is or may be patentable.

As noted in the U.S. Competitiveness Provision, at any time in which an entity cannot meet the requirements of the U.S. Competitiveness Provision, the entity may request a modification or waiver of the U.S. Competitiveness Provision. For example, the entity may propose modifying the language of the U.S. Competitiveness Provision in order to change the scope of the requirements or to provide more specifics on the application of the requirements for a particular technology. As another example, the entity may request that the U.S. Competitiveness Provision be waived in lieu of a net benefits statement or U.S. manufacturing plan. The statement or plan would contain specific and enforceable commitments that would be beneficial to the U.S. economy and competitiveness. Commitments could include manufacturing specific products in the U.S., making a specific investment in a new or existing U.S. manufacturing facility, keeping certain activities based in the U.S. or supporting a certain number of jobs in the U.S. related to the technology. If DOE, in its sole discretion, determines that the proposed modification or waiver promotes commercialization and provides substantial U.S. economic benefits, DOE may grant the request and, if granted, modify the award terms and conditions for the requesting entity accordingly.

The U.S. Competitiveness Provision is implemented by DOE pursuant to a Determination of Exceptional Circumstances (DEC) under the Bayh-Dole Act and DOE Patent Waivers. See Section VIII.J. Title to Subject Inventions of this FOA for more information on the DEC and DOE Patent Waivers.

xxi. Data Management Plan (DMP) (if applicable)

Each applicant whose Full Application is selected for award negotiations will be required to submit a DMP during the award negotiations phase. A DMP explains how, when appropriate, data generated in the course of the work performed under an EERE award will be shared and preserved in order to validate the results of the proposed work or how the results could be validated if the data is 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 publications.

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C. Program Down-Select

For Subtopic Areas 2a and 3a, EERE intends to conduct a competitive project review (down-selection process) upon the completion of Phase 1. Recipients will present their projects to EERE individually (not to other recipients). Subject matter experts from academia, national laboratories, and industry may be used as reviewers, subject to conflict of interest and non-disclosure considerations. Projects will be evaluated based on the criteria listed in **Appendix I – Preliminary Design Requirements**.

To ensure rapid execution of Phase 2, the readiness of all projects will be evaluated at the down-select review. Within the availability of DOE funding, only the projects demonstrating the most mature project execution plans prepared in Phase 1 will be considered to proceed to Phase 2. All Project Phase 1 deliverables will be evaluated based on the following criteria:

- The degree to which the Phase 1 deliverables present a comprehensive and complete description of the scope, schedule, and budget that will be required to successfully execute Phase 2.
- Demonstration that all prior-scale data which will be necessary to rapidly execute Phase 2 has been obtained and incorporated into the project plans.
- The degree to which sufficient cost share, contingency, and other financial resources have been secured to enable rapid execution of Phase 2.
- The degree to which all other project resources, such as, but not limited to: site access, required permitting and regulatory approvals, stakeholder and sponsor support, and any licensing agreements have been secured.

Upon completion of the competitive project review (down-selection process), EERE will select which projects will receive federal funding beyond Phase 1. Due to the availability of funding and program considerations, only a portion of the recipients will be selected to receive funding for project continuation. As a result of this down-select process, certain projects will not receive federal funding beyond Phase 1 even if the project is meeting the pre-defined metrics.

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: BETOScaleUp@ee.doe.gov. Questions must be submitted not later than 3

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business days prior to the application due date and time. Please note, feedback on individual concepts will not be provided through Q&A.

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. 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.

C. 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.

D. Treatment of Application Information

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. Applicants are advised to not include any critically sensitive proprietary detail.

If an application includes trade secrets or information that is commercial or financial, or information that is confidential or privileged, it is furnished to the

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Government in confidence with the understanding that the information shall be used or disclosed only for evaluation of the application. Such information will be withheld from public disclosure to the extent permitted by law, including the Freedom of Information Act. Without assuming any liability for inadvertent disclosure, EERE will seek to limit disclosure of such information to its employees and to outside reviewers when necessary for merit review of the application or as otherwise authorized by law. This restriction does not limit the Government's right to use the information if it is obtained from another source.

Full Applications, and other submissions containing confidential, proprietary, or privileged information must be marked as described below. Failure to comply with these marking requirements may result in the disclosure of the unmarked information under the Freedom of Information Act or otherwise. The U.S. Government is not liable for the disclosure or use of unmarked information, and may use or disclose such information for any purpose.

The cover sheet of the Full Application, and other submission must be marked as follows and identify the specific pages containing trade secrets, confidential, proprietary, or privileged information:

Notice of Restriction on Disclosure and Use of Data:

Pages [list applicable pages] of this document may contain trade secrets, confidential, proprietary, or privileged information that 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 confidential, proprietary, or privileged information must be marked as follows: "Contains Trade Secrets, Confidential, Proprietary, or Privileged Information Exempt from Public Disclosure." In addition, each line or paragraph containing proprietary, privileged, or trade secret information must be clearly marked with double brackets or highlighting.

E. Evaluation and Administration by Non-Federal Personnel

In conducting the merit review evaluation, the Go/No-Go Reviews and Peer Reviews, 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, including EERE contractors.

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The applicant, by submitting its application, consents to the use of non-federal reviewers/administrators. Non-federal reviewers must sign conflict of interest (COI) and non-disclosure acknowledgements (NDA) prior to reviewing an application. Non-federal personnel conducting administrative activities must sign an NDA.

F. 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.

G. 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).

H. 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.

I. Retention of Submissions

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

J. Title to Subject Inventions

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

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- 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.

- Advance and Identified Waivers: For an applicant not covered by a Class Patent Waiver or the Bayh-Dole Act, the applicant 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.
- DEC: On June 07, 2021, DOE approved a DETERMINATION OF EXCEPTIONAL CIRCUMSTANCES (DEC) UNDER THE BAYH-DOLE ACT TO FURTHER PROMOTE DOMESTIC MANUFACTURE OF DOE SCIENCE AND ENERGY TECHNOLOGIES. In accordance with this DEC, all awards, including sub-awards, under this FOA shall include the U.S. Competitiveness Provision in accordance with Section VI.B.xx. U.S. Manufacturing Commitments of this FOA. A copy of the DEC can be found at <https://www.energy.gov/gc/determination-exceptional-circumstances-decs>. Pursuant to 37 CFR § 401.4, any nonprofit organization or small business firm as defined by 35 U.S.C. 201 affected by any DEC has the right to appeal it by providing written notice to DOE within 30 working days from the time it receives a copy of the determination.

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K. Government Rights in Subject Inventions

Where prime recipients and subrecipients retain title to subject inventions, the U.S. government retains certain rights.

i. 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.

ii. 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.

L. 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

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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 data 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.

M. 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.

N. Export Control

The U.S. government regulates the transfer of information, commodities, technology, and software considered to be strategically important to the U.S. to protect national security, foreign policy, and economic interests without imposing undue regulatory burdens on legitimate international trade. There is a network of federal agencies and regulations that govern exports that are collectively referred to as “Export Controls”. To ensure compliance with Export Controls, it is the prime recipient’s responsibility to determine when its project activities trigger Export Controls and to ensure compliance.

Export Controls may apply to individual projects, depending on the nature of the tasks. When Export Controls apply, the recipient must take the appropriate steps to obtain any required governmental licenses, monitor and control access to restricted information, and safeguard all controlled materials. Under no circumstances may foreign entities (organizations, companies or persons) receive access to export controlled information unless proper export procedures have been satisfied and such access is authorized pursuant to law or regulation.

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O. Personally Identifiable Information (PII)

All information provided by the applicant must to the greatest extent possible exclude PII. The term “PII” refers to information which can be used to distinguish or trace an individual's identity, such as their name, social security number, biometric records, 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. (See OMB Memorandum M-07-16 dated May 22, 2007, found at:

<https://www.whitehouse.gov/sites/whitehouse.gov/files/omb/memoranda/2007/m07-16.pdf>

By way of example, applicants must screen resumes to ensure that they do not contain PII such as personal addresses, personal landline/cell phone numbers, and personal emails. **Under no circumstances should Social Security Numbers (SSNs) be included in the application.** Federal agencies are prohibited from the collecting, using, and displaying unnecessary SSNs. (See, the Federal Information Security Modernization Act of 2014 (Pub. L. No. 113-283, Dec 18, 2014; 44 U.S.C. § 3551).

P. Annual Independent Audits

If a for-profit entity is a prime recipient and has expended \$750,000 or more of DOE awards during the entity's fiscal year, an annual compliance audit performed by an independent auditor is required. For additional information, please refer to 2 CFR 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 awards during the non-federal entity's fiscal year, then a Single or Program-Specific Audit is required. For additional information, please refer to 2 CFR 200.501 and Subpart F.

Applicants and subrecipients (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.

Q. 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

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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.

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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. The 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:

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- 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.

General Cost Sharing Rules on a DOE Award

1. **Cash Cost Share** – encompasses all contributions to the project made by the recipient or subrecipient(s), for costs incurred and paid for during the project. This includes when an organization pays for personnel, supplies, equipment for their own company with organizational resources. If the item or service is reimbursed for, it is cash cost share. All cost share items must be necessary to the performance of the project.
2. **In-Kind Cost Share** – encompasses all contributions to the project made by the recipient or subrecipient(s) that do not involve a payment or reimbursement and represent donated items or services. In-Kind cost share items include volunteer personnel hours, donated existing equipment, donated existing supplies. The cash value and calculations thereof for all In-Kind cost share items must be justified and explained in the Cost Share section of the project Budget Justification. All cost share items must be necessary to the performance of the project. If questions exist, consult your DOE contact before filling out the In-Kind cost share section of the Budget Justification.
3. **Funds from other federal sources MAY NOT be counted as cost share.** This prohibition includes FFRDC subrecipients. Non-federal sources include any source not originally derived from federal funds. Cost sharing commitment letters from subrecipients must be provided with the original application.
4. **Fee or profit, including foregone fee or profit, are not allowable as project costs (including cost share) under any resulting award.** The project may only incur those costs that are allowable and allocable to the project (including cost share) as determined in accordance with the applicable cost principles prescribed in FAR Part 31 for For-Profit entities and 2 CFR Part 200 Subpart E - Cost Principles for all other non-federal entities.

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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 FAR, 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; and
 - 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

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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:

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-
- 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.

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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)

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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)

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APPENDIX C – WAIVER REQUESTS AND APPROVAL PROCESSES: 1. FOREIGN ENTITY PARTICIPATION AS THE PRIME RECIPIENT; AND 2. PERFORMANCE OF WORK IN THE UNITED STATES (FOREIGN WORK WAIVER)

1. Waiver for Foreign Entity Participation as the Prime Recipient

As set forth in Section III.A., 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 and have a physical location for business operations in 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 and the extent, if any, the entity is state owned or controlled;
- 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; and
- 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.

2. **Waiver for Performance of Work in the United States (Foreign Work Waiver)**

As set forth in Section III.A., 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 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 U.S. 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.

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APPENDIX D – GLOSSARY

1. Technology Specific Definitions

“Algae” for the purpose of this FOA, as included in the definition of “biomass” above is defined as eukaryotic microalgae, macroalgae (seaweed), and cyanobacteria.

“Biodiesel” as defined by the U.S. Energy Information Administration, is a fuel typically made from soybean, canola, or other vegetable oils; animal fats; and recycled grease. It can serve as a substitute for petroleum-derived diesel or distillate fuel. For EIA reporting, it is a fuel composed of mono-alkyl esters of long chain fatty acids derived from vegetable oils or animal fats, designated B100, and meeting the requirements of ASTM (American Society for Testing materials) D 6751.

“Biogas” for the purpose of this FOA, refers to the mixture of gases produced by the breakdown of organic matter in the absence of oxygen, primarily consisting of methane and carbon dioxide.

“Biomass” is defined generally in the authorizing language of EPCA 2005, §932 (reproduced below). More specifically for the purposes of this FOA, biomass includes agricultural residues, forest resources, perennial grasses, woody energy crops, algae, organic wet waste (e.g., biosolids), sorted municipal solid waste, food waste, and biogas.

“Carbon Dioxide by Direct Air Capture” for the purposes of this FOA, refers to carbon dioxide (CO₂) from the ambient air, which has been either captured in Direct Air Capture (DAC) machines and delivered to algal systems or captured through chemically, biologically, or mechanically assisted accelerated diffusion of air into algal system growth media.

“Construction and Demolition Waste” or “C&D Waste” for the purposes of this FOA, refers to a type of waste that is not included in municipal solid waste (MSW). Materials included in the C&D debris generation estimates are steel, wood products, drywall and plaster, brick and clay tile, asphalt shingles, concrete, and asphalt concrete. These materials are used in buildings, roads and bridges, and other sectors.

“Food Waste” for the purposes of this FOA, is defined as food from industrial, commercial, and residential sources that is no longer suitable for human consumption which would have otherwise entered an anaerobic digester, landfill or other post consumer disposition.

“Grain Starch” for the purposes of this FOA, refers to commercially available starch derived yellow dent feed corn, wheat and grain sorghum/milo. Please note that Greenhouse Gas reductions of at least 70% must be met if utilizing grain starch.

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“Lignocellulosic Feedstocks” are defined generally in the authorizing language of EPCA 2005, §932 (reproduced below). More specifically for the purposes of this FOA, are defined as any portion of a plant or coproduct from conversion, including crops, trees, forest residues, and agricultural residues not specifically grown for food, [emphasis added] including from barley grain, grape seed, rice bran, rice hulls, rice straw, soybean matter, and sugarcane bagasse.

“Oilseed Crops” for the purposes of this FOA, refers to US-produced, oil producing crops including, but not limited to soybeans, cottonseed, sunflower seed, canola, rapeseed, peanuts, camelina, carinata, pennycress, and oil producing annual cover crops⁸⁸⁸⁹. Please note that Greenhouse Gas reductions of at least 70% must be met if utilizing an oil seed crop(s).

“Organic Wet Waste” for the purpose of this FOA, “wet waste” refers to the following: primary, secondary, tertiary, and post-anaerobic digestion sludge (i.e., biosolids) from municipal wastewater treatment systems; food wastes from industrial, commercial, and residential sources; organic-rich wastewaters from industrial and commercial operations; manure slurries from animal husbandry operations.

“Renewable Diesel” as defined by the U.S. Energy Information Administration, is a biofuel that is chemically the same as petroleum diesel fuel. Renewable diesel meets the American Society for Testing and Materials (ASTM) specification ASTM D975 for petroleum diesel and may be used in existing petroleum pipelines, storage tanks, and diesel engines. It can be produced from cellulosic biomass materials such as crop residues, wood and sawdust, and switchgrass, and it qualifies as an advanced biofuel under the Renewable Fuel Standard (RFS) Program.

“Scale-up Factor” for the purposes of this FOA, are the ratio of the proposed scale to the previous scale on a unit operation basis.

“Sorted Municipal Solid Waste” for the for the purposes of this FOA, is defined as the organic and plastic constituents of the MSW stream going to the landfill (typically known as municipal garbage). See chapter 2 in the Resource Conservation and Recovery Act Orientation Manual 2014 - <https://www.epa.gov/sites/production/files/2015-07/documents/rom.pdf>

“Sustainable Aviation Fuel” or SAF is defined as a renewable or waste derived aviation fuel that achieves net greenhouse gas emissions reductions and other sustainability criteria for aviation fuel on a life cycle basis. SAF must be approved through the ASTM D4054 process and produced to meet the ASTM D7566 standard specification for aviation turbine fuel containing synthesized hydrocarbons.

⁸⁸ [https://www.ers.usda.gov/topics/crops/soybeans-oil-crops/oil-crops-sector-at-a-glance/#:~:text=The%20major%20U.S.%20oilseed%20crops,percent%20of%20U.S.%20oilseed%20production.&text=Field%20Crops%20for%20soybean%20dates%20by%20region\).](https://www.ers.usda.gov/topics/crops/soybeans-oil-crops/oil-crops-sector-at-a-glance/#:~:text=The%20major%20U.S.%20oilseed%20crops,percent%20of%20U.S.%20oilseed%20production.&text=Field%20Crops%20for%20soybean%20dates%20by%20region).)

⁸⁹ <https://www.epa.gov/renewable-fuel-standard-program/approved-pathways-renewable-fuel>

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“Sustainable Marine Fuel” for the purposes of this FOA, is defined as a renewable or waste derived fuel that achieves net greenhouse gas emissions reductions of at least 70% on a life cycle basis when compared to Heavy Fuel Oil as defined by ASTM D396. Please note that this FOA will exclude biodiesels, straight vegetable oil, and any other commercially produced fuel as sustainable marine fuels. Applicant must address the scalability of the proposed sustainable marine fuel in their application.

“Sustainable Rail Fuel” for the purposes of this FOA, is defined as a renewable or waste derived fuel that achieves net greenhouse gas emissions reductions of at least 70% on a life cycle basis when compared to traditional off-road diesel (as defined by ASTM D975). Please note that this FOA will exclude biodiesels, straight vegetable oil, and any other commercially produced fuel as sustainable rail fuels.

“Unit Operation” for the purposes of this FOA, is a basic process operations involving a physical or chemical transformation.

“Utilizable Biogenic Carbon” or **“Utilizable Carbon”** for the purposes of this FOA, is define as the carbon contained in all the biofuels and coproducts generated from a process. carbon found in waste streams, or streams consumed as a part of the production process, is not included in this calculation. For instance, CO₂ from a fermentation, light gasses produced from biomass feedstock used for process heat, or char from a catalytic fast pyrolysis process would be considered traditional waste streams, even though there are technologies that can utilize these streams to further reduce the Carbon Index (CI) score and benefit the overall economics of a process. This will different between technologies and it is up to the Applicant to determine and argue the applicability of their process streams under this definition.

“Waste Carbon Dioxide” for the purpose of this FOA, refers to any waste carbon dioxide (CO₂) produced as a byproduct from fermentation or the combustion of biomass or other biopower processes.

2. General FOA Definitions

Applicant – The lead organization submitting an application under the FOA.

Continuation application – A non-competitive application for an additional budget period within a previously approved project period. At least ninety (90) days before the end of each budget period, the Recipient must submit to EERE its continuation application, which includes the following information:

- i. A report on the Recipient’s progress towards meeting the objectives of the project, including any significant findings, conclusions, or developments, and an estimate of any unobligated balances remaining at the end of the budget period. If the remaining unobligated balance is estimated to exceed 20 percent of the funds available for the

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budget period, explain why the excess funds have not been obligated and how they will be used in the next budget period.

- ii. A detailed budget and supporting justification if there are changes to the negotiated budget, or a budget for the upcoming budget period was not approved at the time of award.
- iii. A description of any planned changes from the negotiated Statement of Project Objectives and/or Milestone Summary Table.

Cooperative Research and Development Agreement (CRADA) – a contractual agreement between a national laboratory contractor and a private company or university to work together on research and development. For more information, see <https://www.energy.gov/gc/downloads/doe-cooperative-research-and-development-agreements>

Federally Funded Research and Development Centers (FFRDC) - FFRDCs are public-private partnerships which conduct research for the United States government. A listing of FFRDCs can be found at <http://www.nsf.gov/statistics/ffrdclist/>.

Go/No-Go Decision Points: – A decision point at the end of a budget period that defines the overall objectives, milestones and deliverables to be achieved by the recipient in that budget period. As a result of EERE's review, EERE may take one of the following actions: 1) authorize federal funding for the next budget period; 2) recommend redirection of work; 3) discontinue providing federal funding beyond the current budget period; or 4) place a hold on federal funding pending further supporting data.

Project – The entire scope of the cooperative agreement which is contained in the recipient's Statement of Project Objectives.

Recipient or "Prime Recipient" – A non-federal entity that receives a federal award directly from a federal awarding agency to carry out an activity under a federal program. The term recipient does not include subrecipients.

Subrecipient – A non-federal entity that receives a subaward from a pass-through entity to carry out part of a federal program; but does not include an individual that is a beneficiary of such program. A subrecipient may also be a recipient of other federal awards directly from a federal awarding agency. Also, a DOE/NNSA and non-DOE/NNSA FFRDC may be proposed as a subrecipient on another entity's application. See section III.E.ii.

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APPENDIX E – DEFINITION OF TECHNOLOGY READINESS LEVELS

TRL 1:	Basic principles observed and reported
TRL 2:	Technology concept and/or application formulated
TRL 3:	Analytical and experimental critical function and/or characteristic proof of concept
TRL 4:	Component and/or breadboard validation in a laboratory environment
TRL 5:	Component and/or breadboard validation in a relevant environment
TRL 6:	System/subsystem model or prototype demonstration in a relevant environment
TRL 7:	System prototype demonstration in an operational environment
TRL 8:	Actual system completed and qualified through test and demonstrated
TRL 9:	Actual system proven through successful mission operations

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APPENDIX F – LIST OF ACRONYMS

ANL	Argonne National Laboratory
ASTM	ASTM International
BETO	Bioenergy Technologies Office
BFD	Block Flow Diagram
BFD & SD	Block Flow Diagram and Supplemental Data
BP	Budget Period
BTU	British Thermal Unit
CD	Critical Decision
CFR	Code of Federal Regulation
CO	Carbon Monoxide
CO ₂ or CO2	Carbon Dioxide
COI	Conflict of Interest
CORSIA	Carbon Offsetting and Reduction Scheme for International Aviation
CRADA	Cooperative Research and Development Agreement
C&D	Construction and Demolition
DEC	Determination of Exceptional Circumstances
DEIP	Diversity, Equity and Inclusion Plan
DMP	Data Management Plan
DOE	U.S. Department of Energy
DOI	Digital Object Identifier
DMT	Dry Metric Ton
DTPD	Dry Tons Per Day
DUNS	Dun and Bradstreet Universal Numbering System
EERE	Energy Efficiency and Renewable Energy
EPA	Environmental Protection Agency
FAR	Federal Acquisition Regulation
FEL	Front-End Loaded
FFATA	Federal Funding and Transparency Act of 2006
FOA	Funding Opportunity Announcement
FOIA	Freedom of Information Act
FFRDC	Federally Funded Research and Development Center
FY	Fiscal Year
GAAP	Generally Accepted Accounting Principles
GGE	Gallons of Gasoline Equivalent
GHG	Greenhouse Gas
REET	Greenhouse Gases, Regulated Emissions, and Energy Use in Technologies
HAZOP	Hazard and Operability
HBCU	Historically Black Colleges and Universities

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IBR	Integrated Biorefinery
IE	Independent Engineer
IER	Independent Engineer Review
IP	Intellectual Property
IPMP	Intellectual Property Management Plan
LCA	Life Cycle Analysis
M&O	Management and Operating
MMBTU	Million British Thermal Units
MPIN	Marketing Partner ID Number
MFSP	Minimum Fuel Selling Price
MSI	Minority Serving Institutions
MSW	Municipal Solid Waste
MYPP	Multi-Year Program Plan
NIST	National Institute of Standards and Technology
NDA	Non-Disclosure Acknowledgement
NEPA	National Environmental Policy Act
NNSA	National Nuclear Security Agency
NREL	National Renewable Energy Laboratory
NREL-SI	National Renewable Energy Laboratory Systems Integration
NSF	National Science Foundation
OMI	Other Minority Institutions
OMB	Office of Management and Budget
OPEX	Operating Expenses
OSTI	Office of Scientific and Technical Information
P&ID	Piping and Instrumentation Diagram
PMP	Project Management Plan
PII	Personal Identifiable Information
R&D	Research and Development
RD&D	Research, Development and Demonstration
RDD&D	Research, Development, Demonstration and Deployment
RFI	Request for Information
RFP	Request for Proposal
RMP	Risk Mitigation Plan
RNG	Renewable Natural Gas
SAM	System for Award Management
SAF	Sustainable Aviation Fuel
SCF	Standard Cubic Foot
SMART	Specific, Measurable, Achievable, Relevant, and Timely
SOPO	Statement of Project Objectives
SOT	State of Technology
STEM	Science, Technology, Engineering, and Mathematics
STP	Standard Temperature and Pressure
SPOC	Single Point of Contact
TEA	Techno-Economic Analysis

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TRL	Technology Readiness Level
UCC	Uniform Commercial Code
VOC	Volatile Organic Compound
WBS	Work Breakdown Structure
WP	Work Proposal
WTE	Waste-to-Energy

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APPENDIX G - ACCEPTABLE FEEDSTOCKS

The Bioenergy Technologies Office works with biomass-based feedstocks, per the authorizing language in EAct 2005 (see below). Each Subtopic Area in this FOA has specific feedstock requirements which are identified in the Table below. **Applications proposing the use of any feedstock not identified as an acceptable feedstock for the particular Subtopic Area will not be further considered.**

Subtopic Area	Acceptable Feedstock Breakdown per Subtopic Area										
	Ligno-cellulosic	Algae	Organic Wet Waste	Sorted MSW	Food Waste	Biogas	Grain Starch	Oilseed Crops	C&D Waste	Waste Carbon Dioxide	Carbon Dioxide from Ambient Air
1a: Pre-pilot Technologies	Yes	Yes						Yes	Yes	Yes	No
1b: Pre-pilot - CO ₂ Direct Air Capture	No	No						No	No	No	Yes
2a: Pilot (Preliminary Design & Phased Construction)	Yes	Yes						Yes	Yes	Yes	Yes
2b: Pilot (Final Design & Construction)	Yes	Yes						Yes	Yes	Yes	Yes
3a: Demo (Preliminary Design & Phased Construction)	Yes	Yes						Yes	Yes	Yes	Yes
3b: Demo (Final Design & Construction)	Yes	Yes						Yes	Yes	Yes	Yes
4a: Gen-1 Corn Ethanol Emission Reduction (Feasibility Studies)	Yes	Yes						Yes	No	Yes	Yes
4b: Gen-1 Corn Ethanol Emission Reduction (Pre-pilot)	Yes	Yes						Yes	No	Yes	Yes

Feedstock Definitions:

“Biomass” is defined generally in the authorizing language of EAct 2005, §932 (reproduced below). More specifically for the purposes of this FOA, biomass includes agricultural residues, forest resources, perennial grasses, woody energy crops, algae, organic wet waste (e.g., biosolids), sorted municipal solid waste, food waste, and biogas.

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“Lignocellulosic Feedstocks” are defined generally in the authorizing language of EPCA 2005, §932 (reproduced below). More specifically for the purposes of this FOA, are defined as any portion of a plant or coproduct from conversion, including crops, trees, forest residues, and agricultural residues not specifically grown for food, [emphasis added] including from barley grain, grape seed, rice bran, rice hulls, rice straw, soybean matter, and sugarcane bagasse.

“Algae” for the purpose of this FOA, as included in the definition of “biomass” above is defined as eukaryotic microalgae, macroalgae (seaweed), and cyanobacteria.

“Organic Wet Waste” for the purpose of this FOA, “wet waste” refers to the following: primary, secondary, tertiary, and post-anaerobic digestion sludge (i.e., biosolids) from municipal wastewater treatment systems; food wastes from industrial, commercial, and residential sources; organic-rich wastewaters from industrial and commercial operations; manure slurries from animal husbandry operations.

“Sorted Municipal Solid Waste” for the for the purposes of this FOA, is defined as the organic and plastic constituents of the MSW stream going to the landfill (typically known as municipal garbage). See chapter 2 in the Resource Conservation and Recovery Act Orientation Manual 2014 - <https://www.epa.gov/sites/production/files/2015-07/documents/rom.pdf>

“Food Waste” for the purposes of this FOA, is defined as food from industrial, commercial, and residential sources that is no longer suitable for human consumption which would have otherwise entered an anaerobic digester, landfill or other post consumer disposition.

“Biogas” for the purpose of this FOA, refers to the mixture of gases produced by the breakdown of organic matter in the absence of oxygen, primarily consisting of methane and carbon dioxide.

“Grain Starch” for the purposes of this FOA, refers to commercially available starch derived yellow dent feed corn, wheat and grain sorghum/milo. Please note that Greenhouse Gas reductions of at least 70% must be met if utilizing grain starch.

“Oilseed Crops” for the purposes of this FOA, refers to US-produced, oil producing crops including, but not limited to soybeans, cottonseed, sunflower seed, canola, rapeseed, peanuts, camelina, carinata, pennycress, and oil producing annual cover crops⁹⁰⁹¹. Please note that Greenhouse Gas reductions of at least 70% must be met if utilizing an oil seed crop(s).

⁹⁰ [https://www.ers.usda.gov/topics/crops/soybeans-oil-crops/oil-crops-sector-at-a-glance/#:~:text=The%20major%20U.S.%20oilseed%20crops,percent%20of%20U.S.%20oilseed%20production.&text=Field%20Crops%20for%20soybean%20dates%20by%20region\).](https://www.ers.usda.gov/topics/crops/soybeans-oil-crops/oil-crops-sector-at-a-glance/#:~:text=The%20major%20U.S.%20oilseed%20crops,percent%20of%20U.S.%20oilseed%20production.&text=Field%20Crops%20for%20soybean%20dates%20by%20region).)

⁹¹ <https://www.epa.gov/renewable-fuel-standard-program/approved-pathways-renewable-fuel>

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“Construction and Demolition Waste” or “C&D Waste” for the purposes of this FOA, refers to a type of waste that is not included in municipal solid waste (MSW). Materials included in the C&D debris generation estimates are steel, wood products, drywall and plaster, brick and clay tile, asphalt shingles, concrete, and asphalt concrete. These materials are used in buildings, roads and bridges, and other sectors.

“Waste Carbon Dioxide” for the purpose of this FOA, refers to any waste carbon dioxide (CO₂) produced as a byproduct from fermentation or the combustion of biomass or other biopower processes.

“Carbon Dioxide by Direct Air Capture” for the purposes of this FOA, refers to carbon dioxide (CO₂) from the ambient air, which has been either captured in Direct Air Capture (DAC) machines and delivered to algal systems or captured through chemically, biologically, or mechanically assisted accelerated diffusion of air into algal system growth media.

EPAct 2005, §932, codified at 42 U.S.C. § 16232. BIOENERGY PROGRAM.

(a) DEFINITIONS.—In this section:

(1) BIOMASS.—The term “biomass” means—

- (A) any organic material grown for the purpose of being converted to energy;
- (B) any organic byproduct of agriculture (including wastes from food production and processing) that can be converted into energy; or
- (C) any waste material that can be converted to energy, is segregated from other waste materials, and is derived from—
 - (i) any of the following forest-related resources: mill residues, precommercial thinnings, slash, brush, or otherwise non-merchantable material; or
 - (ii) wood waste materials, including waste pallets, crates, dunnage, manufacturing and construction wood wastes (other than pressure-treated, chemically-treated, or painted wood wastes), and landscape or right-of-way tree trimmings, but not including municipal solid waste, gas derived from the biodegradation of municipal solid waste or paper that is commonly recycled.

(2) LIGNOCELLULOSIC FEEDSTOCK.—The term “lignocellulosic feedstock” means any portion of a plant or coproduct from conversion, including crops, trees, forest residues, and agricultural residues not specifically grown for food, [emphasis added] including from barley grain, grape seed, rice bran, rice hulls, rice straw, soybean matter, and sugarcane bagasse.

(b) PROGRAM.—The Secretary shall conduct a program of research, development, demonstration, and commercial application for bioenergy, including—

(1) biopower energy systems;

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- (2) biofuels;
- (3) bioproducts;
- (4) integrated biorefineries that may produce biopower, biofuels, and bioproducts;
- (5) cross-cutting research and development in feedstocks; and
- (6) economic analysis

(c) **BIOFUELS AND BIOPRODUCTS.**—The goals of the biofuels and bioproducts programs shall be to develop, in partnership with industry and institutions of higher education—

- (1) advanced biochemical and thermochemical conversion technologies capable of making fuels from lignocellulosic feedstocks that are price-competitive with gasoline or diesel in either internal combustion engines or fuel cell-powered vehicles;
- (2) advanced biotechnology processes capable of making biofuels and bioproducts with emphasis on development of biorefinery technologies using enzyme-based processing systems;
- (3) advanced biotechnology processes capable of increasing energy production from lignocellulosic feedstocks, with emphasis on reducing the dependence of industry on fossil fuels in manufacturing facilities; and
- (4) other advanced processes that will enable the development of cost-effective bioproducts, including biofuels.

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APPENDIX H – SUPPLEMENTAL CONTENT REQUIREMENTS & INSTRUCTIONS

- A Block Flow Diagram and Supplemental Data is required with the application for Topic Areas 1, 2, 3, and 4. Please See **Block Flow Diagram Instructions in section i.** below.
- A Proforma Cash Flow Analysis is required with the application for Topic Areas 2 and 3. Please see **Proforma Cash Flow Analysis Instructions in section ii.** below.
- Life Cycle Assessment is required with the application for Topic Areas 2 and 3. Please see **Life Cycle Assessment Instructions in section iii.** below.

i. **Block Flow Diagram Instructions and Overview:**

All topic areas will utilize a Block Flow Diagram and Supplemental Data template (BFD & SD). The purpose of the BFD & SD is to assess the merits of the selected technology and the status of the process technology in order to gain an understanding of project risks and the potential viability of the proposed project. Please refer to the Word documents titled, “BFD & SD Template”, for the respective scale, available for download from EERE Exchange for the Block Flow Diagram and Supplemental Data instructions, overview, and recommended templates. Use of the template is not required, however equivalent data must be submitted with all applications.

ii. **Proforma Cash Flow Analysis Instructions:**

Topic Areas 2 and 3 will utilize a Proforma Cash Flow Analysis (proforma). A feasible commercial pro forma cash flow analysis showing the expected cash flow of the proposed integrated biorefinery (IBR) under the performance parameters at steady state production. Include a sensitivity analysis by showing results using a range of reasonable assumptions for such as feedstock cost and market price of products compared to low, reference, and high oil prices cases. All assumptions regarding product and consumable prices, annual product production, inflation, and other inputs must be clearly delineated. Applicants may use their own model or edit the provided template. Please refer to the MS Excel file titled, “Proforma Template” available for download from EERE Exchange for the Proforma Cash Flow Analysis instructions,

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overview, and recommended templates. Use of the template is not required, however equivalent data must be submitted with Topic Areas 2 and 3 applications.

iii. **Life Cycle Analysis Instructions:**

Topic Areas 2 and 3 will utilize Life Cycle Analyses (LCA). The LCA will be utilized to assess the potential GHG reduction and environmental performance of the proposed technology. Applicants may use any standardized approach to calculating life cycle GHG emissions e.g. Argonne National Laboratory GREET model⁹² or provide schemes developed the CORSIA (Carbon Offsetting and Reduction Scheme for International Aviation) methodology⁹³ for calculating life cycle emissions. Argonne National Laboratory has developed publicly available life-cycle assessment tools that Applicants may utilize. Use of these tools are not required, however equivalent data must be submitted with applications.

ANL GREET Model Link:

<https://greet.es.anl.gov/index.php>

⁹² <https://greet.es.anl.gov/>

⁹³ <https://www.icao.int/environmental-protection/CORSIA/Pages/CORSIA-Eligible-Fuels.aspx>

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APPENDIX I – PRELIMINARY DESIGN REQUIREMENTS

For projects selected under Subtopic Area 2a and Subtopic Area 3a to move from Phase 1 (Verification & Design Basis Definition) into Phase 2 (Design, Construction, Operation) and projects selected under Subtopic Area 2b and 3b to move out of Budget Period 1 (Verification of Design Package) into Budget Period 2 (Project Execution - complete final design and construction), key deliverables must be provided to EERE for review in order to show project readiness prior to moving into Phase 2. These deliverables include, but are not limited to:

- Independent Engineers (IE) verification of work at prior scale to confirm that the proposed integrated biorefinery (IBR) meets the appropriate TRL. The IE will be retained by DOE to verify the accuracy of application data, observe the reproduction of process experimental data, and prepare an Independent Engineers Report (IER) with an assessment of technology readiness to proceed to Phase 2;
- Successful completion of the Go/No-Go review at the conclusion of the Independent Engineer verification of work at prior scale;
- A Front-End Loaded – 3 (FEL-3) Basic Engineering Design package (-5%/+15% cost estimate accuracy) including but not limited to a Process Design Basis, Refined Mass and Energy Balances, Equipment Specifications and Lists, Pre-Design Process hazard analysis, Utility Flow Diagrams, Instrument Specifications and Lists, General Arrangement Drawings, Detailed P&ID's, Electrical Single Line Diagrams, Site Plans / Plot Plans, and Detailed Project Schedule;
- An appropriate NEPA Determination;
- A Project Management Plan (PMP) and Risk Mitigation Plan (RMP) that clearly demonstrate sufficient project controls are in place and that the Recipient is ready to execute Phase 2;
- A strategy to qualify for or obtain any necessary regulatory approvals to ensure that the biofuel(s) and bioproduct(s) are acceptable for sale into commerce;
- An updated Life Cycle Analysis (LCA) showing that the biofuel(s) and bioproducts(s) meet or exceed the 70% GHG reduction requirement and describe how the proposed project presents a significant LCA improvement over competing technologies;

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- Applicants may use any standardized approach to calculating life cycle GHG emissions e.g. Argonne National Laboratory GREET model⁹⁴ or provide schemes developed through the CORSIA methodology⁹⁵ for calculating life cycle emissions;
- A Process Design Basis Document describing the proposed technology, plant inputs, outputs, key constraints, boundaries, etc.;
- Process Flow Diagrams for the proposed technology;
- Mass and Energy Balances;
- Preliminary Project Schedule (Level 2 Summary Master Schedule);
- An updated Project Pro-Forma Cash Flow Analysis;
 - A feasible commercial pro-forma cash flow analysis of the expected cash flow of the proposed IBR under the performance parameters at steady state production. A sensitivity analysis by showing results using a range of reasonable assumptions such as feedstock cost and market price of products compared to low, reference, and high oil prices cases should be included. All assumptions regarding product and consumable prices, annual product production, inflation, and other inputs must be clearly delineated. Applicants may use their own model or edit the provided Cash Flow pro forma.xls as detailed in Appendix H.
- A business plan that clearly shows the Recipient has:
 - secured the rights to practice all necessary intellectual property to construct and operate the proposed IBR facility;
 - a firm written commitment for the project site, including all applicable permits;
 - the appropriately-skilled team to execute the project to completion;
 - the financial and project management capabilities to complete the project from construction through commissioning, startup, and operations;
 - a scale-up analysis that clearly addresses the scale-up factors and risks associated with each of the process units;
 - feedstock purchase contracts for sufficient quantities of material to execute the proposed project;
 - any necessary utility supply, interconnect, or export agreements indicating sufficient power, water, or similar services will be available to the facility;
 - off-take agreements for any product(s) that will be produced from the facility;

⁹⁴ <https://greet.es.anl.gov/>

⁹⁵ <https://www.icao.int/environmental-protection/CORSIA/Pages/CORSIA-Eligible-Fuels.aspx>

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- market analysis of all major facility inputs and outputs at initial (first facility), transitional, and mature (10 or more facilities) market share points considering any planned transitions in the fuel to products ratio as market share and number of plants increase in the U.S.
- A Techno-Economic Analysis (TEA) that clearly shows how the pioneer (1st commercial scale) and follow-on mature commercial facilities, should they become operational, would result in substantive and measurable reductions in the cost of producing drop-in hydrocarbon biofuels and bioproducts;
 - Additional factors to be incorporated into the required TEA include, but are not limited to:
 - Economic competitiveness of proposed solutions compared to existing alternatives, with and without incentives or subsidies;
 - Avoided costs when compared to alternative solutions, such as biosolids disposal costs; and
 - Production of any co-products
- Sufficient cost share in the form of allowable and readily available resources to complete Phase 2. In addition to other forms of cost share, this requirement may include a Memorandum of Understanding (or other contractual agreement) with a third party(ies), assuring cost share availability once a DOE “Go” determination has been made. All cost share must be available prior to start of construction.
- The continuation application for Phase 2 must include documentation showing that the Recipient has access to the minimum 25% required contingency. Contingency funds must be: (a) liquid, (b) immediately available, and (c) unrestricted funds dedicated exclusively to the project for the purpose of mitigating project performance baseline risk. The contingency reserve is in addition to Total Project Costs and cannot count towards cost share, until expended. If expended, the contingency will not result in reimbursement by DOE above the total federal share approved in the award. DOE discourages recipients from reducing scope to comply with the contingency reserve requirement.
- Subtopic Area 2b and Subtopic Area 3b must identify technology providers for each major unit operation found in the Block Flow Diagram; if that technology provider is not the prime recipient, it should be listed as a subrecipient in the project budget to minimize scale-up risk and maximize engagement.

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