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

FY21 BETO Scale-up and Conversion FOA DE-FOA-0002396

Funding Opportunity Announcement (FOA) Number: DE-FOA-0002396
FOA Type: Mod 00001
CFDA Number: 81.087

FOA Issue Date:	04/08/2021
Informational Webinar (Topic Area 1 only):	04/16/2021 3:00pm ET
Submission Deadline for Concept Papers:	04/30/2021 5:00pm ET
Submission Deadline for Full Applications:	06/21/2021 5:00pm ET
Expected Submission Deadline for Replies to Reviewer Comments:	07/20/2021 5:00pm ET
Expected Date for EERE Selection Notifications:	08/23/2021
Expected Timeframe for Award Negotiations:	August 2021 - September 2021

- 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 Funding Opportunity Announcement are highlighted in yellow in the table below.

Mod. No.	Date	Description of Modifications
00001	05/06/2021	**SECTION IV.D.I: FULL APPLICATION CONTENT REQUIREMENTS (TOPIC AREAS 1B AND 1C)** For Topic Areas 1b and 1c the requirement for a Risk Mitigation Plan (RMP) has been removed as this is a deliverable within a successfully negotiated award. ~~RISK MITIGATION PLAN~~ | ~~MS WORD, PDF~~ | ~~10~~ | ~~CONTROLNUMBER_LEADORGANIZATION_RMP~~ **APPENDIX G - ACCEPTABLE FEEDSTOCKS:** The original topic area text is correct, however Appendix G contained an error. Appendix G has been modified to allow the following feedstocks for topic area 3a: organic wet waste, sorted municipal solid waste, food waste, biogas, and waste carbon dioxide. **APPENDIX H - SUPPLEMENTAL CONTENT REQUIREMENTS & INSTRUCTIONS** No Risk Mitigation Plan is required for applications submitted under Topic Area 1: Topic Area 1 Scale-up of Biotechnologies: ● A Block Flow Diagram and Supplemental Data is required with the application for Topic Area 1a, 1b, and 1c applications. Please See **Block Flow Diagram Instructions in section i.** below. ● A Proforma Cash Flow Analysis is required with the application for Topic Areas 1b and 1c. Please see **Proforma Cash Flow Analysis Instructions in section ii.** below. ● Life Cycle Assessment is required with the application for Topic Areas 1b and 1c. Please see **Life Cycle Assessment Instructions in section iii.** below.

		● Risk Mitigation Plan is required with the application for Topic Areas 1b and 1c. Please see **Risk Mitigation Plan Instructions in section iv.** below. iv. **Risk Mitigation Plan Instructions:** Topic Areas 1b and 1c will utilize a Risk Mitigation Plan (RMP). The RMP will be utilized to assess not only the risks included, but more importantly the risks that are omitted from the RMP. This will allow reviewers to further understand the readiness of the applicant to proceed into either a pilot or demonstration project. Please refer to the PDF titled, "Risk Mitigation Template" available for download from EERE Exchange for the Risk Mitigation Plan instructions, overview, and recommended templates. Use of the template is not required, however equivalent data must be submitted with Topic Areas 1b and 1c applications.

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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 achieve carbon pollution-free electricity sector by 2035 and 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 2050."[1] The Department of Energy (DOE) 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.

In support of these Administration priorities, the Bioenergy Technologies Office (BETO) is focused on developing technologies that convert domestic biomass and other waste resources (e.g., municipal solid waste, biosolids) into low-carbon biofuels and bioproducts. These bioenergy technologies can enable a transition to a clean energy economy, create high-quality jobs, support rural economies, and spur innovation in renewable energy and chemicals production – the bioeconomy. The activities funded through this opportunity will mobilize public clean energy investment in the biofuels, chemical and agricultural industries, accelerate the deployment of bioenergy technologies, and support achieving economy-wide net-zero emissions by 2050.

This FOA supports high-impact technology RDD&D to accelerate the bioeconomy and, in particular, the production of low-carbon fuels for the aviation industry. BETO is focusing on applied RDD&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 commercial-scale integrated biorefineries and reduce greenhouse gas emissions from hard to decarbonize sectors, such as aviation. The Program is focused on developing and demonstrating technologies that are capable of producing low-carbon drop-in biofuels at $2.50 per gallon gasoline equivalent (GGE) by 2030, as well as associated renewable chemical co-products to achieve this target.[2] BETO is focused on biofuel production pathways

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

[2] U.S. Department of Energy (2020), Bioenergy Technologies Office 2019 R&D State of Technology, DOE/EE-2082, https://www.energy.gov/sites/prod/files/2020/07/f76/beto-2019-state-of-technology-july-2020-r1.pdf

that can deliver at least 70% lower lifecycle greenhouse gas emissions than petroleum.

The research and development (R&D) activities to be funded under this FOA will support 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 RDD&D focusing on the production of low-GHG fuels for the aviation industry, as well as the long-haul trucking and marine industries by soliciting proposals to scale-up technologies; cost effectively produce biomass derived sugars as an intermediate for the production of biofuels and bioproducts; and support cost effective separation technologies. In addition, the FOA will support increasing the efficiency of residential wood heaters and the production of renewable natural gas.

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 end use. Potential end products include biofuels for commercial aviation, marine vessels, renewable diesel, off-road transportation, biogas, renewable home heating oil, and bioproducts. Although BETO focuses on biofuel, it also pursues strategies to develop high-value bioproducts 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 programs focus on overcoming key technology barriers that affect technology pathways and the ability to economically scale-up these pathways to industrially-relevant volumes.

Illustrative biofuel pathway progress is assessed annually by BETO using techno-economic analyses (TEA), which translate technology development into 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 (SOT). Figure 1 illustrates the TEA impact of technology development progress representing a 42% reduction in the modeled Minimum Fuel Selling Price (MFSP) in 4 years and projections of future improvements for one example technology pathway (wood biomass via catalytic fast pyrolysis with upgrading to hydrocarbon fuel).

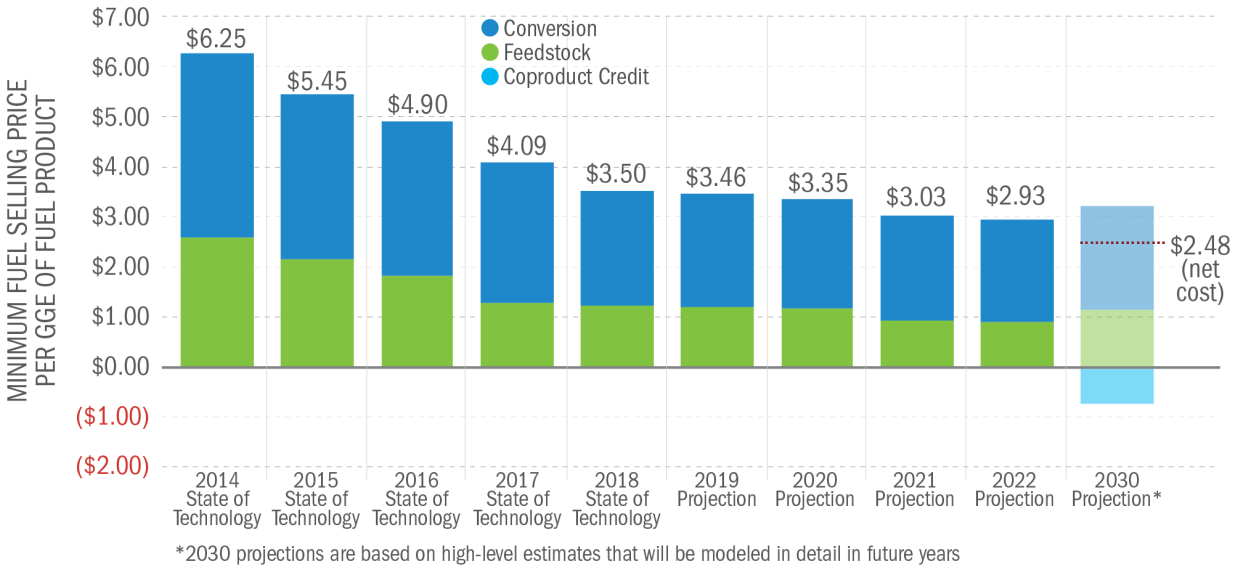

Figure 1: Illustrative biofuel pathway progress toward $3/GGE (woody feedstocks via catalytic fast pyrolysis and upgrading pathway).[3]

There is significant research, development and demonstration (RD&D) that is still required in order to reach the ultimate trajectory of a modeled mature biofuel MFSP of less than $2.50/GGE. The Topic Areas in this Funding Opportunity Announcement 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.
- R&D on conversion technologies able to efficiently process diverse and variable feedstocks into cost effective cellulosic sugars.
- R&D on separation technologies able to efficiently separate bioprocess intermediates to enable downstream processing.
- R&D to make residential wood heaters more efficient.
- R&D on conversion technologies able to produce renewable natural gas.

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

[3] Adapted from "Ex Situ Catalytic Fast Pyrolysis of Lignocellulosic Biomass to Hydrocarbon Fuels: 2018 State of Technology and Future Research." National Renewable Energy Laboratory. NREL/TP-5100-1954, accessible at: https://www.nrel.gov/docs/fy19osti/71954.pdf. Projections are interpolations of unpublished data

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 equity[4] 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.[5]

As part of this whole of government approach, this FOA seeks to encourage the participation of underserved communities[6] and underrepresented groups. Applicants are highly encouraged to include individuals from groups historically

[4] 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.

[5] Executive Order 13985, "Advancing Racial Equity and Support for Underserved Communities Through the Federal Government" (Jan. 20, 2021).

[6] 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 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.

underrepresented[7,8] 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.xvii). The plan should include SMART (Specific, Measurable, Assignable, Realistic and Time-Related) milestones supported by metrics to measure the success of the proposed actions. This plan will be evaluated as part of the technical review process.

Further, Minority Serving Institutions[9], Minority Business Enterprises, Minority Owned Businesses, Woman Owned Businesses, Veteran Owned Businesses, or entities located in a underserved community that meet the eligibility requirements (See Section III) are encouraged to apply as the prime applicant or 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.).

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[7] 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—blacks 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

[8] 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.

[9] 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.

B. Topic Areas

Topic Area	Title
1	Scale-up of Biotechnologies 1a: Pre-Pilot for Biofuels and Bioproducts 1b: Pilot for Biofuels and Bioproducts 1c: Demonstration for Biofuels and Bioproducts
2	Affordable, Clean Cellulosic Sugars for High Yield Conversion
3	Separations to Enable Biomass Conversion 3a: Separations to Improve Arrested Anaerobic Digestion Process Development 3b: Separations to Enable Biomass Conversion (Bioprocessing Separations Consortium)
4	Residential Wood Heaters
5	Renewable Natural Gas (RNG) 5a: RNG Research & Development 5b: RNG Pilot

i. Topic Area 1: Scale-up of Biotechnologies 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 ultimately 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.

This new strategy will include a multi-faceted approach in partnership with the private sector, the DOE national laboratories, and academia using the following elements:

- Focusing on the RDD&D of sustainable aviation fuels, while still recognizing the need to RDD&D of renewable diesel and sustainable marine fuels. A sustainable aviation fuel (SAF) is defined within the U.N. International Civil Aviation Organization 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;
- Allowing the use of waste resources as a low-cost feedstock including Municipal Solid Waste (MSW) and waste Carbon Dioxide (CO_2), in addition to traditional agricultural and forestry wastes;
- Allowing bioproduct opportunities to enable biofuels development.
- Leveraging first-generation biorefinery infrastructure, supply chains, and resources to integrate technologies to produce fuels from grain starch.
- Leveraging other existing infrastructure from sister industries, including but not limited to petrochemical and pulp and paper;
- Leveraging US-produced, oilseed crops (see Appendix G) that meet all other metrics of the topic area, including achieving at least 70% GHG reductions;
- Development and use of predictive models and high performance computing as tools to lower risk and accelerate scale-up of biotechnologies; and
- Opportunities for pre-pilot, pilot, and demonstration scale projects.

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

To reach these goals, Topic Area 1 of this FOA will fund projects at various levels of technology readiness including pre-pilot, pilot, and demonstration scale, jointly ranging from Technology Readiness Level (TRL) 3 to 7. BETO will identify, evaluate, and select applications proposing the scale-up of key process steps from lab 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 aviation and marine fuels, CO_2 conversion, waste and underutilized carbon feedstocks[10], and novel process technologies at the pilot scale that leverage existing first generation biorefinery assets and infrastructure.

Bioproducts are allowable as the primary product for proposed technologies under Subtopic Area 1a (pre-pilot) and 1b (pilot) as long as they enable biofuel development. Applications are required to show how the proposed bioproduct(s) enables biofuel production at larger scales. Applicants are required to provide a

[10] https://www.energy.gov/eere/bioenergy/waste-energy

market analysis discussing the bioproduct's market size, that considers the balance of fuel to products ratio and market share of each as the number of the proposed facilities increase in the U.S. The goal of the analysis is to understand whether or not a technology will flood a proposed product market as fuel production increases. Emphasis will be placed on projects with increasing potential fuel production volumes as the technology deploys to multiple commercial scale facilities and beyond. Bioproducts are not allowable as the primary product for the proposed technology under Subtopic Area 1c (demonstration). They may be considered as a coproduct (no more than 40% on a carbon basis) if essential for the overall economics of biofuel production. Grain starch and oilseed crops can only be used to produce fuels under Subtopic Areas 1b and 1c. DOE (or Federal) funds cannot be used to support the production of non-fuel products (primary or coproducts) from grain starch and/or oilseed crop fed processes; nor can funds used for the production of non-fuel products from grain starch and/or oilseed crop fed processes count as cost share; i.e., all costs associated with non-fuel products (primary or coproducts) from grain starch and/or oil seed crops must be excluded from the proposed project. Grain starch and oilseed crops are unallowable feedstocks under Subtopic Area 1a.

A total of $30,280,000 is anticipated to be available to fund pre-pilots (Subtopic Area 1a), pilots (Subtopic Area 1b – Phase 1), or demonstration (Subtopic Area 1c – Phase 1) projects, or a combination of the three depending on the applicant pool and the outcome of the selection process.

Due to the high dollar value and great complexity of pilot and demonstration scale projects (Subtopic Areas 1b and 1c), a down-selection process will be employed for both of those Subtopic Areas. In Phase 1, more than one application may be selected for negotiation of award, in order to verify the technology design basis. After completion of Phase 1, a down-select will occur in which one (1), some, or none of Topic Areas 1b and 1c Phase 1 awards will enter into negotiations for a Phase 2 award. Applicants should consider Subtopic Areas 1b and 1c Phase 2 (Design, Construction, Operation) projects on the order of $15M and $40M (respectively) of federal funds plus a minimum of 50% applicant cost-share when developing their Phase 1 proposals. Phase 2 funds are subject to future appropriations, availability of funds, and may be obligated to successful Subtopic Area 1b and 1c Phase 2 awards once a down-select occurs (see section VI.C.).

Topic Area 1: Scale-up Subtopic Area Summary Table

	Subtopic 1a: Pre-pilot	Subtopic 1b: Pilot	Subtopic 1c: Demonstration
Allowable Feedstocks	Lignocellulosic Feedstocks, Algae, Organic Wet Waste, Sorted Municipal Solid Waste, Food Waste, Biogas, and Waste Carbon Dioxide (CO_2)	Lignocellulosic Feedstocks, Algae, Organic Wet Waste, Sorted Municipal Solid Waste, Food Waste, Biogas, Grain Starch, Oilseed Crops	Lignocellulosic Feedstocks, Algae, Organic Wet Waste, Sorted Municipal Solid Waste, Food Waste, Biogas, Grain Starch, Oilseed Crops
Allowable Primary Products	sustainable aviation fuel, renewable diesel, sustainable marine fuels, bioproducts	sustainable aviation fuel, renewable diesel, sustainable marine fuels, bioproducts*	sustainable aviation fuel, renewable diesel, sustainable marine fuels
Minimum Throughput	0.5 Dry Tons Per Day (DTPD) equivalent; or 12,500 gallons of intermediate per year for an algal process equivalent; or 8 million British Thermal Units (MMBTU)/day of biogas equivalent; or 35 gallons per day of final fuel equivalent for processes that utilize CO_2 as a feed	20,000 gallons of biofuel per year equivalent; or 25,000 gallons of intermediate per year for an algal process equivalent; or 16 MMBTU/day of biogas equivalent	1,000,000 gallons of biofuel per year equivalent; or 1,250,000 gallons of intermediate per year for an algal process equivalent; or 800 MMBTU/day of biogas equivalent
Full Integration	No	Yes	Yes
Minimum GHG Reduction	70%	70%	70%
Fuel Selling Price	$2.75/GGE	$2.75/GGE	$2.75/GGE
Cumulative Time on Stream	500 hours	1,000 hours	1,000 hours
Continuous Time on Stream	100 hours	500 hours	500 hours
Phased Project	No	Yes	Yes

*Grain starch and oilseed crops may only be used to produce fuel as discussed in the Scale-up of Biotechnologies Overview section above.

ii. Subtopic Area 1a: Scale-up of Biotechnologies - Pre-Pilot for Biofuels and Bioproducts

Many technologies developed at the bench scale, both externally and within the other BETO programs, require further development prior to full system scaling. This subtopic area will scale up key process steps from lab scale unit operations (TRL 3) to industrially-relevant piece(s) of equipment (TRL 5). 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. 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. In addition, 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 $2.50/Gasoline Gallon Equivalent (GGE) Minimum Fuel Selling Price (MFSP) with at least 70% reduction in greenhouse gas emissions relative to petroleum-derived fuels. As such, the following metrics will be required for award:

Metric:	Minimum:	Stretch Target:
Fuel Selling Price	$2.75/GGE	$2.50/GGE
Cumulative Time on Stream	500 hours	1,000 hours
Continuous Time on Stream	100 hours	250 hours
Throughput Equivalent	0.5 Dry Tons Per Day (DTPD) equivalent; or 12,500 gallons of intermediate per year for an algal process equivalent; or 8 million British Thermal Units (MMBTU)/day of biogas equivalent; or 35 gallons per day of final fuel equivalent for processes that utilize CO_2 as a feed	1 DTPD equivalent; or 25,000 gallons of intermediate per year for an algal process equivalent; or 16 MMBTU/day of biogas equivalent; or 70 gallons per day of final fuel equivalent for processes that utilize CO_2 as a feed
Greenhouse Gas (GHG) Reductions	70%	80%

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

- Applications for Sustainable Aviation Fuels and Sustainable Marine Fuels;
- Waste and underutilized carbon feedstocks[11];
- Biorefinery technologies taking advantage of existing assets and infrastructure;
- Development of Predictive Models and High Performance Computing as Tools to Accelerate Scale-up; and
- Bioproducts that can be shown to lower the accompanied biofuel selling price below $2.75/GGE.

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.):

[11] https://www.energy.gov/eere/bioenergy/waste-energy

- Projects selected for negotiation of award will be subject to verification immediately after award.
- A Block Flow Diagram and Supplemental Data template are required as part of the application.
- Applications must describe a credible plan to run the proposed unit operations 500 cumulative hours on stream, with a minimum of 100 continuous hours.
- Applications proposing mock or ideal feedstocks and process streams will not be considered.
- The primary biofuel stream(s) must be a liquid at standard temperature and pressure (STP).
- Applications whose primary biofuel stream(s) contain at least 50% of the utilizable biogenic carbon will be prioritized over those who do not.
- 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.
- Applicants must include a plan toward ASTM International (ASTM) approval (or similar regulatory approval) of a biofuel and/or bioproduct in the scope of their project.
    - If the scope of the project includes the production of a final biofuel(s) and/or bioproduct(s), the applicant must prove that it has a reasonable chance of receiving ASTM approval (or similar). Official approval is not required by the end of the project, however produced biofuels and bioproducts must be tested using the appropriate ASTM standard practice (or similar) by the end of the project and provide those results. Work towards this regulatory testing should be included within the statement of project objectives (SOPO).
    - If the scope of the project focuses on an upstream operation and does not include the production of a final biofuel or bioproduct (e.g. feedstock handling unit operation), the project must show that there is a current technology pathway to convert or upgrade their produced intermediate(s) into a biofuel or bioproduct that meets ASTM specifications (or similar regulatory approval).
- The biofuel(s) either being produced or enabled by the proposed technology must be a liquid biobased hydrocarbon fuel for aviation, marine, or heavy-duty applications.
- Primary products must qualify as biofuels and/or bioproducts with at least a 70% reduction in greenhouse gas (GHG) emissions over the petroleum derived equivalent. 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) model[12] or provide schemes developed through the CORSIA (Carbon Offsetting and Reduction Scheme for International Aviation) methodology[13] for calculating life cycle emissions

- Bioproducts are allowable as the primary product for proposed technologies under Subtopic Area 1a as long as they enable biofuel development. Applications are required to show how the proposed bioproduct(s) enables biofuel production at larger scales. Applicants are required to provide a market analysis discussing the bioproduct's market size, that considers the balance of fuel to products ratio and market share of each as the number of the proposed facilities increase in the U.S. The goal of the analysis is to understand whether or not a technology will flood a proposed product market when fuel production increases.
- 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.

Subtopic 1a Allowable Feedstocks (see Appendix G for feedstock definitions)

Feedstock	Subtopic 1a
Lignocellulosic Feedstocks	Yes
Algae	Yes
Organic Wet Waste	Yes
Sorted Municipal Solid Waste	Yes
Food Waste	Yes
Biogas	Yes
Waste CO_2	Yes
Grain Starch	No
Oilseed Crops	No

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 this Subtopic Area:

- Applications submitted under this subtopic area are required to participate in a Verification as described in Section I.C.
- A publicly releasable final technical report describing how the technology would contribute to the BETO 2030 goal of $2.50/GGE MFSP with at least 70% reduction in greenhouse gas emissions relative to petroleum derived fuels.

[12] https://greet.es.anl.gov/

[13] https://www.icao.int/environmental-protection/CORSIA/Pages/CORSIA-Eligible-Fuels.aspx

Subtopic Area 1a Applications Specifically Not of Interest

- Those identified in Section I.D. of the FOA;
- Applications that use of grain starch or oilseed crops as a feedstock will not be considered; and
- Applications whose primary product is biopower or heat.
- Applicants whose primary fuel product is not intended for aviation, long-haul trucking, or marine usage.

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

iii. Subtopic Area 1b: Scale-up of Biotechnologies - Pilot Scale for Biofuels and Bioproducts

Subtopic Area 1b 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 manufacture of sustainable aviation and marine fuels; or
- waste and underutilized carbon feedstocks[14]; or
- novel process technologies that leverage existing first generation, grain starch, biorefinery assets and infrastructure.
- 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.

Subtopic Area 1b will provide the ability for pre-pilot scale technologies to scale to pilot scale. Pilot scale facilities developed under Subtopic Area 1b 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, or heavy-duty applications.

Scale-up and validation of these process technologies is essential to enable the industry to build future pioneer and commercial scale facilities. This industry segment has been lacking in many visible commercial successes with the exception of renewable natural gas and renewable diesel. Successfully scaling and validating process technology is critical for biotechnologies to remain a significant near-term decarbonization pathway.

In addition to more traditional biomass feedstocks (see Subtopic Area 1b Allowable Feedstocks table below), Subtopic Area 1b intends to leverage first generation starch-based ethanol facilities to produce renewable hydrocarbons

[14] https://www.energy.gov/eere/bioenergy/waste-energy

from grain starch feedstocks and intends to leverage novel process technologies that utilize US-produced oilseed crops. Validation of process technologies using lower cost sugar feedstocks and leveraging existing assets and infrastructure reduces technology risk and catalyzes future renewable and waste feedstock based processes.

Subtopic Area 1b seeks applications to first verify the technology design basis, and then construct and operate pilot scale Integrated Biorefinery (IBR) facilities. Given the high cost and complexity of pilot scale projects, recipients in Subtopic Area 1b will undergo an extended 12 month Verification & Design Basis Definition period to validate prior scale data and readiness to proceed (Phase 1). DOE will conduct a down-select review between Phase 1 and the design / construction / operation phase (Phase 2). One (1), some, or no projects may be selected to move into Phase 2. Further, if there is a Phase 2 selection under Subtopic Area 1b, it will be funded subject to future year appropriations.

Applications submitted under Subtopic Area 1b must meet a minimum neat biofuel throughput of 20,000 gallons per year equivalent. Bioproducts are allowed as the primary output from the pilot scale facility, but these projects must show how the bioproduct enables co-production of fuel at higher scales and minimum biofuels throughput must still be met. This will allow for enough biofuel volumes for regulatory approval and possible fleet / off-take testing. 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.** The minimum baseline technology readiness level for projects submitted under this topic is TRL is 4 with a maximum of TRL 6 at the conclusion of Phase 2. As such, the following metrics will be required for award:

Metric:	**Minimum:**
Fuel Selling Price	$2.75/GGE
Cumulative Time on Stream	1,000 hours
Continuous Time on Stream	500 hours
Throughput Equivalent	20,000 gallons of biofuel per year equivalent; or 25,000 gallons of intermediate per year for an algal process equivalent; or 16 MMBTU/day of biogas equivalent
GHG Reductions	70%

Subtopic Area 1b Allowable Feedstocks (see Appendix G for definitions)

Feedstock	Subtopic 1b
Lignocellulosic Feedstocks	Yes
Algae	Yes
Organic Wet Waste	Yes
Sorted Municipal Solid Waste	Yes
Food Waste	Yes
Biogas	Yes
Waste CO_2	No
Grain Starch	Yes (fuel only)
Oilseed Crops	Yes (fuel only)

Subtopic Area 1b Project and Award Structure

As noted above, Subtopic Area 1b seeks applications to first verify prior scale data and the technology design basis, and then construct and operate pilot scale Integrated Biorefinery (IBR) facilities. Given the high cost and complexity of pilot scale projects, recipients in Subtopic Area 1b will undergo an extended 12 month Verification & Design Basis Definition phase to validate prior scale data and readiness to proceed (Phase 1). DOE will conduct a down-select review between Phase 1 and the design / construction / operation phase (Phase 2), also referred to as Critical Decision (CD) 2[15]. The down-select decision will be made by DOE at the completion of the 12 month Phase 1. Project performance in Phase 1, as well as portfolio balance, availability of funds, and other factors, will be considered in the down select process. Only projects selected by DOE as a result of the down-select process will be eligible to receive additional 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).

Phases	Budget Periods	Scope
Phase 1 – Verification & Design Basis Definition (12 Months)	BP1	Verification of baseline data presented in application
	Go/No-Go	Review of Verification outcome

[15] https://www.directives.doe.gov/directives-documents/400-series/0413.3-BOrder-b/@@images/file

<table>
<tr><td></td><td>BP2</td><td>Design Basis Definition</td></tr>
<tr><td colspan="3">Down Select (CD-2)
Approve project scope and begin design (Subject to future appropriations)</td></tr>
<tr><td rowspan="5">Phase 2 - Design, Construction, Operation
(42-48 Months)</td><td>BP3</td><td>Project Definition - preliminary planning and design</td></tr>
<tr><td colspan="2">Go/No-Go (CD-3)
Review to approve start of construction</td></tr>
<tr><td>BP4</td><td>Project Execution - complete final design and construction</td></tr>
<tr><td colspan="2">Go/No-Go (CD-4)
Performance test to verify readiness to begin operations</td></tr>
<tr><td>BP5</td><td>Operations</td></tr>
</table>

Subtopic Area 1b Phase 1 Deliverables

Key deliverables that will be provided to DOE at the end of the 12 month Phase 1 period, which will be used by DOE to inform the down-select review and decision, include, but are not limited to:

- Independent Engineers (IE) verification of work at prior scale to confirm that the proposed IBR meets TRL 6. 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 -15/+30% budgetary estimate;
- 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;

- Applicants may use any standardized approach to calculating life cycle GHG emissions e.g. Argonne National Laboratory GREET model[16] or provide schemes developed through the CORSIA methodology[17] 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 integrated biorefinery (IBR) facility;
  - a preliminary 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;
  - an analysis of feedstock purchase options for sufficient quantities of material to execute the proposed project;
  - confirmation that sufficient power, water, or similar services will be available to the facility;
  - preliminary off-take agreements for any product(s) that will be produced from the facility;
  - a market analysis of all major facility inputs and outputs at initial (first facility), transitional, and mature (10 or more facilities) market share

[16] https://greet.es.anl.gov/

[17] https://www.icao.int/environmental-protection/CORSIA/Pages/CORSIA-Eligible-Fuels.aspx

points, considering the balance of fuel to products ratio and market share as the 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;
    - Production of any co-products; and
- Sufficient cost share in the form of allowable and readily available resources to complete Phase2.

Subtopic Area 1b Initial Project Verification

After negotiation and execution of the Phase 1 award, 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 validation 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 validation review will result in a 'No-Go' decision. Projects that receive a 'Go' decision at the conclusion of the initial validation effort and proceed to Budget Period 2 will also be subject to a final validation review as part of the down-select process prior to Phase 2.

Subtopic Area 1b National Environmental Policy Act (NEPA) Considerations

All Subtopic Area 1b project activities will be subject to NEPA review. Applicants should 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 should be accounted for within the proposed project's application.

Subtopic Area 1b 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 prior to entering into each Phase of the project. Recipients are required to secure all cost share and contingency prior to proceeding into the next project Phase or 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 Phase 2 activities. DOE experience and industry best practice show that a minimum of 25% of Total Project Cost (federal share and cost share) 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 the project. The continuation application for Phase 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 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.):

- Applications submitted under this subtopic area are required to participate in a Verification as described in Section I.C.
- A Block Flow Diagram and Supplemental Data template are required as part of the application.
- Applications proposing mock or ideal feedstocks and process streams will not be considered.
- The primary biofuel stream(s) must be a liquid at standard temperature and pressure (STP).
- Applications whose primary biofuel stream(s) contain at least 50% of the utilizable biogenic carbon will be prioritized over those that do not.
- 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 must show a reasonable chance of receiving ASTM International (ASTM) or other regulatory approvals.
- Primary products must qualify as biofuels with at least a 70% reduction in greenhouse gas (GHG) emissions over the petroleum derived equivalent.
- Applications cannot include greater than 10% of the total project budget for earlier stage R&D, including expenses for equipment, salaries, and supplies.
- The biofuels either being produced by or enabled by the proposed technology must be a renewable diesel, sustainable aviation fuel, and/or sustainable marine fuel.
- Bioproducts are allowable as the primary product for proposed technologies under Subtopic Area 1b as long as they enable biofuel development. Applications are required to show how the proposed bioproduct(s) enables biofuel production at larger scales. Applicants are required to provide a market analysis discussing the bioproduct's market size, that considers the balance of fuel to products ratio and market share of each as the number of the proposed facilities increase in the U.S. The goal of the analysis is to understand whether or not a technology will flood a proposed product market when fuel production increases.
- Biofuels (and bioproducts) must be produced domestically.
- The proposed pilot scale IBR must have a rated capacity of at least 20,000 gallons of neat biofuel per year.

Subtopic Area 1b Applications Specifically Not of Interest

- Those identified in Section I.D. of the FOA;
- Grain starch and oilseed crops can only be used to produce fuels under Subtopic Area 1b. DOE (or Federal) funds cannot be used to support the production of non-fuel products (primary or coproducts) from grain starch and/or oilseed crop fed processes; nor can funds used for the production of non-fuel products from grain starch and/or oilseed crop fed processes count as cost share; i.e., all costs associated with non-fuel products (primary or coproducts) from grain starch and/or oil seed crops must be excluded from the proposed project;
- Applications whose primary product is biopower or heat; or
- Applicants whose primary fuel product is not intended for aviation, long-haul trucking, or marine usage.

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

iv. Subtopic Area 1c: Scale-up of Biotechnologies - Demonstration Scale for Biofuels and Bioproducts

Subtopic Area 1c 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 manufacture of sustainable aviation and marine fuels; or
- waste and underutilized carbon feedstocks[18]; or
- novel process technologies that leverage existing first generation, grain starch, biorefinery assets and infrastructure.
- 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.

Subtopic Area 1c will provide the ability for pilot scale technologies to scale up to demonstration scale. Demonstration scale facilities developed under Subtopic Area 1c must produce at the plant's rated capacity a minimum quantity of 1,000,000 gallons per year of liquid biobased hydrocarbon fuel for aviation, marine, or heavy-duty applications.

[18] https://www.energy.gov/eere/bioenergy/waste-energy

Scale-up and validation of these process technologies is essential to enable the industry to build future pioneer and commercial scale facilities. This industry segment has yet to develop many visible, commercial scale bio-refineries, with the exception of renewable natural gas and renewable diesel. Successfully scaling and validating process technology is critical for biotechnologies to remain a significant near-term decarbonization pathway.

In addition to more traditional biomass feedstocks (see Subtopic Area 1c Allowable Feedstocks table below), Subtopic Area 1c intends to leverage first generation starch-based ethanol facilities to produce renewable hydrocarbons from grain starch feedstocks and intends to leverage novel process technologies that utilize US-produced oilseed crops. Validation of process technologies using lower cost sugar feedstocks and leveraging existing assets and infrastructure reduces technology risk and catalyzes future renewable and waste feedstock based processes.

Subtopic Area 1c seeks applications to first verify the technology design basis, and then construct and operate demonstration scale Integrated Biorefinery (IBR) facilities. Given the high cost and complexity of demonstration scale projects, recipients in Subtopic Area 1c will undergo an extended 12 month Verification & Design Basis Definition period to validate prior scale data and readiness to proceed (Phase 1). DOE will conduct a down-select review between Phase 1 and the design / construction / operation phase (Phase 2). One (1), some, or no projects may be selected to move into Phase 2. Further, if there is a Phase 2 selection under Subtopic Area 1c, it will be funded subject to future year appropriations.

Applications submitted under Subtopic Area 1c must meet a minimum neat biofuel throughput of 1,000,000 gallons per year equivalent. This will allow for enough biofuel volumes for regulatory approval and possible fleet / off-take testing. 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.** The minimum baseline technology readiness level for projects submitted under this topic is TRL 6 with a maximum of TRL 7 at the conclusion of Phase 2. As such, the following metrics will be required for award:

Metric:	**Minimum:**
Fuel Selling Price	$2.75/GGE
Cumulative Time on Stream	1,000 hours
Continuous Time on Stream	500 hours

Throughput Equivalent	1,000,000 gallons of biofuel per year equivalent; or 1,250,000 gallons of intermediate per year for an algal process equivalent; or 800 MMBTU/day of biogas equivalent
GHG Reductions	70%

Subtopic Area 1c Allowable Feedstocks (see Appendix G for definitions)

Feedstock	**Subtopic 1c**
Lignocellulosic Feedstocks	Yes
Algae	Yes
Organic Wet Waste	Yes
Sorted Municipal Solid Waste	Yes
Food Waste	Yes
Biogas	Yes
Waste CO_2	No
Grain Starch	Yes (fuel only)
Oilseed Crops	Yes (fuel only)

Subtopic Area 1c Project and Award Structure

As noted above, Subtopic Area 1c seeks applications to first verify prior scale data and the technology design basis, and then construct and operate demonstration scale Integrated Biorefinery (IBR) facilities. Given the high cost and complexity of demonstration scale projects, recipients in Subtopic Area 1c will undergo an extended 12 month Verification & Design Basis Definition phase to validate prior scale data and readiness to proceed (Phase 1). DOE will conduct a down-select review between Phase 1 and the design / construction / operation phase (Phase 2), also referred to as Critical Decision (CD) 2[19]. The down-select decision will be made by DOE at the completion of the 12 month Phase 1. Project performance in Phase 1, as well as portfolio balance, availability of funds, and other factors, will be considered in the down-select process. Only projects selected by DOE as a result of the down-select process will be eligible to receive additional 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).

[19] https://www.directives.doe.gov/directives-documents/400-series/0413.3-BOrder-b/@@images/file

Phases	Budget Periods	Scope
Phase 1 – Verification & Design Basis Definition (12 Months)	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 - Design, Construction, Operation (42-48 Months)	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

Subtopic Area 1c Phase 1 Deliverables

Key deliverables that will be provided to DOE at the end of the 12 month Phase 1 period, which will be used by DOE to inform the down-select review and decision, include, but are not limited to:

- Independent Engineers (IE) verification of work at prior scale to confirm that the proposed IBR meets TRL 6. 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 -15/+30% budgetary estimate;
- 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.

  Applicants may use any standardized approach to calculating life cycle GHG emissions e.g. Argonne National Laboratory GREET model[20] or provide schemes developed through the CORSIA methodology[21] 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 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 show the recipient has:
  - secured the rights to practice all necessary intellectual property to construct and operate the proposed integrated biorefinery (IBR) facility;
  - a preliminary 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;
  - an analysis of feedstock purchase options for sufficient quantities of material to execute the proposed project;
  - confirmation that sufficient power, water, or similar services will be available to the facility;

[20] https://greet.es.anl.gov/

[21] https://www.icao.int/environmental-protection/CORSIA/Pages/CORSIA-Eligible-Fuels.aspx

- preliminary off-take agreements for any product(s) that will be produced from the facility;
- a market analysis of all major facility inputs and outputs at initial (first facility), transitional, and mature (10 or more facilities) market share points, considering the balance of fuel to products ratio and market share as the 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 not limited to:
    - Economic competitiveness of proposed solutions compared to existing alternatives, with and without incentives or subsidies;
    - Production of any co-products; and
- Sufficient cost share in the form of allowable and readily available resources to complete Phase2.

Subtopic Area 1c Initial Project Verification

After negotiation and execution of the Phase 1 award, 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 with 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 validation 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 validation review will result in a 'No-Go' decision. Projects that receive a 'Go' decision at the conclusion of the initial validation effort and proceed to Budget Period 2 will also be subject to a final validation review as part of the down-select process prior to Phase 2.

Subtopic Area 1c National Environmental Policy Act (NEPA) Considerations

All Subtopic Area 1c project activities will be subject to NEPA review. Applicants should 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 V.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 Study. Proper budgeting and scheduling should be accounted for within the proposed project's application.

Subtopic Area 1c 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 prior to entering into each Phase of the project. Recipients are required to secure all cost share and contingency prior to proceeding into the next project Phase or 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 Phase 2 activities. DOE experience and industry best practice show that a minimum of 25% of Total Project Cost (federal share and cost share) 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 the project. The continuation application for Phase 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 1c 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.):

- Applications submitted under this subtopic area are required to participate in a Verification as described in Section I.C.
- A Block Flow Diagram and Supplemental Data template are required as part of the application.
- Applications proposing mock or ideal feedstocks and process streams will not be considered.
- The primary biofuel stream(s) must be a liquid at standard temperature and pressure (STP).
- Applications whose primary biofuel stream(s) contain at least 50% of the utilizable biogenic carbon will be prioritized over those that do not.
- 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 must show a reasonable chance of receiving ASTM International (ASTM) or other regulatory approvals
- Primary products must qualify as biofuels with at least a 70% reduction in greenhouse gas (GHG) emissions over the petroleum derived equivalent.
- Applications cannot include greater than 10% of the total project budget for earlier stage R&D, including expenses for equipment, salaries, and supplies.
- The biofuels either being produced by or enabled by the proposed technology must be a renewable diesel, sustainable aviation fuel, and/or sustainable marine fuel.
- Biofuels (and bioproducts) must be produced domestically.
- The proposed demonstration scale IBR must have a rated capacity of at least 1,000,000 gallons of neat biofuel per year.

Subtopic Area 1c Applications Specifically Not of Interest

- Those identified in Section I.D. of the FOA;
- Grain starch and oilseed crops can only be used to produce fuels under Subtopic Area 1c. DOE (or Federal) funds cannot be used to support the production of non-fuel products (primary or coproducts) from grain starch

and/or oilseed crop fed processes; nor can funds used for the production of non-fuel products from grain starch and/or oilseed crop fed processes count as cost share; i.e., all costs associated with non-fuel products (primary or coproducts) from grain starch and/or oil seed crops must be excluded from the proposed project;
- Applications whose primary product is biopower or heat;
- Applicants whose primary fuel product is not intended for aviation, long-haul trucking, or marine usage;
- Bioproducts are not allowable as the primary product for the proposed technology under Subtopic Area 1c (demonstration). They may be considered as a coproduct (no more than 40% on a carbon basis) if essential for the overall economics of biofuel production; or
- Applicants who use grain starch and/or oil seed crops for anything other than fuel production.

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: Affordable, Clean Cellulosic Sugars for High Yield Conversion Overview

Biofuels produced from lignocellulosic biomass feedstocks can deliver significantly lower lifecycle greenhouse gas emissions than commercial starch-based sugars. However, it is much more challenging to produce an intermediate sugar from these feedstocks that is cheap enough and of sufficient quality to support a commercial conversion process. This topic area aims to lower the price of cellulosic sugars and de-risk their use by downstream partners through increased availability and performance. It is designed to attract companies that produce and seek to sell cellulosic sugars. These technologies could include a variety of low severity pretreatment processes, detoxification/impurity removal technologies, amongst others. The topic area also may include funding for downstream partners that are critical to evaluating the quality and convertibility of these sugars. The potential topic area seeks a variety of downstream upgrading approaches (biological, chemical, and electrochemical catalysis) to gain a diverse understanding of the quality of these substrates.

Topic Area 2 Specific Areas of Interest

- Process intensification strategies for reducing the capital/operating expenses associated with pretreatment, enzymatic hydrolysis, and/or sugar conditioning/clarification

- Novel pretreatment processes for deconstructing and fractionating lignocellulosic feedstocks
- Novel processes for conditioning or detoxifying sugars to meet downstream quality and impurity specifications
- Optimization of pretreatment technologies/processes to improve product yields
  Processes that are capable of handling and producing sugars from multiple varieties of feedstocks

Topic Area 2 Metrics

By the completion of the project, applicants must be able to achieve monomeric sugars (glucose and xylose) that:

- Can be produced for less than $0.20/lb. (nth plant economics). The delivered feedstock price, to the plant gate, in the techno-economic analysis should be assumed to be $85.06/ton unless the applicant can provide data to justify otherwise.
- Can be efficiently converted to the target product where: product yield, sugar conversion yield, sugar conversion rate, production rate (productivity), organism optical density, and organism growth rate are demonstrated at values >90% relative to pure glucose or xylose.
- The lead entity must partner with a minimum of 3 downstream processes to verify these 90% performance metrics

Topic Area 2 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.):

- At the time of the application, the lead entity must be able to produce at least 10kg of sugars (dry basis) in a month
- The application must identify at least three external project partners with whom the lead entity will evaluate the performance of their sugars on during the duration of the project. Downstream conversion partners can possess technologies in biochemical upgrading, catalytic upgrading, or a combination thereof. Project partners must provide a letter of support.
- The application must include information on how the team would scale-up the process to a pilot scale (if they have not already done so already).
- The application must include a baseline techno-economic analysis stating the current projected price of sugar production for the proposed technology (see Topic Area 2 Special Deliverables below)

Topic Area 2 Applications Specifically Not of Interest

- Those identified in Section I.D. of the FOA;
- Applications proposing the development of new cellulase/hemicellulase cocktail formulations;
- Consolidated bioprocessing technologies or other technologies that combine the hydrolysis of sugars and fermentation into a single step; or
- Applications that propose >25% of the total project budget involving R&D on downstream conversion strain or catalyst development.

Topic Area 2 Special Deliverables

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

1. Applications submitted under this Topic Area are required to participate in a Verification as described in Section I.C.
2. Applications under Topic Area 2 will be required to provide a techno-economic analysis (TEA) to calculate the minimum sugar selling price. Results from this model must be included in the application to clearly specify the baseline minimum sugar selling price and will be used throughout the project to track progress towards the topic area target of $0.20/lb.
3. A publicly available excel-based sugar production cost model has been developed by the National Renewable Energy Laboratory (NREL). See Appendix I for a link to that model. Applicants may utilize this model or their own internal model to satisfy the requirement for a techno-economic analysis. This techno-economic analysis should include:
    - Costs of enzyme (cellulase and hemicellulase) production and/or purchase;
    - Capital and operating costs for unit operations that are necessary for conversion of lignocellulosic materials into monomeric sugars. This may include but not be limited to: pretreatment, enzymatic hydrolysis, sugars clarification, milling, and water treatment;
    - Delivered feedstock cost of $85.06/ton unless data provided by the applicant can justify otherwise[22]; and

[22] To the extent possible a standard feedstock cost is being used in order to make comparisons between sugar production processes. It is recognized that some feedstocks, e.g. fractions of waste, might be available at significantly lower costs but they are expected to have increased production/detoxification costs

- No co-product credits for other fractions (e.g. lignin).

4. Scope to conduct a life cycle analysis (LCA) must be included as part of the project proposal. The project must develop a life-cycle analysis that tracks the environmental performance of the sugar's production relative to starch-based sugar's production. Argonne National Laboratory (ANL) has developed publicly available life-cycle assessment tools that applicants may utilize. See Appendix I for a link to that model. The life-cycle analysis should, at a minimum, include:
    - GHG emissions tracked in gCO2e/lb. sugars;
    - Water consumption tracked in gallons water/lb. sugars; and
    - Carbon intensity of the process.

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

vi. Topic Area 3: Separations to Enable Biomass Conversion Overview

Separations are energy-intensive and critical to the economics of a bioprocess, and can account for up to 50% of the cost of producing biomass-based chemicals and fuels. Due to the cost and energy intensity, separations can have a large impact on improving economic viability and the lifecycle greenhouse gas benefits for biofuel production. In a biorefinery, bioprocess separations isolate a specific component from a complex mixture and are a critical part of a bioprocess and are often overlooked during technology development. New bioprocesses introduce many variables that may prevent existing separations technologies from being readily deployed. Therefore, co-development of separations with up- and down-stream processes is key to the success of the overall bioprocess. The two (2) subtopic areas below address the complexity and cost of bioprocess separations.

Subtopic Area 3a: Separations to Improve Arrested Anaerobic Digestion Process Development

This subtopic area seeks to develop efficient and cost-effective separations approaches to isolate and potentially upgrade organic acids and products of interest from digesters.

Subtopic Area 3b: Separations to Enable Biomass Conversion (Bioprocessing Separations Consortium)

This subtopic area seeks to improve availability of data that will support separations development, as well as to develop supporting technologies to improve bioprocessing separations. This subtopic area will provide funding for

collaborative projects between an applicant and the Bioprocessing Separations Consortium to address critical bioprocess separations challenges. More information on the capabilities of the Bioprocessing Separations Consortium can be found at https://www.bioesep.org/.

vii. Subtopic Area 3a: Separations to Improve Arrested Anaerobic Digestion Process Development

Arrested anaerobic digestion provides an opportunity for distributed biochemical and biofuel production from waste residues. One of the key challenges facing the deployment of small-scale digesters is the need to produce products that are of higher value than biogas. In order to produce higher value products and fuels, separation strategies must be employed to recover intermediates that can be upgraded. Volatile fatty acids and other organic acids are intermediates produced in the natural decomposition of organic waste (e.g. food waste, manure, municipal sludge).

Topic Area 3a seeks to develop efficient and cost-effective separations approaches to isolate and potentially upgrade organic acids and products of interest from digesters. Improved separations should overcome several technical barriers facing bioprocess development, including: reducing the cost of fuel and chemical production, improving catalyst lifetime by removing product and contaminants, developing selective separations of organic species, improving selective separations of inorganic contaminants, improving water recovery, and enabling process integration. In addition, robust and reliable systems are critical and the technologies proposed must demonstrate their ability to operate continuously.

Applications should address one or more of the following specific areas of interest relating to the separation of products from anaerobic digestion systems.

Subtopic Area 3a Specific Areas of Interest

- Reactive separations of organic species
- Open-source and streamlined process modeling, particularly as applied to selecting and developing new separations processes for anaerobic digestion systems
- Separations paired with comprehensive and rapid compositional analysis
- Separations of small molecules in the presence of solids
- All applications must clearly specify downstream application and downstream partner

Subtopic Area 3a Specific Requirements

Subtopic Area 3a seeks to develop novel separations to de-risk and standardize biomass conversion technologies. 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.):

- Achieve separation efficiency, via purity and yield, that is sufficient for the specified downstream application, and also reduce the energy dedicated to separations compared to the incumbent state-of-the-art by at least 50%, or comprise no more than 25% of the total process energy if no incumbent exists.
- By the end of the project, separation technologies developed must demonstrate a minimum of 100 continuous hours of stable operation and recover a minimum of 1 kilogram (kg) of product(s) over that duration.
- For each area of interest addressed in the application, the applicant must identify the value proposition and environmental impact of the proposed separations technology through technoeconomic and life cycle analyses. The technologies must meet the metrics outlined here, and as required for the downstream application.

Subtopic Area 3a Applications Specifically Not of Interest:

- Those identified in Section I.D. of the FOA.
- Processes that will not be economical when scaled to industrially-relevant size.
- Processes that target small, niche, fine chemical markets, pharmaceutical markets, or nutraceutical markets.

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 this Topic Area:

- Applications submitted under this Topic Area are required to participate in a Verification as described in Section I.C.

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

viii. Subtopic Area 3b: Separations to Enable Biomass Conversion (Bioprocessing Separations Consortium)

The ongoing Bioprocessing Separations Consortium has targeted reducing the cost of separations. Subtopic 3b will provide funding for collaborative projects between an applicant and the Bioprocessing Separations Consortium to address critical bioprocess separations challenges. More information on the capabilities of the Bioprocessing Separations Consortium can be found at https://www.bioesep.org/. Interested parties should coordinate with the Bioprocessing Separations Consortium at bioesep@anl.gov. Applicants must clearly articulate which Subtopic Area 3b areas of interest they plan to address in coordination with the Consortium prior to submission of the full application. The preferred mechanism for collaboration with the Bioprocessing Separations Consortium is to use the Consortium's Cooperative Research and Development Agreement (CRADA) though other mechanisms authorized under the National Laboratory's Management and Operations (M&O) contract are acceptable subject to DOE approval. The template CRADA is here (https://blogs.anl.gov/bioseparations/wp-content/uploads/sites/72/2018/05/Single-lab-single-participant-sample-CRADA.pdf) and must be executed without substantial changes.

Subtopic Area 3b Specific Areas of Interest

- Collection of physical property and thermodynamic data of impactful bioproducts and their separations; coordination with National Institute of Standards and Technology (NIST) and Design Institute for Physical Properties (DIPPR) is encouraged.
- Identify material property gaps for impactful bioproducts (e.g. 2,3-butanediol) and collect relevant physical property and thermodynamic data for priority molecules.
- Incorporate physical property and thermodynamic data into process simulations.
- Liquid-liquid separations with the following advances: extractants that are non-toxic to microorganisms, improving extractant half-life and impact on operating expenses (OPEX), demonstration of truly continuous product recovery out of a liquid extractant, improved contact area between extractant and product stream during a continuous separation.
- Separations that utilize functional materials with tunable physicochemical properties that provide superior selectivity, mechanical robustness, chemical stability, and poisoning/fouling resilience.
- Development of analytical chemistry capabilities to characterize complex feed and product streams.

Subtopic Area 3b Specific Requirements

Subtopic Area 3b seeks to improve the availability of data that will support separations development, as well as to develop supporting technologies to improve bioprocessing separations. 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 seeking to improve separations processes must achieve:

- Separation efficiency, via purity and yield, that is sufficient for the specified downstream application, and also reduce the energy dedicated to separations compared to the incumbent state-of-the-art by at least 50%, or comprise no more than 25% of the total process energy if no incumbent exists.
- By the end of the project, separation technologies developed must demonstrate a minimum of 100 continuous hours of stable operation and recover a minimum of 1 kilogram (kg) of product(s) over that duration.
- For each area of interest addressed in the application, the applicant must identify the value proposition and environmental impact of the proposed separations technology through technoeconomic and life cycle analyses. The technologies must meet the metrics outlined here, and as required for the downstream application.

Projects seeking to improve data availability to support separations must achieve:

- Data analysis pipelines that can apply to multiple product streams.
- Projects seeking to gain thermodynamic and thermophysical data must make the resulting data readily and publicly available.

Subtopic 3b Applications Specifically Not of Interest:

- Those identified in Section I.D. of the FOA.
- Processes that will not be economical when scaled to industrially-relevant size.
- Processes that target small, niche, fine chemical markets, pharmaceutical markets, or nutraceutical markets.
- Applications developed without coordination with the Bioprocessing Separations Consortium.

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

ix. Topic Area 4: Residential Wood Heaters Overview

Wood is an abundant and renewable source of fuel for residential heat in the United States. Residential wood heaters are used in approximately 10% of U.S. households, with 2% using wood as a primary source of heat. Smoke emissions from residential wood heaters are a significant source of national air pollution and a health issue. These emissions contain fine particulate matter (PM) along with other pollutants including carbon monoxide (CO), volatile organic compounds (VOCs), toxic air pollutants (e.g., benzene and formaldehyde), and black carbon. Design and automation improvements of wood heaters can significantly reduce emissions and increase efficiency. This topic area will support the development and testing of low-emission, high efficiency, and cost competitive residential wood heaters. Categories of residential wood heaters of interest include room heaters, hydronic central heaters, and forced air central heaters.

Topic Area 4 Specific Areas of Interest

- Novel and innovative residential wood heater designs to improve combustion chamber geometry, combustion air flow distribution, mixing of combustion air with gasification products, achieve complete combustion of wood, stove baffling designs, and insulation strategies to control stove temperatures in critical locations.
- Improvements in automation of stoves to optimize combustion control:
  - Air inlet / feed control
  - Wood feed systems and control
  - Integrated robust sensing technologies
  - System control strategies to enable efficient wood heater control over a wide range of operating conditions (startup to shutdown)
  - Secure remote control and real-time performance monitoring
  - Performance data acquisition
- Wood heater power generation via thermoelectric module integration
- Advanced modeling and simulation tools to accelerate the process of wood heater research and development
- Improvements in catalyst technologies for emissions reduction
  - Novel catalysts and or catalyst structures for improved performance and durability
  - Catalyst integration into wood heater design

Topic Area 4 National Environmental Policy Act (NEPA) Considerations

All project activities will be subject to NEPA review. Applicants should account for NEPA related efforts in the project scope, schedule, and budget. Please note that testing activities will be subject to additional NEPA review and could require limits on location of testing. See Sections IV.J.ii.1 and V.B.vi for additional information on NEPA requirements.

Topic Area 4 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.):

- Applications must propose to utilize wood chips, cord wood, or wood pellets. No other biomass feedstocks are acceptable.
- Applications must include the **"Baseline Wood Heater Technology and Performance"** as indicated in Appendix H. This data establishes the baseline/as-is performance of the proposed wood heater technology that will be developed during proposed project.
- A detailed description of the technical approach and plan to reduce wood heater emissions by 25-50% relative to the EPA 2020 emission limits and a 5-15% improvement in weighted average efficiency. 2020 emission limits and test methods for room heaters and central heaters are defined in the 2015 Environmental Protection Agency (EPA) standards of performance for residential wood heater particulate matter emissions and subsequent updates[23] (2015 Standard):

Residential Wood Heater	Particulate Matter Emissions Limit
Room Heater	2.0 g/hr., or 2.5 g/hr. (cord wood alternative)
Hydronic	0.1 lb./MMBTU heat output, or 0.15 lb./MMBTU (cord wood alternative)
Forced-Air	0.15 lb./MMBTU heat output

- Final performance testing of integrated residential wood heater designs in prototype form must be incorporated into the project plan. At a minimum, the testing must:
  - Evaluate reductions in PM, reductions in CO, and efficiency improvement.

[23] Standards of Performance for New Residential Wood Heaters, New Residential Hydronic Heaters and Forced-Air Furnaces. Federal Register, Vol. 80, No. 50, Monday, March 16, 2015

  - Be in accordance with relevant criteria (specific to the wood heater type) established in the 2015 Rule to quantify emissions reduction and efficiency improvements (testing in a certified test facility is optional).
  - Expand the testing regimen to evaluate performance over the full cycle of residential wood heater operating conditions (representative of how homeowners actually use their residential wood heaters with representative wood feedstocks). Examples of typical operating conditions include, but are not limited to:
    - Cold start-up;
    - Steady-State;
    - Over feeding;
    - Overnight burn; and
    - Burn out.
- The proposed advancements in wood heater designs or retrofit devices must be cost competitive within the respective market segment. The incremental cost of a redesigned room heater meeting the targets for reduced emissions and efficiency gains should be less than 10% of comparable wood heater in the marketplace. Retrofit device cost must be less than 10% of the target residential wood heater system on an installed basis.
- Applications proposing novel residential wood heater component development (e.g., novel/improved catalyst, improved sensors, and retrofit devices) must propose quantifiable performance metrics and test methods for baseline and final performance testing.

Topic Area 4 Applications Specifically Not of Interest

- Those identified in Section I.D. of the FOA;
- Open fireplaces, cook stoves, camp stoves, non-residential wood heaters;
- Non-innovative adaptation of a proven technology for the limited purpose of residential wood heater certification compliance testing;
- Residential heaters developed to burn fuels other than wood chips, cord wood, or wood pellets including, but not limited to, corn kernels, manure, materials containing plastic, waste petroleum products, coal, trash, grass, residential or commercial garbage, lawn clippings or yard waste, paper products, railroad ties or pressure treated lumber, wood charcoal, torrefied wood or biomass, and construction debris;
- Commercial scale wood heaters or wood heating systems;
- Co-firing of wood and other fuels; and
- Detailed engineering and capital investment for the purpose of transitioning a prototype wood heater or wood heater technology into manufacturing.

Topic Area 4 Metrics

The application must propose to meet all the minimum targets below by the end of the project:

- 25 – 50% reduction in emissions relative to the 2020 residential wood heater emission limits; and
- 5 – 15% improvement in the weighted average delivered efficiency for residential wood heaters relative to their current baseline residential wood heater design.

Topic Area 4 Special Deliverables

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

- Applications submitted under this Topic Area are required to participate in a Verification as described in Section I.C.

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

x. Topic Area 5: Renewable Natural Gas Overview

Renewable natural gas (RNG) is rapidly emerging as a solution to simultaneously address local waste management problems and decarbonize energy sectors that rely on natural gas, such as residential heating or industrial applications. In the United States, several major utilities have committed to or have communicated renewable natural gas targets although several barriers around biogas upgrading and cleanup are still present.

In the United States, there are more than 100 operational RNG projects, with nearly 100 more under construction or advanced development/feasibility. Anaerobic digestion of organic waste at landfills and large dairy or swine operations are the most common sites for these projects. In these operations, the organic waste is converted to approximately 50-60% methane and 30-40% carbon dioxide, in addition to other contaminants and inert compounds (such has hydrogen sulfide, water, and ammonia). The removal of these inert gases, especially carbon dioxide, is operationally intensive.

Another strategy for the production of renewable natural gas, referred to as "power-to-gas" (P2G), is also emerging as an attractive energy storage and

ancillary services solution. This technology is projected as a major source of renewable natural gas, beyond the conversion of organic waste streams. In this process, renewable hydrogen (e.g. through electrolysis) is combined with carbon dioxide found in biogas to produce methane. Other similar conversion strategies exist as well. Note that improvements to anaerobic digestion, such as membrane bioreactors, pretreatments, etc. are not of interest to this topic area.

xi. Subtopic Area 5a: Renewable Natural Gas (R&D)

Subtopic Area 5a is targeted at bench-scale research and development to produce RNG and specifically to develop new technologies for upgrading biogas and carbon dioxide/hydrogen to pipeline quality renewable natural gas.

Subtopic 5a is designed to develop new technologies to:

A. Efficiently remove impurities from biogas to RNG (biogas upgrading) through the use of advanced sorbents, membranes, and/or process intensification and separations strategies; and
B. Develop and demonstrate technologies for conversion of carbon dioxide in biogas and hydrogen to methane. Note that waste carbon dioxide streams other than biogas are not permitted, such as those from the fermentation of ethanol at a biorefinery.

Subtopic Area 5a Performance Metrics (by the end of the project)

- Upgrading or conversion processes must result in a methane stream that meets the following specifications:
  - A maximum of 2% carbon dioxide and 4% total diluent gases;
  - A maximum of 0.25 grains/100 standard cubic foot (SCF) of hydrogen sulfide;
  - A heat content minimum of 970 btu/scf; and
  - The following specifications set forth in Table 1 below (continues on next page):

Gas Quality Specification	Low	High
Heat Content (BTU/scf)	970	1110
Wobbe Number (+/- 4% from historical supply)	1270	1400
Water Vapor Content (lbs./MM scf)		<7
Product Gas Mercaptans (ppmv, does not include gas odorants)		<1
Hydrocarbon Dew Point, (°F) CHDP		15

Hydrogen Sulfide (grain/100 scf)		0.25
Total Sulfur (grain/100 scf)		1
Total Diluent Gases including the following individual constituent limits:		4%
Carbon Dioxide 2% max Nitrogen 2% max Oxygen (O_2) 0.1%-0.4% max		
Hydrogen		0.1-0.3%
Total Bacteria	Comm Free (≤0.2 microns)	
Mercury	Comm Free (<0.06 µg/m³)	
Other Volatile Metals	Comm Free (<213 µg/m³)	
Siloxanes as (D4)	Comm Free (-<0.5 mg Si/m³)	
Ammonia	Comm Free (<10 ppmv)	
Non-Halogenated Semi-Volatile and Volatile Compounds	Comm Free (<500 ppmv)	
Halocarbons (total measured halocarbons)	Comm Free (<0.1 ppmv)	
Aldehyde/Ketones	Comm Free (<100 ppbv)	
PCB's/Pesticides	Comm Free (<1 ppbv)	

Table 1: Gas quality minimum considerations [24]

- Biogas to RNG upgrading projects must achieve a minimum of 25% operational cost improvement relative to commercial technologies (i.e., pressure swing adsorption)
- Projects that are piloting biogas upgrading or conversion to methane must achieve a minimum of 500 continuous hours on-stream by the end of the project while meeting the quality specifications outlined above

Subtopic Area 5a Specific Requirements

- Applicants must quantify the technical and economic state-of-technology for the process being proposed for biogas upgrading or conversion to methane;
- Projects must work with real biogas streams for key milestones including verifications (see section I.C.) and Go/No-Go decision points (see section VI.B.xiv). In places where a direct stream or slipstream cannot be used, bottled biogas can be used for these key milestones. Surrogate or mock biogas will be permitted for other R&D activities; and

[24] Adapted from https://www.northeastgas.org/pdf/nga_gti_interconnect_0919.pdf, pp. 15-16.

- Applications must include techno-economic and life-cycle analyses throughout the project. Life cycle analyses should also include quantification of environmental impacts or benefits of the proposed process including but not limited to: local air quality, organic waste diversion, carbon intensity, and compliance with emerging regulations/policies.

Subtopic Area 5a Applications Specifically Not of Interest

- Those identified in Section I.D. of the FOA;
- Applications proposing improvements to anaerobic digestion, such as membrane bioreactors, pretreatments, etc. are not of interest to this topic area; or
- Power-to-gas technologies that utilize a carbon dioxide source other than biogas.

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

xii. Subtopic Area 5b: Renewable Natural Gas (Pilot Scale)

As noted above, there are a significant number of RNG projects in operation in the United States today. Subtopic Area 5b seeks to advance the technology readiness of next generation biogas upgrading and RNG production technologies through piloting, integrated operations, and increased duration of continuous run-time. Applicants are encouraged to pilot their technology on-site with a biogas or biogas/hydrogen source to the extent possible.

Given the high cost and complexity of pilot scale projects, recipients in Topic Area 5b will undergo an extended 12 month Verification & Design Basis Definition period to validate prior scale data (Phase 1). DOE will conduct a Go/No-Go review process at the end of phase 1. Please see the section below (deliverables at the end of Phase 1) for what is expected of projects), also referred to as Critical Decision (CD) 2[25]. Only when projects receive a "Go" decision will they be authorized to move into the design / construction / operation phase of the project (Phase 2).

Subtopic Area 5b is designed to develop new technologies to:

[25] https://www.directives.doe.gov/directives-documents/400-series/0413.3-BOrder-b/@@images/file

- Pilot biogas upgrading and processes for the conversion to methane that are more economically and energetically efficient compared to incumbent processes;
- Assist technologies in maturing from bench/engineering scale (less than TRL 5) to pilot scale (TRL 6); and
- Demonstrate integration of the process in a continuous fashion.

Subtopic Area 5b Project and Award Structure

<table>
<tr><th>Phases</th><th>Budget Periods</th><th>Scope</th></tr>
<tr><td rowspan="3">Phase 1 – Verification & Design Basis Definition (12 Months)</td><td>BP1</td><td>Verification of baseline data presented in application</td></tr>
<tr><td colspan="2">Go/No-Go
Review of Verification outcome</td></tr>
<tr><td>BP2</td><td>Design Basis Definition</td></tr>
<tr><td colspan="3">Go/No-Go (CD-2)
Approve project scope and begin design (Subject to future appropriations)</td></tr>
<tr><td rowspan="5">Phase 2 - Design, Construction, Operation (42-48 Months)</td><td>BP3</td><td>Project Definition - preliminary planning and design</td></tr>
<tr><td colspan="2">Go/No-Go (CD-3)
Review to approve start of construction</td></tr>
<tr><td>BP4</td><td>Project Execution - complete final design and construction</td></tr>
<tr><td colspan="2">Go/No-Go (CD-4)
Performance test to verify readiness to begin operations</td></tr>
<tr><td>BP5</td><td>Operations</td></tr>
</table>

Subtopic Area 5b Performance Metrics (by the end of the project)

- Upgrading or conversion processes must result in a methane stream that meets the following specifications:
  - A maximum of 2% carbon dioxide and 4% total diluent gases;
  - A maximum of 0.25 grains/100 scf of hydrogen sulfide;
  - A heat content minimum of 970 btu/scf; and
  - The specifications as identified in Table 1 in the Subtopic Area 5a Performance Metrics section above.
- Biogas to RNG upgrading projects must achieve a minimum of 25% operational cost improvement relative to commercial technologies (i.e., pressure swing adsorption).

- Projects that are piloting biogas upgrading or conversion to methane must achieve a minimum of 1,000 continuous hours on-stream by the end of the project while meeting the quality specifications outlined above.

Subtopic Area 5b Specific Requirements

- Applicants must quantify the technical and economic state-of-technology for the process being proposed for biogas upgrading or conversion to methane;
- Projects must work with real biogas streams for key milestones including verifications (see section I.C.) and Go/No-Go decision points (see section VI.B.xiv). In places where a direct stream or slipstream cannot be used, bottled biogas may be used for these key milestones. Surrogate or mock biogas will be permitted for other R&D activities but not in pilot activities;
- Applications must include techno-economic and life-cycle analyses throughout the project. Life cycle analyses should also include quantification of environmental impacts or benefits of the proposed process including but not limited to: local air quality, organic waste diversion, carbon intensity, and compliance with emerging regulations/policies; and
- Applications must include relevant data to demonstrate scale-up readiness for the proposed process including mass and energy balances, demonstrated continuous hours of operation, etc.

Subtopic Area 5b Applications Specifically Not of Interest

- Subtopic Area 5b seeks novel technologies for piloting only. Projects must propose new or significantly improved technology as compared to the commercial technology in service in the United States at the time the proposal is submitted.
- Applications proposing improvements to anaerobic digestion.
- Applications proposing surrogate or mock biogas in pilot activities.
- Power-to-gas technologies that utilize a carbon dioxide source other than biogas.

Subtopic Area 5b Deliverables at the Conclusion of Phase 1

Key outcomes to be provided as deliverables to DOE at the end of Phase 1 to inform the Go/No-Go review (see section VI.B.xiv) and decision include, but are not limited to:

- 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 HAZOP 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;

- A Project Management Plan (PMP) and a Risk Mitigation Plan (RMP) that clearly demonstrate sufficient project controls are in place and that the recipient is ready to execute final design, construction, commissioning, startup, shakedown, and operations of the pilot;
- A strategy to ensure the product gas quality is sufficient to satisfy natural gas pipeline specifications;
- An updated Life Cycle Analysis (LCA) quantifying the GHG reductions compared to commercial technologies;
- A business plan that clearly shows the recipient has:
    - secured the rights to practice all necessary intellectual property to construct and operate the proposed pilot unit;
    - 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; and
    - any necessary utility supply, interconnect, or export agreements indicating sufficient power, water, or similar services will be available to the facility.
- 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 renewable natural gas
    - Additional factors to be incorporated into the required TEA include, but not necessarily 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;
        - Pipeline interconnection costs; and
        - Production of any co-products.

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 Technical datasheets (see Appendix H).
- Establish benchmark, baseline, and associated target values.
- Identify potential major showstoppers and discuss risk mitigation strategies.
- Align project goals with BETO's expectations.

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 Technical datasheet, and subsequently in conjunction with site visits to monitor progress. Please note that Subtopic 1b and 1c 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 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.

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. However, 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. 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.M. 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.

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 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

In addition to the Applications Specifically Not of Interest previously described in Section I.B. above for Topic Areas 1-5, 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 topic area and subtopic area specific parameters as listed 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 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. See Appendix G for listing of acceptable feedstocks by topic area.
- Applications that propose projects employing solely commercially available technologies.

E. Authorizing Statutes

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

II. Award Information

A. Award Overview

i. Estimated Funding

EERE expects to make a total of approximately $61,380,000 of federal funding available for new awards under this FOA in FY21. EERE anticipates making approximately 11 to 27 awards under this FOA. EERE may issue one, multiple, or no awards. Individual awards may vary between $500,000 and $5,000,000 for FY21 selected projects across all Topic Areas. Please note, all FY21 funds will be obligated in FY21 including those selected for Phase 1 (Verification & Design Basis Definition) awards under Subtopic Area 1b (Scale-up: Pilot Scale) and Subtopic Area 1c (Scale-up: Demonstration Scale). These applicants should consider Subtopic Areas 1b and 1c Phase 2 (Design, Construction, Operation) projects on the order of $15M and $40M respectively of federal funds plus a minimum of 50% applicant cost-share when developing their Phase 1 proposals. Phase 2 funds are subject to future appropriations, availability of funds, and may be obligated to successful Subtopic Area 1b and 1c Phase 2 awards once a down-select occurs (see section VI.C.).
EERE may issue awards in one, multiple, or none of the following topic areas:

Topic Area Number	Topic Area Title	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	Anticipated Period of Performance (months)
1a	Scale-up: Pre-Pilot for Biofuels and Bioproducts	0-10	$3,000,000	$4,000,000	FY21: $30,280,000 An estimated federal share of $30,280,000 of FY21 funds will be split across all three Subtopic Areas, 1a, 1b, and 1c. Depending on the strength of applications, none, some, or all funding may be directed to a single subtopic.	24-48
1b (Phase 1)	Scale-up: Pilot Scale for Biofuels and Bioproducts (Phase 1)	0-4	$500,000	$1,000,000		12
1c (Phase 1)	Scale-up: Demonstration Scale for Biofuels and Bioproducts (Phase 1)	0-4	$500,000	$1,000,000		12
1b (Phase 2)	Scale-up: Pilot for Biofuels and Bioproducts (Phase 2)	0-2	TBD	TBD	Applicants should consider Subtopic Areas 1b and 1c Phase 2 (Design, Construction, Operation) projects on the order of $15M and $40M respectively of federal funds plus a minimum of 50% applicant cost-share when developing their Phase 1 proposals. Phase 2 funds are subject to future appropriations, availability of funds, and may be obligated to successful Subtopic Area 1b and 1c Phase 2 awards once a down-select occurs (see section VI.C.)	42-48
1c (Phase 2)	Scale-up: Demonstration for Biofuels and Bioproducts (Phase 2)	0-1	TBD	TBD		42-48
2	Affordable, Clean Cellulosic Sugars for High Yield Conversion	2-4	$2,000,000	$3,500,000	$8,500,000	24-36
3a	Separations to Improve Arrested Anaerobic Digestion Process Development	1-3	$2,000,000	$3,500,000	$8,000,000 Funding will be split between 3a and 3b depending on strength of applications.	36
3b	Separations to Enable Biomass Conversion (Bioprocessing Separations Consortium)	1-3	$2,000,000	$3,500,000		36
4	Residential Wood Heaters	2-5	$1,000,000	$2,500,000	$5,000,000	24-48
5a	Renewable Natural Gas (R&D)	2	$2,300,000	$2,300,000	$4,600,000	24-36
5b	Renewable Natural Gas (Pilot Scale)	1	$5,000,000	$5,000,000	$5,000,000	36-60

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) for Subtopic Areas 1b and 1c, EERE will perform a down-select among Phase 1 recipients and provide additional funding only to a subset of recipients for work to be performed in Phase 2. Phase 2 funds are subject to future appropriations and availability of funds.

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 (see above table in Section II.A.ii. for topic area and subtopic area estimated lengths). Project continuation will be contingent upon several elements, including satisfactory performance and Go/No-Go decision reviews. For a complete list of these elements, 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 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.

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.

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.

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.

NOTE: The eligibility requirements for Topic Area 2, "Affordable, Clean Cellulosic Sugars for High Yield Conversion" are different from those of Topic Areas 1 and 3-5, which are subject to the eligibility criteria set forth below. DOE/NNSA Federally Funded Research and Development Centers (FFRDCs) are eligible to apply for funding as a prime recipient or subrecipient under Topic Area 2 only. In all other topic areas and subtopic areas (1a, 1b, 1c, 3a, 3b, 4, 5a, and 5b) DOE/NNSA and non-DOE/NNSA FFRDCs are restricted from applying for funding as a Prime Recipient, but are eligible to participate as a Subrecipient. Each FFRDC is permitted to participate as a Subrecipient with effort equivalent to up to 50% of the total estimated cost of the project; however, in aggregate, total FFRDC effort shall not exceed 50% of the total estimated cost of the project.

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.

Topic Areas 1a, 1b, 1c, 3a, 3b, 4, 5a, and 5b: DOE/National Nuclear Security Administration (NNSA) FFRDCs are eligible to apply for funding as a subrecipient, but are not eligible to apply as a prime recipient.

Topic Area 2: DOE/NNSA FFRDCs are eligible to apply for funding as a prime recipient or subrecipient.

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

Federal agencies and instrumentalities (other than DOE) are eligible to apply for funding as a subrecipient, but are not eligible to apply as a prime recipient.

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 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

Topic Areas 1a, 2, 3a, 3b, 4, and 5a: 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.)

Topic Area 1b, 1c, and 5b: The cost share must be at least 50% of the total allowable costs for demonstration 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.)

Topic Area Number	Topic Area Title	Cost Share Requirement
1a	Scale-up: Pre-Pilot for Biofuels and Bioproducts	20%
1b (Phase 1 and 2)	Scale-up: Pilot Scale for Biofuels and Bioproducts	50%
1c (Phase 1 and 2)	Scale-up: Demonstration for Biofuels and Bioproducts	50%
2	Affordable, Clean Cellulosic Sugars for High Yield Conversion	20%
3a	Separations to Improve Arrested Anaerobic Digestion Process Development	20%

3b	Separations to Enable Biomass Conversion (Bioprocessing Separations Consortium)	20%
4	Residential Wood Heaters	20%
5a	Renewable Natural Gas (R&D)	20%
5b	Renewable Natural Gas (Pilot Scale)	50%

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.

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 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 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 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

1. *Concept Papers*
   Concept Papers are deemed compliant if:
   - The Concept Paper complies with the content and form requirements in Section IV.C. of the FOA; and
   - The applicant successfully uploaded all required documents and clicked the "Submit" button in EERE Exchange by the deadline stated in this FOA.

2. *Full Applications*
   Full Applications are deemed compliant if:
   - The applicant submitted a compliant Concept Paper;
   - The Full Application complies with the content and form requirements in Section IV.D. of the FOA; and
   - The applicant successfully uploaded all required documents and clicked the "Submit" button in EERE Exchange by the deadline stated in the FOA.

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

D. Responsiveness Criteria

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

E. Other Eligibility Requirements

i. Requirements for DOE/National Nuclear Security Agency (NNSA) Federally Funded Research and Development Centers (FFRDC) Listed as the applicant

A DOE/NNSA FFRDC is eligible to apply for funding under this FOA if its cognizant Contracting Officer provides written authorization and this authorization is submitted with the application.

The following wording is acceptable for the 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.
> (end of acceptable authorization)

If a DOE/NNSA FFRDC is selected for award negotiation, the proposed work will be authorized under the DOE work authorization process and performed under the laboratory's Management and Operating (M&O) contract.

ii. 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:

1. *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.

2. *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.

3. *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.

4. *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.

5. *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.

6. *Limit on FFRDC Effort*
   Topic Areas 1a, 1b, 1c, 3a, 3b, 4, 5a, and 5b: DOE/NNSA and non-DOE/NNSA Federally Funded Research and Development Centers (FFRDCs) are restricted from applying for funding as a Prime Recipient, but are eligible to participate as a Subrecipient. Each FFRDC is permitted to participate as a Subrecipient with effort equivalent to up to 50% of the total estimated cost of the project; however, in aggregate, total FFRDC effort shall not exceed 50% of the total estimated cost of the project.

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

Topic Areas 1b and 1c: An entity may only submit one Concept Paper and one Full Application for each topic area of this FOA. If an entity submits more than one Concept Paper and one Full Application to the same topic area, 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 for the same topic area 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 for each topic area of this FOA.

Topic Areas 1a, 2, 3a, 3b, 4, 5a, and 5b: 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.

G. Questions Regarding Eligibility

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

IV. Application and Submission Information

A. Application Process

The application process will include two phases: A Concept Paper phase and a Full Application phase. **Only applicants who have submitted an eligible Concept Paper will be eligible to submit a Full Application**.

At each phase, EERE performs an initial eligibility review of the applicant submissions to determine whether they meet the eligibility requirements of Section III of the FOA. EERE will not review or consider submissions that do not meet the eligibility requirements of Section III. All submissions must conform to the following form and content requirements, including maximum page lengths (described below) and must be submitted via EERE Exchange at https://eere-Exchange.energy.gov, unless specifically stated otherwise. **EERE will not review or consider submissions submitted through means other than EERE Exchange, submissions submitted after the applicable deadline, 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;
- 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 a Concept Paper, Full Application, or Reply to Reviewer Comments. Once the Concept Paper, Full Application, or Reply to Reviewer Comments is submitted in EERE Exchange, applicants may revise or update that submission until the expiration of the applicable deadline. If changes are made 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.

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:

All Topic Areas (1a, 1b, 1c, 2, 3a, 3b, 4, 5a, and 5b):

Section	Page Limit	Description
Cover Page Section	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	3 pages maximum	Applicants are required to describe succinctly: ● 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); ● 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	1 page maximum	Applicants are required to describe succinctly the qualifications, experience, and capabilities of the proposed Project Team, including: ● 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; ● 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; and ● 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.

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_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 topic area specific requirements (starting on the next page):

Topic Area 1a:

Component	File Format	Page Limit	File Name
Technical Volume	PDF	25	ControlNumber_LeadOrganization_TechnicalVolume
Resumes	MS Word, PDF	1 page each	ControlNumber_LeadOrganization_Resumes
Letters of Commitment	MS Word, PDF	1 page each	ControlNumber_LeadOrganization_LOCs
Statement of Project Objectives	MS Word	10	ControlNumber_LeadOrganization_SOPO
SF-424	MS Word, PDF		ControlNumber_LeadOrganization_App424
Budget Justification Workbook	MS Excel		ControlNumber_LeadOrganization_Budget_Justification
Summary/Abstract for Public Release	MS Word, PDF	1	ControlNumber_LeadOrganization_Summary
Summary Slide	MS PowerPoint, PDF	1	ControlNumber_LeadOrganization_Slide
Subrecipient Budget Justification	MS Excel		ControlNumber_LeadOrganization_Subrecipient_Budget_Justification
DOE Work Proposal for FFRDC, if applicable (see DOE O 412.1A, Attachment 3)	PDF		ControlNumber_LeadOrganization_WP
Authorization from cognizant Contracting Officer for FFRDC	PDF		ControlNumber_LeadOrganization_FFRDCAuth
SF-LLL Disclosure of Lobbying Activities	PDF		ControlNumber_LeadOrganization_SF-LLL
Foreign Entities and Foreign Work	PDF		ControlNumber_LeadOrganization_Waiver
U.S. Manufacturing Plan	PDF		ControlNumber_LeadOrganization_USMP
Block Flow Diagram and Supplemental Data	MS Word, PDF	15	ControlNumber_LeadOrganization_BFD
Diversity Equity and Inclusion Plan	PDF	5	ControlNumber_LeadOrganization_DEIP

Topic Area 1b:

Component	File Format	Page Limit	File Name
Technical Volume	PDF	40	ControlNumber_LeadOrganization_TechnicalVolume
Resumes	MS Word, PDF	1 page each	ControlNumber_LeadOrganization_Resumes
Letters of Commitment	MS Word, PDF	1 page each	ControlNumber_LeadOrganization_LOCs
Statement of Project Objectives	MS Word	10	ControlNumber_LeadOrganization_SOPO
SF-424	MS Word, PDF		ControlNumber_LeadOrganization_App424
Budget Justification Workbook	MS Excel		ControlNumber_LeadOrganization_Budget_Justification
Summary/Abstract for Public Release	MS Word, PDF	1	ControlNumber_LeadOrganization_Summary
Summary Slide	MS PowerPoint, PDF	1	ControlNumber_LeadOrganization_Slide
Subrecipient Budget Justification	MS Excel		ControlNumber_LeadOrganization_Subrecipient_Budget_Justification
DOE Work Proposal for FFRDC, if applicable (see DOE O 412.1A, Attachment 3)	PDF		ControlNumber_LeadOrganization_WP
Authorization from cognizant Contracting Officer for FFRDC	PDF		ControlNumber_LeadOrganization_FFRDCAuth
SF-LLL Disclosure of Lobbying Activities	PDF		ControlNumber_LeadOrganization_SF-LLL
Foreign Entities and Foreign Work	PDF		ControlNumber_LeadOrganization_Waiver
U.S. Manufacturing Plan	PDF		ControlNumber_LeadOrganization_USMP
Block Flow Diagram and Supplemental Data	MS Word, PDF	25	ControlNumber_LeadOrganization_BFD
Proforma Cash Flow Analysis	MS Excel, MS Word, PDF	5	ControlNumber_LeadOrganization_Proforma
Life Cycle Assessment	MS Word, PDF	5	ControlNumber_LeadOrganization_LCA
Diversity Equity and Inclusion Plan	PDF	5	ControlNumber_LeadOrganization_DEIP

Topic Area 1c:

Component	File Format	Page Limit	File Name
Technical Volume	PDF	60	ControlNumber_LeadOrganization_ TechnicalVolume
Resumes	MS Word, PDF	1 page each	ControlNumber_LeadOrganization_ Resumes
Letters of Commitment	MS Word, PDF	1 page each	ControlNumber_LeadOrganization_ LOCs
Statement of Project Objectives	MS Word	15	ControlNumber_LeadOrganization_ SOPO
SF-424	MS Word, PDF		ControlNumber_LeadOrganization_ App424
Budget Justification Workbook	MS Excel		ControlNumber_LeadOrganization_ Budget_Justification
Summary/Abstract for Public Release	MS Word, PDF	1	ControlNumber_LeadOrganization_ Summary
Summary Slide	MS PowerPoint, PDF	1	ControlNumber_LeadOrganization_ Slide
Subrecipient Budget Justification	MS Excel		ControlNumber_LeadOrganization_ Subrecipient_Budget_Justification
DOE Work Proposal for FFRDC, if applicable (see DOE O 412.1A, Attachment 3)	PDF		ControlNumber_LeadOrganization_ WP
Authorization from cognizant Contracting Officer for FFRDC	PDF		ControlNumber_LeadOrganization_ FFRDCAuth
SF-LLL Disclosure of Lobbying Activities	PDF		ControlNumber_LeadOrganization_ SF-LLL
Foreign Entities and Foreign Work	PDF		ControlNumber_LeadOrganization_ Waiver
U.S. Manufacturing Plan	PDF		ControlNumber_LeadOrganization_ USMP
Block Flow Diagram and Supplemental Data	MS Word, PDF	25	ControlNumber_LeadOrganization_ BFD
Proforma Cash Flow Analysis	MS Excel, MS Word, PDF	5	ControlNumber_LeadOrganization_ Proforma
Life Cycle Assessment	MS Word, PDF	5	ControlNumber_LeadOrganization_ LCA
Diversity Equity and Inclusion Plan	PDF	5	ControlNumber_LeadOrganization_ DEIP

Topic Area 2:

Component	File Format	Page Limit	File Name
Technical Volume	PDF	25	ControlNumber_LeadOrganization_ TechnicalVolume
Resumes	MS Word, PDF	1 page each	ControlNumber_LeadOrganization_ Resumes
Letters of Commitment	MS Word, PDF	1 page each	ControlNumber_LeadOrganization_ LOCs
Statement of Project Objectives	MS Word	10	ControlNumber_LeadOrganization_ SOPO
SF-424	MS Word, PDF		ControlNumber_LeadOrganization_ App424
Budget Justification Workbook	MS Excel		ControlNumber_LeadOrganization_ Budget_Justification
Summary/Abstract for Public Release	MS Word, PDF	1	ControlNumber_LeadOrganization_ Summary
Summary Slide	MS PowerPoint, PDF	1	ControlNumber_LeadOrganization_ Slide
Subrecipient Budget Justification	MS Excel		ControlNumber_LeadOrganization_ Subrecipient_Budget_Justification
DOE Work Proposal for FFRDC, if applicable (see DOE O 412.1A, Attachment 3)	PDF		ControlNumber_LeadOrganization_ WP
Authorization from cognizant Contracting Officer for FFRDC	PDF		ControlNumber_LeadOrganization_ FFRDCAuth
SF-LLL Disclosure of Lobbying Activities	PDF		ControlNumber_LeadOrganization_ SF-LLL
Foreign Entities and Foreign Work	PDF		ControlNumber_LeadOrganization_ Waiver
U.S. Manufacturing Plan	PDF		ControlNumber_LeadOrganization_ USMP
Techno-economic analysis of Current MSSP	MS Excel, MS Word, PDF	10	ControlNumber_LeadOrganization_ TEA
Diversity Equity and Inclusion Plan	PDF	5	ControlNumber_LeadOrganization_ DEIP

Topic Areas 3a and 3b:

Component	File Format	Page Limit	File Name
Technical Volume	PDF	25	ControlNumber_LeadOrganization_ TechnicalVolume
Resumes	MS Word, PDF	1 page each	ControlNumber_LeadOrganization_ Resumes
Letters of Commitment	MS Word, PDF	1 page each	ControlNumber_LeadOrganization_ LOCs
Statement of Project Objectives	MS Word	10	ControlNumber_LeadOrganization_ SOPO
SF-424	MS Word, PDF		ControlNumber_LeadOrganization_ App424
Budget Justification Workbook	MS Excel		ControlNumber_LeadOrganization_ Budget_Justification
Summary/Abstract for Public Release	MS Word, PDF	1	ControlNumber_LeadOrganization_ Summary
Summary Slide	MS PowerPoint, PDF	1	ControlNumber_LeadOrganization_ Slide
Subrecipient Budget Justification	MS Excel		ControlNumber_LeadOrganization_ Subrecipient_Budget_Justification
DOE Work Proposal for FFRDC, if applicable (see DOE O 412.1A, Attachment 3)	PDF		ControlNumber_LeadOrganization_ WP
Authorization from cognizant Contracting Officer for FFRDC	PDF		ControlNumber_LeadOrganization_ FFRDCAuth
SF-LLL Disclosure of Lobbying Activities	PDF		ControlNumber_LeadOrganization_ SF-LLL
Foreign Entities and Foreign Work	PDF		ControlNumber_LeadOrganization_ Waiver
U.S. Manufacturing Plan	PDF		ControlNumber_LeadOrganization_ USMP
Diversity Equity and Inclusion Plan	PDF	5	ControlNumber_LeadOrganization_ DEIP

Topic Area 4:

Component	File Format	Page Limit	File Name
Technical Volume	PDF	25	ControlNumber_LeadOrganization_TechnicalVolume
Resumes	PDF	1 page each	ControlNumber_LeadOrganization_Resumes
Letters of Commitment	PDF	1 page each	ControlNumber_LeadOrganization_LOCs
Statement of Project Objectives	MS Word	10	ControlNumber_LeadOrganization_SOPO
SF-424	PDF		ControlNumber_LeadOrganization_App424
Budget Justification Workbook	MS Excel		ControlNumber_LeadOrganization_Budget_Justification
Summary/Abstract for Public Release	PDF	1	ControlNumber_LeadOrganization_Summary
Summary Slide	MS PowerPoint	1	ControlNumber_LeadOrganization_Slide
Subrecipient Budget Justification	MS Excel		ControlNumber_LeadOrganization_Subrecipient_Budget_Justification
DOE Work Proposal for FFRDC, if applicable (see DOE O 412.1A, Attachment 3)	PDF		ControlNumber_LeadOrganization_WP
Authorization from cognizant Contracting Officer for FFRDC	PDF		ControlNumber_LeadOrganization_FFRDCAuth
SF-LLL Disclosure of Lobbying Activities	PDF		ControlNumber_LeadOrganization_SF-LLL
Foreign Entities and Foreign Work	PDF		ControlNumber_LeadOrganization_Waiver
U.S. Manufacturing Plan	PDF		ControlNumber_LeadOrganization_USMP
Baseline Wood Heater Technology and Performance	PDF, MS Excel		ControlNumber_LeadOrganization_Baseline
Diversity Equity and Inclusion Plan	PDF	5	ControlNumber_LeadOrganization_DEIP

Topic Areas 5a and 5b:

Component	File Format	Page Limit	File Name
Technical Volume	PDF	25	ControlNumber_LeadOrganization_TechnicalVolume
Resumes	PDF	1 page each	ControlNumber_LeadOrganization_Resumes
Letters of Commitment	PDF	1 page each	ControlNumber_LeadOrganization_LOCs
Statement of Project Objectives	MS Word	10	ControlNumber_LeadOrganization_SOPO
SF-424	PDF		ControlNumber_LeadOrganization_App424
Budget Justification Workbook	MS Excel		ControlNumber_LeadOrganization_Budget_Justification
Summary/Abstract for Public Release	PDF	1	ControlNumber_LeadOrganization_Summary
Summary Slide	MS PowerPoint	1	ControlNumber_LeadOrganization_Slide
Subrecipient Budget Justification	MS Excel		ControlNumber_LeadOrganization_Subrecipient_Budget_Justification
DOE Work Proposal for FFRDC, if applicable (see DOE O 412.1A, Attachment 3)	PDF		ControlNumber_LeadOrganization_WP
Authorization from cognizant Contracting Officer for FFRDC	PDF		ControlNumber_LeadOrganization_FFRDCAuth
SF-LLL Disclosure of Lobbying Activities	PDF		ControlNumber_LeadOrganization_SF-LLL
Foreign Entities and Foreign Work	PDF		ControlNumber_LeadOrganization_Waiver
U.S. Manufacturing Plan	PDF		ControlNumber_LeadOrganization_USMP
Diversity Equity and Inclusion Plan	PDF	5	ControlNumber_LeadOrganization_DEIP

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_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 table below, 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.

Topic Area Number	Topic Area Title	Page Limit
1a	Scale-up: Pre-Pilot for Biofuels and Bioproducts	25
1b	Scale-up: Pilot Scale for Biofuels and Bioproducts	40
1c	Scale-up: Demonstration for Biofuels and Bioproducts	60
2	Affordable, Clean Cellulosic Sugars for High Yield Conversion	25
3a	Separations to Improve Arrested Anaerobic Digestion Process Development	25
3b	Separations to Enable Biomass Conversion (Bioprocessing Separations Consortium)	25
4	Residential Wood Heaters	25
5a	Renewable Natural Gas (R&D)	25
5b	Renewable Natural Gas (Pilot Scale)	25

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:

All Topic Areas:

SECTION/PAGE LIMIT	DESCRIPTION
Cover Page (1)	The cover page should include the project title, the specific FOA Topic Area being addressed, both the technical and business points of contact, names of all team member organizations, and any statements regarding confidentiality.
Project Overview (Approximately 10% of the Technical Volume)	The Project Overview should contain the following information: ● 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: ● 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: ● 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 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.
- 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:
    - 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:
	  ○ Identification of target market, competitors, and distribution channels for proposed technology along with known or perceived barriers to market penetration, including a mitigation plan
	  ○ Identification of a product development and/or service plan, commercialization timeline, financing, product marketing, legal/regulatory considerations including intellectual property, infrastructure requirements, data dissemination, U.S. Manufacturing Plan, and product distribution.

Technical Qualifications and Resources (Approximately 20% of the Technical Volume)	The Technical Qualifications and Resources should contain the following information:
	• 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:
	  ○ The roles and the work to be performed by each PI and Key Participant;
	  ○ Business agreements between the applicant and each PI and Key Participant;
	  ○ How the various efforts will be integrated and managed;
	  ○ Process for making decisions on scientific/technical direction;
	  ○ Publication arrangements;
	  ○ Intellectual Property issues; and
	  ○ Communication plans

Diversity, Equity, Inclusion (Address in the Diversity, Equity, and Inclusion Plan)	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. Section IV.D.xvii for more information on the contents of the Diversity, Equity, and Inclusion Plan.

iii. Resumes

Applicants are required to submit one-page resumes for key participating team members. Multi-page resumes are not allowed. Save the resumes in a single PDF file using the following convention for the title "ControlNumber_LeadOrganization_Resumes".

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_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 the page limits listed in the table below. The SOPO must not exceed the page limit when printed using standard 8.5 x 11 paper with 1" margins (top, bottom, left, and right) with font not smaller than 12 point.

Topic Area Number	Topic Area Title	Page Limit
1a	Scale-up: Pre-Pilot for Biofuels and Bioproducts	10
1b	Scale-up: Pilot Scale for Biofuels and Bioproducts	10
1c	Scale-up: Demonstration for Biofuels and Bioproducts	15

2	Affordable, Clean Cellulosic Sugars for High Yield Conversion	10
3a	Separations to Improve Arrested Anaerobic Digestion Process Development	10
3b	Separations to Enable Biomass Conversion (Bioprocessing Separations Consortium)	10
4	Residential Wood Heaters	10
5a	Renewable Natural Gas (R&D)	10
5b	Renewable Natural Gas (Pilot Scale)	10

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-242 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_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 not smaller than 12 point. Save the Summary for Public Release in a single PDF file using the following convention for the title "ControlNumber_LeadOrganization_Summary".

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 Key Participant 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_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_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 with the application. The use of a FFRDC must be consistent with the contractor's authority under its award. Save the Authorization in a single PDF file using the following convention for the title "ControlNumber_LeadOrganization_FFRDCAuth".

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_SF-LLL".

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

1. **Foreign Entity Participation:**
   As set forth in Section III.A.iii., 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.

2. **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. 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_Waiver".

xv. U.S. Manufacturing Commitments

Pursuant to the DOE Determination of Exceptional Circumstances (DEC) dated September 9, 2013, each applicant is required to submit a U.S. Manufacturing Plan as part of its application. The U.S. Manufacturing Plan represents the applicant's measurable commitment to support U.S. manufacturing as a result of its award.

Each U.S. Manufacturing Plan must include a commitment 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 applicant can show to the satisfaction of DOE that it is not commercially feasible to do so (referred to hereinafter as "the U.S. Competitiveness Provision"). The applicant further agrees to make the U.S. Competitiveness Provision binding on any subawardee and any assignee or licensee or any entity otherwise acquiring rights to any subject invention, including subsequent assignees or licensees. A subject invention is any invention conceived of or first actually reduced to practice under an award.

Due to the lower technology readiness levels of this FOA, DOE does not expect the U.S. Manufacturing Plans to be tied to a specific product or technology. However, in lieu of the U.S. Competitiveness Provision, an applicant may propose a U.S. Manufacturing Plan with more specific commitments that would be beneficial to the U.S. economy and competitiveness. For example, an applicant may commit specific products to be manufactured in the U.S., commit to a specific investment in a new or existing U.S. manufacturing facility, keep certain activities based in the U.S. or support a certain number of jobs in the U.S. related to the technology. An applicant which is likely to license the technology to others, especially universities for which licensing may be the exclusive means of commercialization the technology, the U.S. Manufacturing Plan may indicate the applicant's plan and commitment to use a specific licensing strategy that would likely support U.S. manufacturing.

If DOE determines, at its sole discretion, that the more specific commitments would provide a sufficient benefit to the U.S. economy and industrial competitiveness, the specific commitments will be part of the terms and conditions of the award. For all other awards, the U.S. Competitiveness Provision shall be incorporated as part of the terms and conditions of the award as the U.S. Manufacturing Plan for that award.

The U.S. Competitiveness Provision is also a requirement for the Class Patent Waiver that applies to domestic large business under this FOA (see Section VIII.K. Title to Subject Inventions).

Save the U.S. Manufacturing Plan in a single PDF file using the following convention for the title “ControlNumber_LeadOrganization_USMP”.

xvi. Data Management Plan (DMP)

Note: All research and development (R&D) awards must submit a Data Management Plan (DMP) according to the timeline selected in the approved FRD.

Applicants whose Full Applications are selected for award negotiations will be required to submit a DMP during the award negotiations phase.

An applicant may select one of the template Data Management Plans (DMP) listed below. Alternatively, instead of selecting one of the template DMPs below, an applicant may submit another DMP provided that the DMP, at a minimum, (1) describes how data sharing and preservation will enable validation of the results from the proposed work, how the results could be validated if data are not

shared or preserved and (2) has a plan for making all research data displayed in publications resulting from the proposed work digitally accessible at the time of publications. DOE Public Access Plan dated July 24, 2014 provides additional guidance and information on DMPs.

Option 1 (when protected data is allowed): For the deliverables under the award, the recipient does not plan on making the underlying research data supporting the findings in the deliverables publicly-available for up to five (5) years after the data were first produced because such data will be considered protected under the award. The results from the DOE deliverables can be validated by DOE who will have access, upon request, to the research data. Other than providing deliverables as specified in the award, the recipient does not intend to publish the results from the project. However, in an instance where a publication includes results of the project, the underlying research data will be made available according to the policies of the publishing media. Where no such policy exists, the recipient must indicate on the publication a means for requesting and digitally obtaining the underlying research data. This includes the research data necessary to validate any results, conclusions, charts, figures, images in the publications.

Option 2: For any publication that includes results of the project, the underlying research data will be made available according to the policies of the publishing media. Where no such policy exists, the recipient must indicate on the publication a means for requesting and digitally obtaining the underlying research data. This includes the research data necessary to validate any results, conclusions, charts, figures, images in the publications.

Save the DMP in a single Microsoft Word file using the following convention for the title "ControlNumber_LeadOrganization_DMP".

xvii. 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 SMART milestones supported by metrics to measure the success of the proposed actions.

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;
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.

Save the Diversity, Equity and Inclusion Plan in a single PDF file using the following convention for the title "ControlNumber_LeadOrganization_DEIP".

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 (see Section III of the FOA). EERE will review and consider each eligible Full Application, even if no Reply is submitted or if the Reply is found to be ineligible.

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

All Topic Areas:

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):

- 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. Dun and Bradstreet Universal Numbering System (DUNS) Number 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 DUNS number in its application; and (3) continue to maintain an active SAM registration with current information at all times during which it has an active federal award or an application or plan under consideration by a federal awarding agency. DOE may not make a federal award to an applicant until the applicant has complied with all applicable DUNS and SAM requirements and, if an applicant has not fully complied with the requirements by the time DOE is ready to make a federal award, the DOE 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.

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 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. 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 1a, 1b, 1c, 2, 3a, 3b, 5a, and 5b: Foreign travel costs are not allowable under this FOA.

Topic Area 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 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, 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:

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

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 (45%)
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 (30%)

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.

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, Data Management Plan, Open Source Software Distribution Plan, U.S. manufacturing plan, 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 October 1, 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;
- 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 processes utilizable biogenic carbon; and
- The degree to which the proposed project reduces Greenhouse Gas emissions when compared to the petroleum derived equivalent.

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 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 C.F.R. § 200.205.

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.

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 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 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. DUNS Number

Obtain a DUNS number (including the plus 4 extension, if applicable) at http://fedgov.dnb.com/webform.

3. 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.

4. 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.

5. **Grants.gov**

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

6. **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.

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 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 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 prohibiting or otherwise restricting its employees or contactors 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.

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)

Within 30 days of selection, applicants 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.

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.

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 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 and subtopic area in Sections I.B.

BETO Reporting Requirements
Attendance 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.

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, 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. Table of Personnel

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. The table should include the individuals' names, job titles, role in the project and their organization. Recipients will have an ongoing responsibility to notify DOE of changes to the personnel and submit an updated list during the life of the life of the award as there are changes to the personnel working on the project.

xix. Pending and Current Sources of Support

Pending and current sources of support is intended to allow the identification of potential duplication, overcommitment, potential conflicts of interest or commitment, and all other sources of support. If selected for award negotiations, the principal investigator and each senior/key person at the recipient 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 pending and current support. 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.

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
- 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.

C. Program Down-Select

For Subtopic Areas 1b and 1c, 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 following criteria:

During Phase 1, recipients must prepare the following deliverables:

- 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 HAZOP 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;
- A Project Management Plan (PMP) and a Risk Mitigation Plan (RMP) that clearly demonstrate sufficient project controls are in place and that the recipient is ready to execute final design, construction, commissioning, startup, shakedown, and operations of the integrated biorefinery;
- A strategy to qualify for or obtain any necessary regulatory approvals to ensure that the Biofuel(s) and product(s) would be acceptable for sale into commerce such as the ASTM D4054 Sustainable Aviation Fuel qualification;
- An updated Life Cycle Analysis (LCA) demonstrating the technology meets or exceeds the relevant GHG reduction requirement;
- A business plan that clearly shows the recipient has:
    - secured the rights to practice all necessary intellectual property to construct and operate the proposed integrated biorefinery (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;
  - 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, bioproducts, or biopower;
  - Additional factors to be incorporated into the required TEA include, but not necessarily 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
    - Production of any co-products
- Sufficient cost share and contingency in the form of allowable and readily available resources to complete the remainder of the project.

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: *FY21BETOMultiTopicFOA@ee.doe.gov*. Questions must be submitted not later than 3 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 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.

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

J. Title to Subject Inventions

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

- Domestic Small Businesses, Educational Institutions, and Nonprofits: Under the Bayh-Dole Act (35 U.S.C. § 200 et seq.), domestic small businesses, educational institutions, and nonprofits may elect to retain title to their subject inventions;
- All other parties: The federal Non-Nuclear Energy Act of 1974, 42. U.S.C. 5908, provides that the government obtains title to new inventions unless a waiver is granted (see below);
- Class Patent Waiver:

DOE has issued a class waiver that applies to this FOA. Under this class waiver, domestic large businesses may elect title to their subject inventions similar to the right provided to the domestic small businesses, educational institutions, and nonprofits by law. In order to avail itself of the class waiver, a domestic large business must agree that any products embodying or produced through the use of a subject invention first created or reduced to practice under this program will be substantially manufactured in the United States, unless DOE agrees that the commitments proposed in the U.S. Manufacturing Plan are sufficient.

- Advance and Identified Waivers: Applicants may request a patent waiver that will cover subject inventions that may be invented under the award, in advance of or within 30 days after the effective date of the award. Even if an advance waiver is not requested or the request is denied, the recipient will have a continuing right under the award to request a waiver for identified inventions, i.e., individual subject inventions that are disclosed to EERE within the timeframes set forth in the award's intellectual property terms and conditions. Any patent waiver that may be granted is subject to certain terms and conditions in 10 CFR 784; and

- DEC: Each applicant is required to submit a U.S. Manufacturing Plan as part of its application. If selected, the U.S. Manufacturing Plan shall be incorporated into the award terms and conditions for domestic small businesses and nonprofit organizations. DOE has determined that exceptional circumstances exist that warrants the modification of the standard patent rights clause for small businesses and non-profit awardees under Bayh-Dole to the extent necessary to implement and enforce the U.S. Manufacturing Plan. Any Bayh-Dole entity (domestic small business or nonprofit organization) affected by this DEC has the right to appeal it.

K. Government Rights in Subject Inventions

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

1. Government Use License

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

2. March-In Rights

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

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

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

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

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 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.

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 C.F.R. § 910.501 and Subpart F.

If an educational institution, non-profit organization, or state/local government is a prime recipient or subrecipient and has expended $750,000 or more of federal 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 C.F.R. § 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 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.

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:

- 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.

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

will be consumed in the performance of the award or fully depreciated by the end of the award. In cases where the full value of a donated capital asset is to be applied as cost sharing or matching, that full value must be the lesser or the following:

a. The certified value of the remaining life of the property recorded in the recipient's accounting records at the time of donation; or

b. The current fair market value. If there is sufficient justification, the Contracting Officer may approve the use of the current fair market value of the donated property, even if it exceeds the certified value at the time of donation to the project. The Contracting Officer may accept the use of any reasonable basis for determining the fair market value of the property.

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

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

(4) Valuing property donated by third parties.

a. Donated supplies may include such items as office supplies or laboratory supplies. Value assessed to donated supplies included in the cost sharing or matching share must be reasonable and must not exceed the fair market value of the property at the time of the donation.

b. Normally only depreciation or use charges for equipment and buildings may be applied. However, the fair rental charges for land and the full value of equipment or other capital assets may be allowed, when they will be consumed in the performance of the award or fully depreciated by the end of the award, provided that the Contracting Officer has approved the charges. When use charges are applied, values must be determined in accordance with the usual accounting policies of the recipient, with the following qualifications:

i. The value of donated space must not exceed the fair rental value of comparable space as established by an independent appraisal of comparable space and facilities in a privately-owned building in the same locality.

ii. The value of loaned equipment must not exceed its fair rental value.

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

a. Volunteer services must be documented and, to the extent feasible, supported by the same methods used by the recipient for its own employees.

b. The basis for determining the valuation for personal services and property must be documented.

APPENDIX B – SAMPLE COST SHARE CALCULATION FOR BLENDED COST SHARE PERCENTAGE

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

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

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

Each task must be calculated individually as follows:

Task 1
$1,000,000 divided by 80% = $1,250,000 (Task 1 Cost)
Task 1 Cost minus federal share = non-federal share
$1,250,000 - $1,000,000 = $250,000 (non-federal share)

Task 2
$500,000 divided 80% = $625,000 (Task 2 Cost)
Task 2 Cost minus federal share = non-federal share
$625,000 - $500,000 = $125,000 (non-federal share)

Task 3
$400,000 / 50% = $800,000 (Task 3 Cost)
Task 3 Cost minus federal share = non-federal share
$800,000 - $400,000 = $400,000 (non-federal share)

Task 4
Federal share = $100,000
Non-federal cost share is not mandated for outreach = $0 (non-federal share)

The calculation may then be completed as follows:

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

Blended Cost Share %
Non-federal share ($775,000) divided by Total Project Cost ($2,775,000) = 27.9% (non-federal)
Federal share ($2,000,000) divided by Total Project Cost ($2,775,000) = 72.1% (federal)

APPENDIX C – 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.iii., 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 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. 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 US economy;
- The associated benefits to be realized and the contribution to the project from the foreign work;
- How the foreign work will benefit U.S. research, development and manufacturing, including contributions to employment in the U.S. and growth in new markets and jobs in the U.S.;
- How the foreign work will promote domestic American manufacturing of products and/or services;
- A description of the likelihood of Intellectual Property (IP) being created from the foreign work and the treatment of any such IP;
- The total estimated cost (DOE and recipient cost share) of the proposed foreign work;
- The countries in which the foreign work is proposed to be performed; and
- The name of the entity that would perform the foreign work.

EERE may require additional information before considering the waiver request.

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

APPENDIX D – GLOSSARY

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

Biofuels – For the purposes of this Funding Opportunity Announcement are defined as renewable diesel, sustainable aviation fuel, and sustainable marine fuel produced from an allowable feedstock as defined in Appendix G.

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 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 of 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.

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

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
CO2	Carbon Dioxide
COI	Conflict of Interest
CORSIA	Carbon Offsetting and Reduction Scheme for International Aviation
CRADA	Cooperative Research and Development Agreement
DEC	Determination of Exceptional Circumstances
DEIP	Diversity, Equity and Inclusion Plan
DIPPR	Design Institute for Physical Properties
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
GREET	Greenhouse Gases, Regulated Emissions, and Energy Use in Technologies
HAZOP	Hazard and Operability
HBCU	Historically Black Colleges and Universities
IBR	Integrated Biorefinery
IE	Independent Engineer

IER	Independent Engineer Review
IP	Intellectual Property
ISO	International Organization for Standards
IPMP	Intellectual Property Management Plan
lbs	Pounds
LCA	Life Cycle Analysis
µg	Micrograms
mg	Milligrams
M&O	Management and Operating
MMBTU	Million British Thermal Units
MPIN	Marketing Partner ID Number
MFSP	Minimum Fuel Selling Price
MSSP	Most Sugar 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
O2	Oxygen
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
P2G	Power-to-Gas
PCB	Polychlorinated Biphenyls
PM	Particulate Matter
PMP	Project Management Plan
PII	Personal Identifiable Information
ppbv	Parts-Per-Billion-Volume
ppmv	Parts-Per-Million-Volume
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
SciENcv	Science Experts Network Curriculum Vita
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
TRL	Technology Readiness Level
UCC	Uniform Commercial Code
VOC	Volatile Organic Compound
WBS	Work Breakdown Structure
WP	Work Proposal
WTE	Waste-to-Energy

APPENDIX G - ACCEPTABLE FEEDSTOCKS

The Bioenergy Technologies Office works with biomass-based feedstocks, per the authorizing language in EPAct 2005 (see below). Each Topic Area and Subtopic has specific feedstock requirements and those are summarized here for reference.

Topic Area	Biomass (general definition, see next page)	Biomass Breakdown per Topic Area							Other Feedstocks		
		Lignocellulosic Feedstocks	Wood	Algae	Organic Wet Waste	Sorted Municipal Solid Waste	Food Waste	Biogas	Waste Carbon Dioxide	Grain Starch	Oilseed Crops
1a: Scale-up (pre-pilot)	Yes	Yes							Yes	No	No
1b: Scale-up (pilot)	Yes	Yes							No	Yes (fuel only)	Yes (fuel only)
1c: Scale-up (demonstration)	Yes	Yes							No	Yes (fuel only)	Yes (fuel only)
2: Clean Sugars	No	Yes	Yes	No	No	Yes	Yes	No	No	No	No
3a: Separations (non-consortium)	No	No	No	No	Yes	Yes	Yes	Yes	Yes	No	No
3b: Separations (consortium)	Yes	Yes							Yes	No	No
4: Wood Heaters	No	No	Yes	No	No	No	No	No	No	No	No
5a: RNG (R&D)	No	No	No	No	No	No	Yes	Yes	No	No	No
5b: RNG (pilot)	No	No	No	No	No	No	Yes	Yes	No	No	No

"Biomass" is defined generally in the authorizing language of EPAct 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.

"Lignocellulosic Feedstocks" are defined generally in the authorizing language of EPAct 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.

"Wood" for the purpose of this FOA, is defined as wood chips, cord wood, or wood pellets. Unacceptable feedstocks include corn kernels, manure, materials containing plastic, waste petroleum products, coal, trash, grass, residential or commercial garbage, lawn clippings or yard waste, paper products, railroad ties or pressure treated lumber, wood charcoal, torrefied wood or biomass, and construction debris.

"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.

"Waste Carbon Dioxide" for the purpose of this FOA, refers to any waste carbon dioxide (CO_2) produced as a byproduct from fermentation or the combustion of biomass or other biopower processes.

"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 grain starch may only be used to produce fuel, bioproduct production in not allowed with grain starch.

"Oilseed Crops" for the purposes of this FOA, refers to US-produced, oil producing crops including, but not limited to soybeans, cottonseed, sunflowerseed, canola, rapeseed, peanuts, camelina, and oil producing annual covercrops[26][27]. Please note that Greenhouse Gas reductions of at least 70% must be met if utilizing an oil seed crop(s).

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;

[26] 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).

[27] https://www.epa.gov/renewable-fuel-standard-program/approved-pathways-renewable-fuel

(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.

APPENDIX H – SUPPLEMENTAL CONTENT REQUIREMENTS & INSTRUCTIONS

Topic Area 1 Scale-up of Biotechnologies:

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

Topic Area 2 Affordable, Clean Cellulosic Sugars for High Yield Conversion:

- A Techno-Economic Analysis of Current Minimum Sugar Selling Price is required with the application for Topic Area 2 applications. Please see **Techno-Economic Analysis of Current Minimum Sugar Selling Price Instructions section v.** below.

Topic Area 4 Residential Wood Heaters:

- The data described in that section is required within the narrative of the application. Please see the **Baseline Technology and Performance Data in Section vi. below**.
- Life Cycle Assessment is required with the application for Topic Areas 2. Please see **Life Cycle Assessment Instructions in section iii.** below.

i. Block Flow Diagram Instructions and Overview:

Topic Areas 1a, 1b, and 1c 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 PDF titled, "BFD & SD Template" 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 Subtopic Areas 1a, 1b, and 1c applications.

ii. Proforma Cash Flow Analysis Instructions:

Topic Areas 1b and 1c will utilize a Proforma Cash Flow Analysis (proforma). A feasible commercial pro forma cash flow analysis showing the expected cash flow of the proposed 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, overview, and recommended templates. Use of the template is not required, however equivalent data must be submitted with Topic Areas 1b and 1c applications.

iii. Life Cycle Analysis Instructions:

- Topic Areas 1b, 1c, and 2 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 model[28] or provide schemes developed the CORSIA (Carbon Offsetting and Reduction Scheme for International Aviation) methodology[29] for calculating life cycle emissions. Argonne National Laboratory has developed publicly available life-cycle assessment tools that applicants may utilize. See Appendix I for the link. Use of these tools are not required, however equivalent data must be submitted with applications.

iv. Techno-Economic Analysis of Current Minimum Sugar Selling Price Instructions:

Topic Area 2 will utilize a Techno-economic analysis (TEA) to calculate minimum sugar selling price. Results from this model should be included in the application to clearly specify the baseline minimum sugar selling price and will be used throughout the project to track progress towards the topic area target of $0.20/lb.

A publicly available excel-based sugar production cost model has been developed by NREL. See Appendix I for a link to that model. Applicants may utilize this model or their own internal model to satisfy this requirement. This techno-economic analysis should include:

- Costs of enzyme (cellulase and hemicellulase) production and/or purchase
- Capital and operating costs for unit operations that are necessary for conversion of lignocellulosic materials into monomeric sugars. This may include but not be

[28] https://greet.es.anl.gov/

[29] https://www.icao.int/environmental-protection/CORSIA/Pages/CORSIA-Eligible-Fuels.aspx

limited to: pretreatment, enzymatic hydrolysis, sugars clarification, milling, and water treatment.

- Delivered feedstock cost of $85.06/ton unless data provided by the applicant can justify otherwise[30].
- No co-product credits for other fractions (e.g. lignin)

v. Baseline Technology and Performance Data Instructions:

Applicants to Topic Area 4 are required to provide the baseline wood heater or wood heater technology performance data indicated in the following table **in the Technical Volume of the Full Application**. This data should be included in the Technical Description, Innovation and Impact section of the Technical Volume (see IV.D.ii.)

Baseline Wood Heater Technology and Performance (continues on next page)

Residential Wood Heater Type	Room, central hydronic, or central forced air
Catalyst	Catalytic or Non-Catalytic
Power Generation (if applicable)	Thermoelectric device description and output
Integrated Sensors	Type and Location
Other Technology	Brief description of wood heater technology for emissions reduction or efficiency improvement
Wood used for testing	Species, moisture content, type (e.g., crib, cord, pellet)
Applicable test methods	For example EPA Method 28
Particulate emissions concentration	mg/m^3
Emissions Rate	g/hr.
Emissions factor	g/kg and lb./ MMBTU
Weighted Delivered Efficiency	%
Max heat output	BTU/hr.
Average Stack Gas CO	%
Average Stack Gas CO_2	%

[30] To the extent possible a standard feedstock cost is being used in order to make comparisons between sugar production processes. It is recognized that some feedstocks, e.g. fractions of waste, might be available at significantly lower costs but they are expected to have increased production/detoxification costs

APPENDIX I – LINK TO LIFE CYCLE ANALYSIS (GREET) MODEL AND SUGAR MODEL

Argonne National Laboratory and the National Renewable Energy Laboratory regularly publish Excel-based and ASPEN models that quantify the life-cycle and techno-economic results associated with particular pathways. For topic area 2, applicants must include a baseline minimum sugars selling price as part of the application. For applicants that do not have an existing techno-economic model, applicants may choose to use the NREL sugar model (see link below) or use something similar.

A baseline life-cycle analysis is not required as part of the application, but projects will be required to track the progress on key sustainability indicators if selected. Project teams may choose to use the GREET model (link below) or use something similar.

ANL GREET Model Link:
https://greet.es.anl.gov/index.php

Material and Energy Flows in the Production of Cellulosic Feedstocks for Biofuels for GREET1_2013:
https://greet.es.anl.gov/publication-feedstocks-13

NREL 2017 Biochemical Sugar Model Title link:
https://www.nrel.gov/extranet/biorefinery/aspen-models/