Key Dates	
Solicitation Issue Date	September 10, 2020
Link to Pre-Recorded Informational Webinar	https://www.labpartnering.org/TCF/about
Submission Deadline for Proposal Eligibility Declarations (See Section IV)	October 8, 2020 5:00 p.m. (ET)
Submission Deadline for Proposals (See Section VI)	December 15, 2020 5:00 p.m. (ET)
Expected Date for Selection Notifications	Spring 2021

Summary Information	
Means of Submission	Due to unforeseen circumstances, in FY 21 Applicants must submit their Proposal Eligibility Documents by email to TCF@hq.doe.gov and TCFsubmissions@inl.gov using the template provide at https://www.labpartnering.org/TCF/about. Applicants with eligible proposals must submit full proposal materials through OTT's submission portal, Proposal and Review Operations Platforms (*PROPs*), which is administered by Idaho National Laboratory: https://proposalsott.inl.gov OTT expects PROPs to be available by the time it makes eligibility notifications. OTT will not review or consider full proposals submitted through other means.
Total Amount to be Provided	DOE expects to make available approximately $23.1 million - $28.5 million of Federal funding for award(s) under this Solicitation. See table on page 11. Amounts available are dependent on FY 2021 Congressional appropriations. Ranges shown here are estimates and may be revised subject to FY 2021 Congressional appropriations. DOE reserves the right to issue one, multiple, or no awards. Award amounts are: • Topic 1: $100,000-$250,000 • Topic 2: $250,000-$1,500,000
Period of Performance	Topic 1: 6-18 months Topic 2: 12-36 months
Eligible Entities	U.S. Department of Energy National Laboratories, Plants, and Sites (DOE Facilities)
TCF Matching Funds/Non-Federal Cost Requirement	Projects require matching non-Federal funds of at least 50% of the total project cost.
Submission of Multiple Proposals	National Laboratories, Plants, and Sites may submit multiple proposals. There is no limit on the number of proposals a Principal Investigator or DOE Facility may submit.
Proposal Eligibility Declarations	Proposal Eligibility Declarations (PEDs) are mandatory. PEDs consist of information submitted using a form which is available online. To submit a PED, email the completed form to TCF@hq.doe.gov and TCFsubmissions@inl.gov. Full Proposals will only be accepted with a corresponding tracking number from an eligible PED, which will be provided in the email indicating full proposal eligibility.
Proposal Forms	The proposal requirements are contained in this document. There is a six (6) page limit for Topic 1 proposals. The page limit for Topic 2 proposals is 12 pages.
Questions	Questions about the TCF program rules and proposal process should be directed to TCF@hq.doe.gov. Questions about *the PED submittal process and about using PROPs for Full Proposals*, should be directed to TCFsubmissions@inl.gov. Note: All questions and answers about the TCF program rules and proposal process will be distributed via email to the points of contact listed in Appendix D as well as to everyone from an eligible DOE Facility who submits a question. Please use your DOE Facility email to submit questions as OTT will not respond to questions from non-eligible applicants. Please provide the subject of your question (e.g., application elements, matching funds, previously funded projects) in the subject line of your email. Please do not provide proprietary or business sensitive information when posing questions.

	Questions must be submitted by 5:00 p.m. (ET) on December 10, 2020. Questions submitted after this deadline may not be answered.

Fiscal Year 2021 Solicitation

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Section I: Background and Description of the Solicitation

A. SUMMARY

In support of the U.S. Department of Energy's (DOE's) efforts to increase the commercial impact of DOE National Laboratories, Plants, and Sites (hereinafter referred to as DOE Facilities) and their engagement with industry—as well as to fulfill statutory direction in the Energy Policy Act of 2005 (EPAct 2005)—DOE's Office of Technology Transitions (OTT) seeks proposals for its Technology Commercialization Fund (TCF). The TCF is intended to facilitate the commercialization of energy technologies with promising potential that are developed at DOE Facilities. The TCF is part of a broader set of initiatives to foster stronger partnerships among DOE Facilities, private sector companies, and other entities involved in bringing energy technologies to the marketplace. EPAct 2005 encourages and supports the development of energy systems across the entire range of generation sources. DOE strongly encourages applicants to look across their portfolios of applied energy programs for candidate technologies. A complete list of eligible technology areas is in Appendix A.

B. GOALS

The TCF is part of a broad array of activities that DOE and its Facilities undertake to ensure Federal research and development (R&D) investments in technologies with commercial potential find their way to a viable market. TCF Federal funds are matched with non-Federal contributions to:

1. Perform technology maturation with the intent of attracting a private partner that is willing to support the technology's commercialization.
2. Support cooperative development of technology with a private partner for a specific commercial application.

C. BACKGROUND

DOE's enterprise of Facilities has a more than 70-year history of delivering world-class science and technology solutions to pressing national issues. DOE Facilities are proven partners in collaborative R&D projects that provide the foundational science and technology for the private sector to then derive new products and processes in myriad industries. DOE's multibillion-dollar annual investment in research at DOE Facilities results in the invention and development of novel technologies and other forms of intellectual property (IP). DOE Facilities have developed partnerships with private parties to pursue commercial applications of these technologies. To date, there have been thousands of licenses between DOE Facilities and private partners. Nevertheless, an even larger reservoir of IP has not transitioned to the private sector because a technology may not be mature enough to attract a partner—or its market potential may not be fully understood.

DOE's Facilities have consistently identified as a problem the lack of sufficient resources to develop technologies to a stage that attracts private sector interest. In many cases, public funding—from DOE or other sources—supports R&D activities up to an early Technology Readiness Level, but such funding is cut off before a technology matures to a point that a business will enter into a cooperative R&D agreement or seek to license a technology. A 2013 report commissioned by the White House Office of Science and Technology Policy concluded that "[m]any promising early-stage technologies developed at Department of Energy National Laboratories require 'maturation' in the form of additional development, testing, or prototyping before companies are willing to invest in them for commercial purposes."[a]

[a] IDA Science and Technology Policy Institute. "Department of Energy Technology maturation Programs." May 2013. Available online at: https://www.ida.org/~/media/Corporate/Files/Publications/STPIPubs/ida-p-5013.ashx (accessed December 8, 2017).

Congress authorized under Section 1001 of EPAct 2005, as amended, the establishment of the Technology Commercialization Fund (TCF):

> *e) TECHNOLOGY COMMERCIALIZATION FUND – The Secretary shall establish an Energy Technology Commercialization Fund, using 0.9% of the amount made available to the Department for applied energy research, development, demonstration, and commercial application for each fiscal year based on future planned activities and the amount of the appropriations for the fiscal year, to be used to provide matching funds with private partners to promote promising energy technologies for commercial purposes.*

The TCF provides an opportunity to support collaboration between DOE Facilities and private industry. Specifically, the TCF is intended to incentivize DOE Facilities to pursue active industry engagement and customer scouting for select, promising energy technologies. Researchers at DOE Facilities, as well as their technology transfer offices, often lack the resources or a particular DOE Program Office's guidance to focus on actively engaging industry partners to commercialize their technologies.[b, c]

Through the TCF, DOE's applied energy Program Offices (see Appendix A for the list and their technology areas) and its Facilities can pursue a strategic, forward-looking, competitive approach to commercializing technologies developed there. This process better enables DOE Facilities to prepare these technologies for commercial adoption, identify the highest-quality prospective partners, and assist those industry partners in evaluating technologies for their business models. Potential benefits of this approach include:

1. Creating a stronger incentive for DOE Facilities to identify both their most promising technologies for commercialization and industry partners;
2. Empowering a broader set of potential industry partners to engage with DOE Facilities;
3. Enabling DOE Facilities to identify a commercialization pathway for their technologies that have good potential;
4. Promoting DOE Facility technologies that cut across DOE's Program Offices and technology areas.

D. TCF STRUCTURE

Proposals must pursue one of the following two Topic Areas:

Topic 1

Topic 1 projects focus on DOE Facility-developed technologies that have commercial promise and have the potential to attract a private partner. The target TCF funding for each Topic 1 award is $100,000-$250,000. The target period of performance for a Topic 1 award is 6-18 months.

Topic 2

Topic 2 projects focus on technologies for which DOE Facilities have already identified a commercial partner willing to execute a partnership agreement. This Topic supports cooperative development with a private partner of a commercial application for technology developed at DOE Facilities. Applicants will have already undertaken some form of evaluation to determine if their technology is viable for commercialization—such as IP mapping, participation in the Energy I-Corps program, or other relevant activities. The target TCF funding for each Topic 2 award is $250,000-$1,500,000. The target period of performance for a Topic 2 award is 12-36 months.

[b] OTT 2015 RFI input from the National Laboratories put significant emphasis on the importance of more strategic industry engagement in order to attract industry and identify partners to commercialize technology.

[c] A key finding from the temporary EERE Technology Commercialization Fund from FY2007-2008 found that National Laboratories would have benefited from additional time and resources to search for the most promising industry partners.

E. PROJECT SCOPE

The scope of a project should allow it to meet TCF's goals for the type of project it is—i.e., Topic 1 or Topic 2. The activities described below correlate to the independent merit review criteria in Section IV. All projects, whether proposed as Topic 1 or Topic 2, need to address the four areas described here. Depending on the Topic area, the breadth and level of detail will vary. In all cases, proposals must address the following items to the degree of specificity appropriate to the chosen topic area.

1. **Commercial Impact**

   Both Topic 1 and Topic 2 proposals need to address the proposed technology's potential market impacts if it is commercialized. Topic 1 projects are intended to focus on maturing a technology to the point that it can attract and secure a private partner, or on further developing the technology and existing partnership for a larger Topic 2 project. Topic 1 proposals need to provide evidence that the technology has potential market impact. Topic 2 projects are intended to focus primarily on the commercialization of the technology in concert with a private partner. Therefore, a Topic 2 proposal should contain more expansive information about the commercial impact of the technology. There must be a clear explanation of the current or anticipated market for the technology. This should include a description of the significant market need that the project addresses. The applicant should also specify whether the proposed technology could achieve market penetration independent of complementary technologies, processes, or other requirements. If other factors, such as policy or regulations, are required for the technology to achieve market penetration, the applicant should identify them and discuss the circumstances.

2. **Technology Maturity**

   Proposals for both Topic 1 and Topic 2 need to address what the project intends to accomplish in terms of advancing the maturity of its technology. Topic 1 projects are intended to focus on whichever advances are necessary and appropriate to attract and secure a private partner—or in the cases of Topic 1 projects that already have a partner, on developing both the technology and the relationship to take next steps, such as those described for Topic 2 proposals. Topic 2 projects may require that the technology be further matured or demonstrated at a larger scale. Topic 2 proposals should describe which activities need to be undertaken to achieve the commercialization goals of the project. There must be a clear explanation of the current state of the technology, as well as the anticipated state of the technology at the end of the project. To the degree they can be anticipated, the applicant should explain the technical challenges and unanswered technical questions that must be addressed to reach the desired maturity of the technology. There should be an explanation of any complementary technology(ies) necessary for the proposed technology to function and to have relevance in the market.

3. **Project Plan**

   Both Topic 1 and Topic 2 proposals need to include a project plan, which should focus on the project's objectives. Depending on the topic area and the specific project objectives, the plan should focus on tasks and activities to accomplish those objectives. There must be a clear explanation of the goals and outcomes of the proposed project, and a viable approach to address the technical and commercialization challenges of bringing the technology to the market. Tasks should be clearly linked to performance metrics and deliverables. There must also be a delineation of risks or uncertainties—e.g., to the technology itself, to the market—and a plan to manage or retire them.

4. **Project Team and Resources**

There must be a clear articulation that the project team and resources are qualified and capable of successfully completing the project. This includes both the Facility and partner teams. Proposals must clearly define team members' roles and responsibilities. There should be evidence that the necessary personnel, facilities, and equipment are available and committed to the project.

Section II: Eligibility for Award

Applicants for a TCF award are required to meet the eligibility requirements described in this section.

A. APPLICANTS

Eligible applicants are any DOE Facilities as defined in Section I to include the U.S. Department of Energy National Laboratories, Plants and Sites.[d] No other entities, public or private, are eligible for award. Project directors or PIs must be employees of a DOE Facility. OTT will only accept Proposal Eligibility Declarations (PEDs) and Full Proposals from eligible DOE Facility email addresses. Applicants are eligible for multiple awards under this solicitation. Multiple DOE Facilities may partner together on a single proposal. In that case, TCF funds flow to the lead DOE Facility, which would then distribute them to partner DOE facilities as appropriate.

B. PROJECTS

Eligible applicants may propose projects under one of two topic areas per project:

Topic 1
Topic 2

Topic 1 projects may—but are not required to—involve a partner. Topic 2 projects MUST involve a partner. TCF projects that involve partners are expected to use a CRADA or other partnering mechanism, as approved by their respective DOE Facility site office.

Topic 1— $100,000-$250,000 per award

Eligible projects for Topic 1 must involve currently existing DOE Facility technology or IP that demonstrates evidence of commercial potential—with or without a private partner. Evidence of commercial potential includes technology having demonstrated analytical and experimental proof of concept in a laboratory environment. For example, experiments or modeling and simulation have validated performance prediction of the technology's capability; design techniques have been identified or developed; scaling studies have been initiated. Projects funded under Topic 1 have a performance period of 6-18 months. The target Topic 1 award amount is $100,000-$250,000.

Topic 2— $250,000-$1,500,000 per award

Eligible projects for Topic 2 must involve currently existing Facility technology or IP, and the Facility must have a non-Federal partner with a defined commercial application for the technology. Whenever possible, partner(s) should be identified in the Proposal Eligibility Declaration. Partner(s) must be identified in the full proposal. A CRADA or other approved partnership agreement for the proposed TCF scope of work does not have to be in place already to be eligible for award. If funds are allocated before a CRADA or other partnership agreement is in place, work shall not begin until one is executed. If a CRADA or other partnership agreement is not executed within 6 months of DOE's obligating the funds to the DOE Facility, the Department may cancel the award. A project or work scope under an existing CRADA or other partnership agreement at the time of TCF proposal submission is not eligible for an award under the TCF. However, DOE Facilities that have established umbrella CRADA agreements may utilize those for TCF awards if appropriate and approved by their respective site offices. Projects funded under Topic 2 have a performance period of 12-36 months. The target Topic 2 award amount is $250,000 - $1,500,000.

Relevance Considerations

All projects proposed for funding must demonstrate mission area relevance to one or two of the DOE Program Office Technology Areas (i.e., Congressional control accounts) in Appendix A. It is incumbent

[d] NETL is ineligible for an award for a Topic 1 project unless it finds a private partner.

on applicants to identify and select the correct Program Office(s) and Technology Area(s) in their Proposal Eligibility Declarations (PEDs). DOE Facilities may submit proposals with cross-programmatic application or benefit. For example, a wind farm load forecasting model could be applicable to the Wind Energy Technologies Area within the Office of Energy Efficiency and Renewable Energy, as well as to the Transmission Reliability and Resilience Technology Area within the Office of Electricity.

Intellectual Property (IP): Patent and Copyright Protection
All TCF projects must have in place for their technologies the patent or copyright protection described below **by the time DOE obligates TCF funding**:

- **Topic 1**. Applicants must have filed a provisional or non-provisional patent application or for copyright protection, if applicable. This is the minimum requirement.

- **Topic 2**. Applicants must have filed a non-provisional patent application or for copyright protection, if applicable. This is the minimum requirement.

In cases where a DOE Facility co-owns IP that is the subject of a TCF proposal, the applicant shall document in the proposal:

- That there is a co-owner of the technology;
- How the co-owner became a co-owner;
- The co-owner's involvement with the TCF project, including funding research and development activities and entering into an approved partnership agreement
- Whether or not the laboratory and co-owner executed an agreement concerning licensing of the technology.

When Applicants submit their Proposal Eligibility Declarations, they agree to have those protections in place by the time they receive funding, if their proposal is selected for award. (Please see the Project Administrative Detail and Summary affirmation in Section V. C.1.c). Unless these patent or copyright protections are already in place, applicants will have a window to file the necessary patent or copyright application between their FY21 selection notification and when DOE funding arrives at the DOE Facility.

Additional Funding Eligibility Considerations
Technologies previously funded as Topic 1 projects are eligible to submit Topic 2 proposals under the same field of use or market segment as the original TCF project. After completing Topic 1 and Topic 2 projects under a single field of use or market segment, a technology is eligible to receive funding again as either a Topic 1 or a Topic 2, provided the new project articulates a different field of use or market segment, and the previous TCF project(s) meet the following conditions:

- The project (scope of work) is complete by the Full Proposal deadline
- The project has complied with all interim reporting requirements (a final report is due three months from the completion of the scope of work, but is not a precursor for selection)
    - In addition to the Funding Program Office requirements, TCF Project recipients will be required to upload project information to the Program Information Collection System (PICS) at the beginning and end of the project as well as on an as-needed basis when requested by DOE's Office of Technology Transitions (OTT). This is separate from any reporting required by the funding Program Office.
- The new funding request meets the Solicitation's requirements and advances the technology toward commercialization.

Funding Availability Considerations

Applicants should carefully consider the available funding range for a Program Office when submitting a proposal with funding requests at the upper end of the Topic 2 scale.

C. PARTNERS

Partners can be any non-Federal entity, including private companies, state or local governments—or entities created by a state or local government—universities, tribal entities or non-profit organizations. Partners must agree to engage in activities that focus on commercializing or deploying technologies in the marketplace, agree to provide cost match and be willing to sign a partnership agreement with the DOE Facility. Only entities that have agreed to provide cost match and are willing to sign a partnership agreement are considered to be partners.

D. MATCHING FUNDS

All projects require matching funds of at least 50% of the total project costs, which must come from non-Federally-appropriated funds. If a DOE Facility is providing the matching funds, it must be a cash contribution. If a private partner is providing the matching funding, it can be a cash or in-kind contribution. Applicants may enter into a partnership agreement with partners whose contributions are in-kind only, and must ensure that in-kind contributions meet all of DOE's requirements pertaining to in-kind contributions. DOE Facilities are ultimately responsible for verifying that all matching contributions are made and properly accounted for. For more information and examples, please see Appendix B.

Section III: Award Information & Administration

A. TYPE OF AWARD INSTRUMENT

TCF awards will be documented and funded through the existing work authorization and funds management processes of the DOE Program Office(s) providing the funding. DOE Facilities will be required to track Federal funds in accordance with normal Departmental processes. DOE Facilities will also be required to track non-Federal funds in accordance with established DOE Facility accounting processes.

B. ESTIMATED FUNDING

DOE anticipates that approximately $23.1M - $28.5M will be available for the TCF in Fiscal Year (FY) 2021.

OTT anticipates that available funding will breakdown across the participating Program Offices as follows:

Participating DOE Program Office	Estimated FY20 Funding Range
Energy Efficiency and Renewable Energy (EERE)	$15M - $17.5M
Nuclear Energy (NE)	$5.5M – $6.7M
Fossil Energy (FE)	$1.1M - $2.5M
Electricity Delivery and Energy Reliability (OE)	$1.1M - $1.3M
Cybersecurity, Energy Security, and Emergency Response (CESER)	$0.2M - $0.4M
Total TCF	**$23.1M - $28.5M**

Amounts available are dependent on FY 2021 Congressional appropriations. Ranges shown here are estimates and may be revised subject to FY 2021 congressional appropriations. DOE may issue one, multiple, or no awards.

Number of Selections: The number of selections will depend on the number of meritorious proposals and the availability of congressionally appropriated funds in each DOE Program Office or Technology Area.

Funding will be allocated from one or two appropriation accounts/Technology Areas listed in Appendix A.

Funding Amount per Selection:

Topic 1 Projects: $100,000-$250,000 per award
Topic 2 Projects: $250,000-$1,500,000 per award

DOE reserves the right to fund, in whole or in part, any, all, or none of the proposals submitted in response to this Solicitation.

C. PERIOD OF PERFORMANCE

Topic 1 projects: 6-18 months
Topic 2 Projects: 12-36 months

D. CROSSCUTTING AWARDS AND MISSION AREA RELEVANCE

DOE Facilities may submit proposals they view as having crosscutting applicability or benefit. In the mandatory Proposal Eligibility Declaration, applicants may identify up to two (2) Technology Areas per project, and **must** provide a short explanation that articulates the technology's mission area relevance for **each area**. Applicants should assume that these are reviewed separately, so they should write independent and coherent justifications (i.e., they should avoid things like "continued below," "see

above," and "furthermore,"). DOE is under no obligation to accept an applicant's determination of crosscutting applicability. DOE reserves the right to make final determinations about which Program Office(s) will bear what share of the Federal costs for crosscutting awards.

E. MULTIPLE AWARDS
DOE Facilities are eligible for more than one award. Awards are made on a per proposal basis. Each proposal must define a single project. Individual proposals are not eligible for multiple awards.

F. NOTIFICATIONS
OTT will inform the DOE Facility Technology Transfer Offices as it moves through some phases of the selection cycle—after the deadline for Full Proposals. For example, OTT will communicate that the Independent Merit Reviews have begun and concluded (which will signal that the three-day review response window will open shortly thereafter); that the results of the Independent Merit Review are with the participating Program Offices for their input.

The first decision notification follows the Proposal Eligibility Declaration review. This is a go-no-go decision that determines whether or not DOE will accept a Full Proposal for the corresponding Proposal Eligibility Declaration.

Following the conclusion of Full Proposal Independent Merit Reviews, applicants will receive review comments. Applicants will have an opportunity to provide an optional and brief response to review comments. OTT will forward these applicant responses to the relevant DOE Program Office(s) as well as to the members of the Merit Review Committee for use at their meeting. OTT anticipates emailing independent review comments to PIs and each DOE Facility Tech Transfer Office no later than late March 2021.

Notification of DOE's TCF selection decisions follows the conclusion of the evaluation and selection process. DOE's decision to select a project for award is not an authorization to begin performance. Selected projects are required to finalize the Scope of Work (SOW)/Work Plan with the funding Program Office(s) prior to work authorization and release of funds. OTT and/or the funding DOE Program Office(s) reserve the right to request additional or clarifying information before proceeding to the SOW finalization stage.

All of DOE's decisions are final when communicated to applicants. OTT notifies each proposal's points of contact electronically of its decisions and provides a summary to each DOE Facility's Tech Transfer Office.

G. SUCCESSFUL SUBMISSIONS
OTT reserves the right to require for any reason additional or clarifying information about selected projects.

H. PROJECT ADMINISTRATION
Projects selected for award are managed by the DOE Facilities in accordance with their requisite policies and procedures. Each awarded project will be funded according to the Program Office Technology Areas (Congressional control accounts) listed in Appendix A. Applicants are encouraged to select up to two Program Office Technology Areas as applicable to their project's crosscutting potential—and to its mission area relevance to each selection. Please see the description of mission area relevance reviews in Section IV for more information.

The template for TCF-funded project's final report is in Appendix C, and can be downloaded from the PICs at: https://www.picsott.com/

I. PROJECT REPORTING

In addition to the Funding Program Office requirements, TCF Project recipients will be required to upload project information at the beginning and end of the project to the Program Information Collection System (PICS) and on an as-needed basis when requested by DOE's Office of Technology Transitions (OTT). OTT will provide initial training on the PIC System for new Project Recipients.

Section IV: Proposal Requirements and Review Information

A. PROPOSAL ELIGIBILITY DECLARATIONS AND ELIGIBILITY REVIEWS

Proposal Eligibility Declarations are mandatory. ***The deadline to submit Proposal Eligibility Declarations is 5:00 p.m. (ET) October 8, 2020. OTT WILL NOT ACCEPT PROPOSAL ELIGIBILITY DECLARATIONS EMAILED AFTER THE DEADLINE.***

At the Proposal Eligibility Declaration stage, applicants must select a Primary Technology Area to which their proposal relates. Applicants may also select an optional Secondary Technology Area. Primary and Secondary Technology Areas may be within different DOE Program Offices, or within the same DOE Program Office. All Proposal Eligibility Declarations are subject to a review to determine whether or not DOE will accept a Full Proposal for the same project. OTT's multi-phase eligibility review is in place to determine:

1. That the applicant is eligible under this solicitation
2. That the Proposal Eligibility Declaration is complete and contains all the required information
3. That the Proposal Eligibility Declaration describes a project responsive to this Solicitation's objectives
4. That the Proposal Eligibility Declaration demonstrates and accurately articulates mission area relevance to the applicant-selected Program Office(s) and Technology Area(s).

Mission Area Relevance Reviews

To be eligible to submit Full Proposals, Proposal Eligibility Declarations must pass both the conformance review **and** the relevance review in **at least one** of the applicant-selected Technology Areas—Primary (mandatory) or Secondary (optional).

If an applicant only selects a Primary Technology Area, and the Proposal Eligibility Declaration fails that mission area relevance review, the applicant is not eligible to submit a Full Proposal for that Proposal Eligibility Declaration. If a Proposal Eligibility Declaration fails the mission area relevance review in the Primary Technology Area, it may still pass in a Secondary Area, if the applicant selected one. In that case, the Secondary Technology Area becomes the new Primary Technology Area.

Proposal Eligibility Declarations that fail the conformance review or do not pass at least one mission area relevance review are eliminated from further consideration. DOE will not accept full proposals for those Proposal Eligibility Declarations. DOE anticipates making eligibility notifications by **5:00 p.m. (ET) on November 3, 2020.**

B. FULL PROPOSALS AND ELIGIBILITY REVIEW

Proposals will only be accepted with a corresponding tracking number from an eligible Proposal Eligibility Declaration—and only in the Technology Area(s) in which it passed the mission area relevance review(s). ***FULL PROPOSALS ARE DUE BY 5:00 P.M. (ET) ON DECEMBER 15, 2020. OTT WILL NOT ACCEPT FULL PROPOSALS AFTER THE DEADLINE***. All Full Proposals will be subject to an eligibility review to determine that:

1. The Full Proposal matches the project described in the corresponding Proposal Eligibility Declaration;
2. The Full Proposal for funding is complete and contains all the information required;
3. All mandatory requirements are satisfied;
4. The proposed project is responsive to the objectives of this Solicitation.

PROPOSALS THAT FAIL TO PASS THE ELIGIBILITY REVIEW WILL NOT BE FORWARDED FOR INDEPENDENT MERIT REVIEW AND WILL BE ELIMINATED FROM FURTHER CONSIDERATION.

C. MERIT REVIEW CRITERIA

Proposals that pass the eligibility screen will be forwarded for independent merit review. Proposals are independently merit reviewed only in their Primary Technology Areas. OTT makes use of Secondary Technology Areas during the Merit Review Committee meeting in cases where possibilities might exist to fund meritorious projects after funding is exhausted in the Primary Technology Area. TCF Selections are based on the following merit review criteria:

1. **Commercialization Evaluation (35% of composite score)**
   Commercial Impact Criterion consist of the following components:
   - Extent to which the proposed technology will result in a commercially-successful product and/or company.
   - Extent to which the proposed technology has the ability to be successfully commercialized in a reasonable timeframe.
   - Extent to which the proposed technology represents an innovative or significant improvement from current state of the art technologies that results in either a product or solution that transforms or replaces existing industry approaches or is a new product or solution that can be widely used by the existing industry and will have significant market impact.
   - Extent to which the project team understands the market and its barriers to commercialization.
   - Extent to which the applicant identifies and discusses factors or circumstances such as policy or regulations required for the technology to achieve market penetration.

2. **Technical Merit Evaluation (65% of composite score)**
   Technical Impact consists of three criteria within which are multiple components as described below along with their individual contributions to this portion of the composite score:

   Technical Merit Criterion 1: Technology Maturity (40%)
   - Technology has demonstrated analytical and experimental proof of concept in a laboratory environment. For example, experiments or modeling and simulation have validated performance prediction of technology capability. Design techniques been identified or developed. Scaling studies have been initiated.
   - Extent to which the applicant describes an understanding of complementary technologies or processes that are necessary for the technology to have relevance in the market.

- Extent to which the applicant describes an understanding of technical issues to be addressed to achieve a successful commercial deployment.
- Evidence that the technology can be deployed at scale.

Technical Merit Criterion 2: Project Plan (40%)

- Technical and Commercialization Approach –
    - Quality and reasonableness of the applicant's plan for closing technical gaps and addressing unanswered technical questions.
    - Quality and reasonableness of the applicant's business plan for market penetration/adoption.
- Risk Management –
    - Extent to which the applicant discusses and demonstrates understanding of the key technical and commercial uncertainty and risks involved in the proposed work.
    - Extent to which the applicant adequately describes how the applicant's team will manage and retire risks.
- Goals and Outcomes –
    - Extent to which the project plan clearly describes the goals and outcomes of the project, including measures of technical advancement and business success.
    - Extent to which the proposed tasks and subtask activities in the work plan are verified through performance metrics, milestones, and deliverables that are specific, measurable, aggressive (but attainable), realistic, and timely (i.e., not a report summarizing work to be done).

Technical Merit Criterion 3: Project Team and Resources (20%)

- Capabilities – The extent to which the capability of the Principal Investigator(s) and the proposed team, including partnerships, can address all aspects of the proposed project, including, but not limited to, qualifications, relevant expertise, and time commitment of the individuals on the team.
- Contributions – Clarity, adequacy, and completeness of roles and contributions of each team member in development of the project and/or commercialization of the products, including financial support of partners.
- Readiness – Extent to which the final team, facilities, and equipment required to complete this project are fully in place, assembled, and committed to the project (e.g., there are no key members that are "to be hired at a later date").
- Commitment – Extent to which there is demonstrated institutional commitment from senior DOE Facility management and corporate officers of partners.
- Resources – Sufficiency of facilities to support the proposed work, and reasonableness and adequacy of the proposed budget to meet proposed project objectives.

D. PROGRAM POLICY FACTORS

In addition to the criteria above, the following program policy factors may be considered in determining which proposals to select for negotiations:

- The degree to which the proposed project offers an opportunity to facilitate commercialization of a promising technology that does not currently have other programmatic support.
- Whether the proposed project offers crosscutting or multi-program benefit and passed the mission relevance review in both its Primary and Secondary Technology Areas.
- Diverse representation of DOE Facilities in the TCF's project portfolio.
- Diversity of technologies.
- Diversity of projects spanning participating DOE Program Offices.

Section V: Proposal Submission & Format

A. PROPOSAL SUBMISSION INFORMATION

Due to unforeseen circumstances beyond OTT's control, OTT will accept the initial TCF submission element – the Proposal Eligibility Declaration – via email. OTT expects *PROPs* to be online by the time it notifies applicants about their eligibility to submit Full Proposals. OTT will upload PEDs to *PROPs* when it becomes available. Applicants whose PED(s) pass the eligibility review will receive a tracking number for their Full Proposal(s).

C. PROPOSAL ELEMENTS

1. **Proposal Eligibility Declaration**

   Proposal Eligibility Declarations are mandatory. Proposal Eligibility Declarations consist of information requested via an online form and an attachment for upload. Both must be submitted by email to **TCF@hq.doe.gov and TCFsubmissions@inl.gov** by **5:00 p.m. (ET) on October 8, 2020**. Only one Proposal Eligibility Document should be submitted per email. If multiple versions of the Proposal Eligibility Document are received for a single project only the last version received will be considered. The applicant's point of contact should receive an email acknowledging receipt within one (1) business day of submission. DOE Facility Tech Transfer Offices should receive a summary of their Proposal Eligibility Declarations within three (3) business days following the submission deadline. Please contact TCFSubmissions@inl.gov if an individual receipt or DOE Facility summary is not received.

   a. **Proposal Eligibility Declaration Project Administrative Detail and Summary**

      Information about the project and the applicant's contact information is requested via the Project Administrative Detail and Summary, which is completed via a form that is available online at https://www.labpartnering.org/TCF/about. All information fields are mandatory. The form asks for the following information:

      i. Project Title. Text box provided on form.
      ii. Period of Performance (6-36 months, depending on the Topic). Text box provided on form.
      iii. Brief Overview (for public release). Text box provided for a short description of the proposal (2,000 characters or fewer, including spaces and punctuation). DOE uses this information for its mission relevance review, and to assist in identifying Subject Matter Experts (SMEs) to serve as independent merit reviewers, if applicable.
      iv. Principal Investigator (PI) Information.
      v. Delegate Information (optional where PI's wish to allow others access to edit their proposal information or upload documents)
      vi. Lead DOE Facility. Drop-down menu provided on form
      vii. Topic Selection. Drop-down menu provided on form.
      viii. Technology Area(s). Applicants must select a Primary Program Office/Technology Area, and may select an optional Secondary Program Office/Technology Area. For **each** selection, they must provide a justification of up to 1,000 characters (including spaces and punctuation) that articulates the technology's relevance to the selected primary area and optional secondary area, if applicable. A text box is provided on the online form. Please see the Appendix for a list of the eligible Program Offices and their Technology Areas.
      ix. Partner Organization(s) and Points of Contact, if applicable. Use the text box to provide salutation, first and last name, organization, phone number, email address, city, state, postal code, and country. Congressional District is optional at this time.

x. Energy I-Corps. There is a checkbox to indicate whether the Principal Investigator is now a participant in DOE's Energy I-Corps program or has been in the past. (https://www.energy.gov/eere/technology-to-market/energy-i-corps). Participation in DOE's Energy I-Corps gives neither an advantage nor a disadvantage to TCF applicants. DOE is simply interested to know whether applicants are or have been Energy I-Corps participants.

xi. Lab Partnering Service. There is a checkbox to indicate whether the Principal Investigator is now or has in the past been enrolled in DOE's Lab Partnering Service (https://www.labpartnering.org). Enrollment in DOE's Lab Partnering Service gives neither an advantage nor a disadvantage to TCF applicants. DOE is simply interested to know whether applicants are or have been Lab Partnering Service enrollees.

xii. Keywords. Applicants must provide keywords or phrases—but not additional prose—to describe their projects. The purpose of the keywords is to assist in identifying appropriate SMEs for Independent Merit Review. Applicants should use their best judgment in deciding which keywords or phrases apply to their technology. A minimum of three keywords is required.

b. Proposal Eligibility Declaration Mission Narrative

Applicants must complete the Proposal Eligibility Declaration mission narrative section of the Proposal Eligibility Declaration form. The document must contain a brief project narrative not to exceed 5,000 characters (including spaces and punctuation), which DOE may use for public release, to determine eligibility for Independent Merit Review at the Full Proposal Phase, and to assist in identifying independent merit reviewers.

Applicants may not include in their PEDs any figures, drawings, pictures, schematics, videos, etc. Please see Section V.C.2 for information about including illustrations in Full Proposals.

c. Changes to PEDs Prior to 5:00 p.m. October 8, 2020

Applicants may request to make changes to their submitted PEDs by emailing TCF@hq.doe.gov. The TCF team will return the submitted PED to the applicant for edits and then the applicant should resubmit to TCF@hq.doe.gov.

d. Changes to PEDs After 5:00 p.m. October 8, 2020

Until **5:00 p.m. (ET) December 1, 2020** applicants may request to make **some** changes or updates to their PEDs. To change or update information such as the PI, partner, Topic, TCF funding request, or period of performance, please email TCF@hq.doe.gov. The TCF team will make the updates unless there is any question, in which case someone will contact you for more information or with an explanation about why the change request cannot be accepted. **After the PEDs submission deadline on October 8, 2020, OTT will not consider changes to Technology Area(s) and justification(s), or Mission Narratives. OTT will not consider any updates or changes after 5:00 p.m. (ET) December 1, 2020.**

Please note that the Project Administrative Detail and Summary form includes the following affirmation:

> *I, my home organization, and my proposed partner(s) have read and agree to the requirements as they are outlined in the Solicitation. Agreement by all parties to these requirements is indicated upon submission.*

2. Full Proposals

OTT expects *PROPs* to be available in time for Full Proposal development and submission. Proposals must be uploaded in *PROPs* https://proposalsott.inl.gov. OTT expects *PROPs* to open for Full Proposals when eligibility notifications go out. The deadline for Full Proposals is **5:00 p.m. (ET) December 15, 2020**. The proposal's points of contact should receive an email acknowledging receipt of the proposal within one (1) business day of submission. DOE Facility's Tech Transfer Offices should receive a summary of their proposals within three (3) business days following the submission deadline. Please contact TCFsubmissions@inl.gov if either one is not received.

Following the eligibility notification in November, use *PROPs* to access the Full Proposal materials:

1. Go to https://proposalsott.inl.gov
2. Select "Login" from the top right-hand corner of the screen
3. Enter your user credentials. When OTT uploads the PEDs to PROPs, it will create accounts as needed, and will distribute account information as necessary.
4. Select "Proposals" from the menu
5. Click on "Create New Proposal" for the type you are creating

A. DOCUMENT FORMAT REQUIREMENTS

Using templates where provided, all non-budget documentation is to be prepared as a standard 8.5" × 11" document with 1-inch margins all around (i.e., top, bottom, left, and right), and using a font size no smaller than Times New Roman 11 point. The required file format is Portable Document Format (PDF) for all documents except for budget spreadsheets. **Applicants should not upload scanned images of their proposals, as this will cause them to fail the conformance review**. Instead, applicants must CONVERT DOCUMENTS TO PDF. All spreadsheets are to be uploaded in Excel file format. Do **NOT** lock any cells in the spreadsheet. **All Full Proposal uploads must include a footer with the file name (e.g., FY21 Project Narrative Your Specific Tracking ID#).**

Topic 1 proposal narrative documents must not exceed six (6) pages. Topic 2 proposal narrative documents must not exceed 12 pages. In addition to the narrative document, Full Proposals include the following mandatory supplemental pages, which do not factor into the 6- and 12-page limits:

- Budget form.
- Technical summary/abstract for public release.
- Letter(s) of commitment from any private partner(s) that will sign a CRADA or other approved partnership agreement and is contributing non-federal cost match to the project.

Only the first six (6) pages of a Topic 1 proposal narrative and the first 12 pages of a Topic 2 proposal narrative will be reviewed. OTT will remove and instruct Independent Merit Reviewers that they may not consider information inserted by hyperlink. Applicants should use their best judgment when including footnotes, endnotes, references, illustrations of any kind, etc., which **count** against page limits. ***OTT will delete ALL pages in excess of the six (Topic 1) and 12 (Topic 2) page maximums prior to forwarding Full Proposals for Independent Merit Review as well as to the relevant Program Offices. Pages in excess of the maximums will not receive any consideration.***

To create a full proposal, login to the https://proposalsott.inl.gov site again, and click "Create New Proposal" next to Fiscal Year 2021 Technology Commercialization Fund Full Proposal. The submission system will show the eligible Proposal Eligibility Declaration(s) you already

submitted. When you click on the desired Proposal Eligibility Declaration, the system will generate the full proposal page. The tracking number will be the same and all information except the Proposal Eligibility Declaration attachment itself will appear in the full proposal form. Scroll down immediately and save the proposal. For information about updating changeable information in the PED, please see Section V.C.1.c.

Note: Applicants must provide information for each of the elements described below; however, the depth of the discussion for each element will depend on whether the proposal is seeking funding under Topic 1 or Topic 2.

Full Proposal Elements

1. **Previous Funding**
    a. TCF funding: If your project or technology received any earlier TCF funding, use the + icon to add a text box to identify it by tracking ID(s) (e.g., TCF-XX-XXXX). Use the "Funding Description" text box to explain in 500 characters or less the new and different field of use or market segment that sets apart your FY21 project from the earlier TCF project (s), and summarizes the previous project's status.
    b. Federal Government Funding (other than from the TCF): Use the radio button to answer whether or not your project or technology has received any other Federal Government funding. If you answer "yes," use the text box to describe the funding in 500 characters or less (i.e., agency, purpose/SOW, timeframe, status).

2. **Proposal Narrative Document (PDF Attachment)**
    Please identify the following information in this document:
    Page limits: Topic 1, six (6) pages
    Topic 2, twelve (12) pages

    i. Commercialization Plan

    a. The target market(s) for commercialization of the technology/product, including a brief discussion of identified or anticipated market barriers.
    b. Competing technologies/products and estimated timeframe to overcome technical and market barriers.
    c. Proposed commercialization end state of the project, to include whether the technology/product will be available in the identified markets—and if not, the anticipated follow on activities necessary to bring the product to market.
    d. The extent to which the proposed technology will result in a commercially-successful product and/or solution that transforms or replaces existing industry approaches or solutions that can be widely used by the existing industry.
    e. Clear statement of how the proposed technology represents an innovative and significant improvement with respect to existing commercial products or solutions.

    ii. Technical Narrative

    a. **Project Description** - Describe the project's goals and objectives. Provide a brief history of the technology development and commercialization efforts to date including the current status.
    b. **Project Plan** - Describe the technical and commercialization approach for the project, including how you will close technical gaps and address unanswered questions. Clearly state the business plan for market penetration/adoption and how you have addressed any assumptions used to form your business strategy.

Describe how you will manage technical and commercial risks related to your proposed work and how you will retire those risks as they arise. Clearly articulate the goals and outcomes of the project, including measures of technical and business success.

In addition to the written summary, provide a table with milestones to include a description of the outcomes or goals being achieved. Milestones should be specific, measurable, achievable, realistic, and time-bound (SMART) and represent a tangible and measurable achievement of a project outcome or goal, e.g., completion of a technology upgrade or performance test. The table should also include deliverables with a description of the data and information or knowledge being provided in the deliverable.

c. **Team & Resources -** Describe the capabilities of the project team, including those of the PI(s), partners, and other members, and how each will contribute to the commercialization of the product. Clearly state the team's and the lab's readiness to begin work on the project. Describe the team's commitment to the project, including that of senior Facility management and corporate officers of partner organizations. Describe the facilities needed to support the proposed work. As appropriate, include the names of any partners and a description of their businesses, as well as a discussion of the partners' products and services currently in the market. Describe the history of the Facility's interaction with the partner(s) and the role of the partner(s) in the project including their responsibilities for accomplishment of milestones and deliverables, as well as financial support or in-kind contributions.

The document **must** be saved in Portable Document Format (PDF), and conform to this naming convention: "2021 TCF Full Proposal Narrative Document [Tracking ID #].pdf".

3. **Budget (online form and an Excel file, which will be available in *PROPs* *https://proposalsott.inl.gov/Home/tcf_resources.aspx* when it opens for Full Proposals after eligibility notifications, and on the TCF resource page: https://www.labpartnering.org/TCF/about:)**

Please complete the online form to provide the following information:

i. TCF Funding Requested
ii. Non-Federal Matching Funds
iii. Proposed Total Budget
iv. Non-Federal Source Verification (Checkbox)

Use the Excel budget template (provided online) to submit the following information:

i. Budget by year for the project (FY21-FY23, as applicable)
ii. Budget by cost category:
    - Personnel
    - Travel
    - Equipment
    - Supplies
    - Contractual
    - Other
        - Total Direct Charges (formula auto-calculates)
    - Indirect Charges. Applicants should direct questions about indirect charges to their DOE Facility's Tech Transfer Office. OTT is not able to provide guidance about indirect charges.
        - Total Project Costs (formula auto-calculates)

- Non-Federal Contributions
  - Cash
  - In-Kind

The template **must** be saved as an Excel file, and conform to this naming convention: "2021 TCF Budget [Tracking ID #].xlsx".

4. **Technical Summary/Abstract for Public Release (PDF Attachment)**
   Page Limit: One page.
   The project summary/abstract must be suitable for dissemination to the public, and it must not exceed one (1) page. It should be a self-contained document that identifies the name of the applicant; the project director(s)/PI(s); the project title; list of major deliverables; the project's scope and objectives; a project description, including major tasks (phases, planned approach, etc.) and methods to be employed; the project's potential impact (i.e., benefits and outcomes); and major individual and institutional participants (for collaborative projects). This document must not include any proprietary or business-sensitive information because DOE may make it available to the public, if the project is selected for award.

   The document **must** be saved in Portable Document Format (PDF), and conform to this naming convention: "2021 TCF Abstract [Tracking ID #].pdf".

5. **Appendices**
   Private Partner(s) Letter(s) of Commitment
   For full proposals in both Topic 1 and 2, OTT requires a letter of commitment from all partners that will be providing non-federal cost match, as described in Appendix B, and with whom the applicant expects to sign a CRADA or other approved partnership agreement.

   A template will be available in *PROPs* when the system opens for full proposals, and is available on the TCF resource page:
   https://proposalsott.inl.gov/Home/tcf_resources.aspx.

   I. Letters of Commitment are only required from non-federal cost match-providing partners that willing to execute an approved partnership agreement and must:

   II. Be on company letterhead.
   III. Include the TCF tracking number, title, and name of lead DOE Facility.
   IV. Include signers' names, titles, and contact information.

   Applicants may also include an optional appendix with only a letter of support from the lead DOE Facility and/or team member resumes.

Documents **must** be saved in Portable Document Format (PDF), and conform to this naming convention: "2021 TCF "Name of File" [Tracking ID #].pdf

D. RESPONSE TO REVIEW COMMENTS

Applicants will receive review comments following completion of the Independent Merit Review. Applicants will have a brief opportunity to review the comments and to prepare a short reply responding to comments. The "Response to Review Comments" is an optional submission; applicants are not required to submit this. Applicants will have three (3) business days to provide a response to review comments. OTT will forward these applicant responses to the relevant DOE Program Office(s)

as well as to the members of the Merit Review Committee for use at their meeting. Applicants will not receive their scores.

The response to review comments is not an opportunity to change the outcome or scores of the Independent Merit Review process. Rather, it is an opportunity for applicants to provide feedback to the relevant DOE Program Office(s) and to the Merit Review Committee.

OTT anticipates emailing independent review comments to PIs and each DOE Facility Tech Transfer Office no later than late March 2021. Responses, which are limited to a total of 2,500 characters per Full Proposal, are due in *PROPs* by 5:00 p.m. (ET) three (3) business days later. DOE will not accept responses by other means or after the deadline. The deadline will not be extended for applicants who are unable to submit their response by the deadline.

Section VI: Other Information

A. SOLICITATION MODIFICATIONS

Notices of any modifications to this Solicitation will be distributed via email to the points of contact in Appendix D.

B. TREATMENT OF PROPOSAL INFORMATION

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

Applicants should not include in their proposals trade secrets or commercial or financial information that is privileged or confidential, unless such information is necessary to convey an understanding of the proposed project or to comply with a requirement in this Solicitation. Proposals that contain trade secrets or commercial or financial information that is privileged or confidential—and that the applicant does not want disclosed to the public or used by the Government for any purpose other than proposal evaluation—must be marked as described below. A cover sheet, which does not count against the page limits, must be marked as follows, and must identify the specific pages that contain trade secrets or commercial or financial information that is privileged or confidential.

Notice of Restriction on Disclosure and Use of Data:

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

The header and footer of every page that contains trade secrets or privileged commercial or financial information must be marked as follows:

> "May contain trade secrets or commercial or financial information that is privileged or confidential and exempt from public disclosure."

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

The above referenced markings enable DOE to follow the provisions of 10 CFR 1004.11(d) in the event a Freedom of Information Act (FOIA) request is received for information submitted with a proposal. Failure to comply with these marking requirements may result in the disclosure of the unmarked information under a FOIA request 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.

Subject to the specific FOIA exemptions identified in 5 U.S.C. 552(b), all information submitted to OTT by an applicant is subject to public release under the Freedom of Information Act, 5 U.S.C. §552, as amended by the OPEN Government Act of 2007, Pub. L. No. 110-175. It is the proposer's responsibility to review FOIA and its exemptions to understand:

1. What information may be subject to public disclosure; and
2. What information applicants submit to the Government that is protected by law

In some cases, DOE may be unable to make an independent determination regarding which information submitted is releasable and which is protected by an exemption. In such cases DOE will consult with the applicant in accordance with 10 C.F.R. §1004.11, to solicit the proposer's views on how the information should be treated.

Appendix A: Eligible DOE Program/Technology Areas

OFFICE OF CYBERSECURITY, ENERGY SECURITY, AND EMERGENCY RESPONSE (CESER)

The mission of the Office of Cybersecurity, Energy Security, and Emergency Response (CESER) is to improve the security of the United States energy infrastructure against all hazards via Cybersecurity, Infrastructure Security & Energy Restoration, and Innovation, Research & Development.

CESER's supports activities in the following key areas:

- **Cybersecurity Discovery Capabilities**
- **Cyber Threat and Vulnerability Situational Awareness**
- **Focused Cybersecurity Pursuit**
- **Cybersecurity Modeling & Simulation Capabilities**
- **Cybersecurity Information Sharing**
- **Cybersecurity for Emerging Technologies in the Energy Sector**

The following technology area within CESER is eligible for TCF funding in FY 2020:

1. Cybersecurity for Energy Delivery Systems (CE-CEDS)

The vision of CESER's Cybersecurity for Energy Delivery Systems (CEDS) program is that resilient energy delivery systems are designed, installed, operated, and maintained to survive a cyber incident while sustaining critical functions. CEDS will identify—working closely with other CESER components—areas ripe for innovation, research and development to target areas of focus that leverage the DOE complex to address gaps in DOE and the sector's capabilities in the areas of focus identified in the section above.

CEDS R&D activities are summarized below:

1. Prevent, detect, and mitigate cyber incidents in today's energy delivery systems
    - Decrease the cyber-attack surface and block attempted misuse
    - Decrease the risk of malicious components inserted in the supply chain
    - Enable real-time, continuous cyber situational awareness
    - Automatically detect attempts to execute a function that could de-stabilize the system when the command is issued
    - Characterize cyber incident consequences and automate responses
2. Change the game so that tomorrow's resilient energy delivery systems can survive a cyber incident
    - Anticipate future grid scenarios and design cybersecurity into systems from the start
    - Enable power systems to automatically detect and reject a cyber attack, refusing any commands/actions that do not support grid stability
    - Build strategic partnerships and core capabilities in National Labs
    - Enhanced situational awareness and information sharing

OFFICE OF ELECTRICITY (OE)

The Office of Electricity (OE) provides national leadership to strengthen, transform, and improve energy infrastructure so that consumers have access to secure and resilient sources of electricity. OE provides solutions to market, institutional, and operational failures that go beyond any one utility's ability to solve. OE does not fund efforts related to the development of generation sources. To accomplish this critical mission, OE works with private industry and Federal, State, Tribal, territorial, and regional governments on a variety of initiatives to modernize the electric grid and enhance key characteristics of the U.S. electric transmission and distribution systems:

- Resilience—the ability to withstand and quickly recover from disruptions and maintain critical function.
- Security—the ability to protect system assets and critical functions from unauthorized and undesirable actors.
- Reliability—consistent and dependable delivery of high quality power.
- Flexibility—the ability to accommodate changing supply and demand patterns and new technologies.
- Affordability—more optimal deployment of assets to meet system needs and minimize costs.
- Efficiency—low losses in electricity delivery and more optimal use of system assets.

The following OE Technology Areas are eligible for TCF funding in FY 2021:

1. Transmission Reliability and Resilience (OE-TRR). Transmission Reliability and Resilience program provides the electric sector with the necessary tools and analyses to assess risks, inform decisions, and improve power system planning and performance including mitigating the risks of large-scale blackouts. TRR is focused on ensuring the reliability and resiliency of the U.S. electric grid through research and development (R&D) concentrated on measurement and control of the electricity system, as well as model development and validation for assessing risks across integrated energy systems. The TRR program focuses on several key areas:

a. Advancing electrical engineering through activities in electric grid measurements, models, mathematics, and computation
b. Developing and validating proof-of-concept tools intended to enable the electricity system operators and planners to improve reliability, resilience, and security of the system
c. Enhancing risk-based quantification to improve methods and models used to study power system resilience, recovery, and restoration.
d. Address the needs for new sensors and advanced data analysis techniques to enable successful realization of incipient failure detection schemes along with associated condition-based maintenance programs ubiquitously throughout the transmission systems.

2. Resilient Distribution Systems (OE-RDS). The Resilient Distribution Systems program focuses on addressing the challenges facing the electric power grid by developing the innovative technologies, tools, and techniques to enable industry to modernize the distribution portion of the electric delivery system. RDS pursues strategic investments in research and development of innovative technologies and practices that improve reliability, resilience, outage recovery, and operational efficiency, building upon previous and ongoing grid modernization efforts. Technology focus areas include microgrid technologies focused on addressing reliability, resilience, flexibility, and efficiency, particularly at the community level and dynamic controls and communications research and development to enhance the electric distribution grid to harness flexibility across all

distribution assets to withstand and recover from disruptions caused by extreme weather events and man-made events, as well as for normal operations.

3. Energy Storage (Grid Scale) (OE-ES). Grid scale Energy Storage supports a more resilient, secure, reliable, and economically competitive U.S. energy infrastructure. Energy storage is emerging as an integral component to the grid modernization to provide a diverse range of services including energy management, backup power, load leveling, frequency regulation, voltage support, and grid stabilization. In addition to grid services, the Energy Storage program focuses on accelerating the development of new materials and device technologies that can lead to significant improvements in the cost, performance and safety of grid scale energy storage systems and accelerated adoption of the energy storage solutions into the grid infrastructure.

4. Transformer Resilience and Advanced Components (OE-TRAC). The Transformer Resilience and Advanced Components program supports hardening, response, and restoration of the grid by addressing the unique challenges facing transformers and other critical grid components (grid hardware) that are responsible for carrying and controlling electricity from where it is generated to where it is needed. TRAC addresses critical research needs for solid-state power substations (SSPS) with an emphasis on advanced materials, embedded intelligence for equipment monitoring, and capabilities to evaluate prototype converter building blocks.

OFFICE OF ENERGY EFFICIENCY AND RENEWABLE ENERGY (EERE)

The mission of EERE is to create and sustain American leadership in the transition to a global clean energy economy. Its vision is a strong and prosperous America powered by clean, affordable, and secure energy. The following EERE Program Offices and related Technology Areas are eligible for TCF funding in FY 2021:

1. Advanced Manufacturing (EE-AMO)

To drive manufacturing innovation and spur job creation, AMO supports the development of technologies that significantly improve energy efficiency in manufacturing as well as foundational, cross-cutting manufacturing processes, information, and materials technologies critical to efficient and competitive domestic manufacturing. AMO's goals are to stimulate technology innovation, improve the energy productivity of U.S. manufacturing, and enable the manufacture of cutting-edge products in the United States. As part of the FY 2021 Technology Commercialization Fund, AMO seeks to fund projects that align with one or more of the following technology areas:

CHEMICAL MANUFACTURING R&D:

The bulk chemicals industry consumed an estimated 7.28 quadrillion Btu in 2018 and this industry is projected to grow and consume over 30% more energy in 2030 (totaling 9.68 quadrillion Btu.) It was estimated in 2010 that nearly 2 quadrillion Btu of process energy could be saved annually through adoption of state-of-the-art technologies and new technology advancements – an opportunity which will be even larger with the predicted growth. R&D in this area could include:

- Advancement of novel catalysts to optimize conversion rates, selectivity, activity, and stability; enabling at least a 20% improvement in energy intensity.
- Development of new chemical pathways and chemistries to enable simplified process designs or combine multiple process steps resulting in significantly lower energy intensity.
- Advancement of non-thermal or low-thermal budget approaches, such as biological processes, hybrid processes and electro-technologies to enable desired chemical transformations with significantly reduced energy use.

ADVANCED MATERIALS MANUFACTURING:

R&D of new, energy-efficient processes to make materials with desirable properties for use in energy saving applications. Research to improve material processing represents a major opportunity space with wide-ranging benefits. Conventional materials development can take 10-20 years from initial discovery to commercialization of a new material. This can be accelerated through the use of advanced computational, experimental, and data tools to research and validate new processes to develop next generation materials and materials manufacturing processes. Such tools are also needed to address scalability challenges in moving from a concept to a laboratory-developed prototype and full-size commercial product. R&D in this area could include:

- Materials and processes for applications such as lightweight materials that improve vehicle fuel economy, energy conversion materials that improve potential for waste heat recovery, advanced photovoltaic materials, and other materials with a range of potential benefits across the manufacturing supply chain.
- Advanced tools to accelerate materials process development such as high-throughput experimental processes and validation technologies, innovative data management and analytics, and enhanced modeling and simulation capabilities to enable predictive design of materials and manufacturing processes.

2. Bioenergy Technologies (EE-BETO)
The Bioenergy Technologies Office (BETO) develops technologies that convert domestic biomass and waste resources into fuels, products, and power to enable affordable energy, economic growth, and innovation in renewable energy and chemicals production. This work will increase the supply of domestic, affordable energy and create U.S. jobs and economic opportunities while enhancing U.S. energy security and reducing emissions.

BETO manages a diverse portfolio of technologies, covering the full spectrum of bioenergy production, from the feedstock source to end use. Potential product slates include biofuels for ground transportation (both light-duty and heavy-duty), off-road transportation (aviation and marine), biogas, renewable home heating oil, bioproducts, and biopower. Although BETO focuses on bioenergy, BETO pursues strategies for bioproducts to enable and accelerate development of bioenergy technologies.

Key components of the BETO portfolio include the following:

- R&D of feedstock supply systems that can reliably deliver industrially relevant quantities of quality feedstocks including high productivity advanced algal systems,
- R&D of conversion technologies able to efficiently process diverse and variable feedstocks into biofuels (e.g., gasoline, diesel, jet, and marine fuels), bioproducts, and biopower,
- Development of integrated processes, tested and verified at engineering scale, to reduce technology uncertainties and enable industry deployment,
- Co-development of high performance fuels with advanced engine designs, and
- Crosscutting sustainability and strategic analysis of economic, social, and environmental effects to inform decisions, identify emerging opportunities, and assess technology progress.

The following BETO Technology areas are eligible to receive TCF funding in FY 2021:

FEEDSTOCK SUPPLY AND LOGISTICS:
Solutions to reduce the technical, operational and economic uncertainty associated with the production of large, affordable, and sustainable supplies of quality, energy-dense, and conversion-ready feedstocks. The development of cost-effective, reliable, and efficient harvest, collection, storage, preprocessing, and transportation of renewable carbon sources. Identification of key quality and operation factors for conversion performance.

ADVANCED ALGAL SYSTEMS:
Early-stage technology R&D to increase algae productivity through algal strain improvement and efficient cultivation, and solutions to improve the efficiency and reduce the costs of algae logistics. Algae logistics operations include harvesting, dewatering, and producing and stabilizing biofuel intermediates products, such as algal-derived lipids or sugars.

CONVERSION:
Early-stage technology R&D to develop cost-effective conversion technologies for producing bioenergy and bioproducts from a variety of feedstocks and waste. Innovations to reduce the cost of deconstructing feedstock into intermediate products (such as sugars, intermediate chemicals, bio-oils, or gaseous mixtures) and upgrading those intermediates into liquid biofuels, bioproducts, and biopower. Advances and improvements in tools and methods for faster and less costly conversion technology development.

SYSTEMS DEVELOPMENT AND INTEGRATION:
Advancements in mid-to late-stage R&D to reduce technical uncertainty and operations risk for subsequent industry deployment. Development and testing of integrated process technologies to

reduce integration and scale-up risks and produce new biofuels and bioproducts needed to meet specifications for distribution infrastructure and end uses, and high-performance fuels co-developed with advanced engine designs.

DATA, MODELING, AND ANALYSIS:
Methods to track technology progress and identify opportunities and challenges related to the economic, environmental, and social effects of advanced bioenergy systems. Advances in tools to guide decision-making, and analyze cross-program system behaviors.

3. Building Technologies (EE-BTO)
Building Technologies (BTO) supports R&D of innovative building energy technologies such as lighting, space conditioning and refrigeration, windows and envelope and their effective integration into efficient, resilient, grid-interactive, and secure building systems. The ultimate goal is to reduce the average energy of all U.S. buildings, increase load flexibility, and overcome the high degree of fragmentation across the heterogeneous buildings industry spanning construction to appliance and equipment manufacturing. As part of the FY 2021 Technology Commercialization Fund, BTO seeks to fund projects that align with one or more of the following technology areas:

HVAC&R, WATER HEATING, AND APPLIANCES

- Solutions that target low global warming potential (GWP) refrigerant technologies. These technologies could include low charge system architectures (including heat exchanger and compressor designs), and new alternative system architectures that would inherently mitigate flammability risks associated with A2L and A3 refrigerants.

SENSORS AND CONTROLS TECHNOLOGIES

- Sensor and Control projects focused on transitioning control algorithms developed at the national laboratories to industry and sensor technologies that overcome installation and commissioning challenges. In particular sensors that are able to self-calibrate, report their performance state, and provide wire free installation are of interest.

WINDOWS AND OPAQUE ENVELOPE TECHNOLOGIES

- Opaque envelope technologies could include: air sealing and diagnostics technologies; low cost, R8/in or above insulation materials that utilize readily available and scalable manufacturing processes that ideally do not require changes in installation practices; unique coupling of air sealing and insulation energy conservation measures; and other technologies that enable envelope retrofits to be done faster, easier, and at a significantly reduced overall installation cost.
- R10 windows with dynamic solar control have the potential to add positive energy contributions to homes in cold and mixed climates (see draft Window RDO [https://www.energy.gov/eere/buildings/downloads/research-and-development-opportunities-report-windows]). Projects should use commercialized core technology such as vacuum insulated glazings, thin glass inter-lites, electrochromic glazings or automated shades packaged and integrated into common window types (e.g., double hung, casement, horizontal sliders, or picture windows) and be installed in modest size homes with all fenestration except for doors, including sliding glass doors that should be high performing but do not need to be R10 dynamic. Field validation should focus on macro energy savings, peak load reduction, and the ability to dramatically reduce the need for HVAC with small capacity systems.

COMMERCIAL BUILDING INTEGRATION

- Technologies that use deep reinforcement learning to track and manage commercial energy consumption by integrating generation, storage, and end use/load control within existing buildings without compromising building services (especially comfort) or
- Timber product (including cross-laminated timber) characterization, evaluation and/or development to improve control and/or thermal properties to reduce energy consumption in new or existing commercial buildings.

CODES

- Virtual Diagnostics & Inspections: Technology solutions and approaches which enable increased utilization of virtual diagnostics and inspections in residential and commercial buildings. Potential applications include energy-efficiency and demand-respond programs, as well as documentation of energy technologies by the building design and construction industry, including verification of standard construction practices. Successful projects will exhibit robust partnerships with industry stakeholders, such as designers, builders, contractors, local building departments, as well as home energy rating organizations, utilities and other relevant energy efficiency programs. BTO will consider projects that enable virtual inspections (e.g., augmented reality, construction site imaging devices, interoperability between technologies), as well as projects which support the adaptation of existing programs toward a virtual environment, with the objective reducing the costs associated with diagnostic and inspection activities while maximizing desired energy efficiency outcomes.

4. Geothermal Technologies (EE-GTO)

The Geothermal Technologies Office (GTO) supports the effort to commercialize lab developed technologies which can accelerate the deployment of geothermal energy. As part of the FY 2021 Technology Commercialization Fund, GTO seeks to fund projects that align with one or more of the following:

ENHANCED GEOTHERMAL SYSTEMS:

Enhanced Geothermal Systems (EGS) is focused on technologies that enable the creation of an engineered geothermal reservoir where there is hot rock but little to no natural permeability or fluid saturation present in the subsurface. Activities of interest include innovative methods of facilitating characterization of local stress, stimulation technologies that improve permeability, zonal isolation, and understanding of fluid and thermal pathways evolution through space and over time; allowing for economic access to the subsurface thermal resource, while ensuring wellbore integrity over multi-decadal timeframes; and enabling sustainable operation, which involves achieving sufficient productivity for power generation without excessive pressure build up or localization and decrease of flow or reservoir temperature.

HYDROTHERMAL RESOURCE CONFIRMATION:

Hydrothermal Resource Confirmation (HRC) seeks to find new and innovative approaches to exploration that facilitate finding and accessing not yet discovered or “blind” hydrothermal systems. These approaches can include advanced methods to combine various data sets (such as gravity, seismic, and magnetotelluric data, among others) to that reduce upfront exploration risk; improvements to drilling technologies that will reduce the cost of accessing the subsurface through abrasive, crystalline rock formations at elevated temperatures and pressures; new technologies that reduce costs for exploration activities such as microhole drilling applications, self-healing cements, subsurface imaging; alternatives to hydraulic fracturing that reduce, or eliminate, the use of water for fracturing and stimulation activities; or other activities that support wellbore integrity, subsurface stress and induced seismicity, permeability manipulation, and new subsurface signals.

LOW-TEMPERATURE AND CO-PRODUCED RESOURCES:
Low Temperature and Coproduced Resources supports the development of geothermal resources below a temperature of 300°F (150°C) as well as geothermal resources that can be co-developed with existing well-field infrastructure and other clean energy technologies. Activities of interest include recovery of critical minerals, including lithium, from geothermal brines; hybrid systems that pair geothermal with other energy technologies; and direct use of thermal resources for process and space heating applications (including ground source heat pumps). Also of interest are technologies that enable geothermal resources to provide energy storage, flexible generation, and other grid services.

TOOLS:
GTO also supports the development of general tools to increase geothermal adoption in the United States.

5. Hydrogen and Fuel Cell Technologies (EE-HFTO)

HYDROGEN PRODUCTION
The Hydrogen Production subprogram focuses on innovative technologies for low-cost, sustainable hydrogen production through splitting of water or from waste biomass resources, in support of H2@Scale. Technologies in the portfolio are applicable to production at centralized facilities as well as in distributed locations near points of use. End users of the technologies being studied could include steelmaking plants, chemical and synthetic fuel plants, data centers, hydrogen fueling stations for fuel cell electric vehicles, and many other emerging industries for hydrogen.

HYDROGEN STORAGE
The Hydrogen Storage subprogram focuses on technologies to enable low-cost storage of hydrogen for vehicle and stationary applications and long-distance distribution. Three key areas of focus include:

a. Hydrogen carriers. Hydrogen-rich materials that have a high hydrogen density and from which hydrogen can be released under relatively mild conditions have potential for bulk hydrogen storage and transport. The materials need to be stable at near-ambient temperatures and pressures, but can rapidly and controllably release hydrogen under other conditions, such as when the temperature is elevated or when passed through a catalytic reactor. Mission areas include development of novel hydrogen carrier materials, development of catalysts for hydrogen uptake or release and reactor development and demonstration.

b. Low-cost compressed hydrogen storage. Current commercial hydrogen fuel cell transportation applications use high-pressure (350 or 700 bar) compressed hydrogen stored in composite overwrapped pressure vessels. These pressure vessel systems are expensive, creating a barrier to successful widespread commercialization of the technology. Innovative approaches that lower the cost of the storage systems are of interest. Approaches to lower cost could include lower cost, high-strength carbon fiber, reduced use of carbon fiber, or more efficient system design (e.g., conformable pressure vessels that could be packaged onboard vehicles more efficiently than cylinders).

c. Storage of hydrogen at cryogenic temperatures. The energy densities in both liquid hydrogen and cold or cryo-compressed storage systems offer important potential

advantages for a number of emerging applications, including medium and heavy-duty vehicles, fleets, marine, and trains that require extended operating ranges and high-throughput fueling. However, the need for insulation as well as the boil-off and venting that occurs from extended dormancy presents specific challenges to system performance and cost in these approaches. Material, component, and system-level RD&D is being conducted by the Program to address these challenges.

HYDROGEN INFRASTRUCTURE

The Hydrogen Infrastructure subprogram conducts R&D to lower the cost and improve the reliability of hydrogen delivery and distribution in support of the H2@Scale initiative. Examples of potential end uses of hydrogen at scale include steelmaking, chemical and synthetic fuel plants, data centers, and fueling stations for fuel cell electric vehicles. Key methods of long-distance hydrogen delivery include liquefaction plants and liquid tankers, pipelines, and gaseous tube trailers. Key technologies at stations include compressors, cryopumps, storage, and dispensers. To lower the cost and improve reliability of delivery and dispensing technologies, HFTO has funded research on magnetocaloric liquefaction; pipeline materials; thermodynamic analysis of liquid tanker operation; innovative designs and utilization techniques for tube trailers; innovative designs for dispensers, compressors, and storage vessels; and materials compatibility research through the H-Mat consortium and HyBlend concept on hydrogen blending in natural gas pipelines.

FUEL CELLS

The Fuel Cells subprogram conducts early-stage fuel cell component R&D for transportation and cross-cutting applications (like stationary reversible fuel cells for energy storage, or fuel cells for data centers). Early-stage research primarily focuses on direct hydrogen polymer electrolyte membrane fuel cells (PEMFCs) and specific areas include catalysts, electrodes, membranes, gas diffusion layers, bipolar plates, and membrane electrode assemblies (MEAs). All component R&D is aimed at simultaneously improving performance (power density, efficiency, activity, mass transport), reducing costs (less expensive materials, structures or processes) and increasing durability (identifying and mitigating degradation issues). Furthermore, the subprogram is expanding to include fuel cell R&D for medium- and heavy-duty vehicle applications (like trucks, rail, aviation, and marine vessels). These applications require innovative concepts that advance the development and integration of PEMFCs with high durability and high fuel efficiency. Fuel cell systems should demonstrate significant progress towards ultimate targets for efficiency (>65%) and durability (25,000 hours), while limiting platinum group metal (PGM) content to <0.2 mg/cm^2 to reduce cost.

SYSTEMS DEVELOPMENT AND INTEGRATION

The SDI subprogram is currently focused on three application areas: (1) integrated energy systems (including grid-integration, hybrid energy systems, and on- and off-grid power generation); (2) heavy-duty transportation; and (3) chemical and industrial applications. Integrated energy systems are a major focus of the subprogram to demonstrate grid support and energy storage; hybridization with nuclear power plants or renewable power systems; and hydrogen combustion, either blended with natural gas or in pure form. Demonstration of hydrogen and fuel cells in heavy-duty transportation applications, including heavy-duty trucks, maritime, and rail is another high priority.

SAFETY, CODES AND STANDARDS

The Safety, Codes, and Standards (SCS) subprogram is focused on conducting R&D to enable the development of codes and standards for adoption of hydrogen and fuel cell technologies. The research and development performed by this subprogram includes hydrogen behavior, safety sensor R&D and deployment guidance, hydrogen contaminant detection for transportation fuel and fuel quality, quantitative risk assessment, component failure R&D and non-destructive evaluation of infrastructure components, with the objective of enabling a 40% reduction in footprint for hydrogen installations and a reduction in overall cost and reducing regulatory barriers impacting H2@Scale deployment. Additionally, SCS subprogram work ensures that safety considerations are integrated into projects and activities funded through the program. Activities under this subtask also enable the development and widespread sharing of safety-related information resources and lessons learned through such entities as the Center for Hydrogen Safety.

6. Solar Energy Technologies (EE-SETO)

The U.S. Department of Energy **Solar Energy Technologies Office (SETO)** supports research and development to improve the flexibility and performance of solar technologies that contribute to a reliable and resilient U.S. electric grid. The office invests in innovative research efforts that advance SETO Program Goals to securely integrate more solar energy into the grid, enhance the use and storage of solar energy, and lower solar electricity costs.

SETO seeks projects that align with one or more of the following areas for funding under the FY21 TCF:

PHOTOVOLTAICS:

SETO supports the research and development of photovoltaic (PV) technologies that improve efficiency and reliability, lower manufacturing costs, and drive down the cost of solar electricity. The program funds innovative concepts and experimental designs across a range of materials and PV system components, to include balance of system hardware, that have the potential to make solar energy among the least expensive forms of energy available by reaching a levelized cost of energy of $0.03 per kilowatt-hour. The PV subprogram is particularly interested in proposals to advance inherently scalable devices and manufacturing that show the potential to rapidly increase capacity with reduced capital cost requirements.

Notable PV technology areas of interest include:

- Crystalline Silicon
- Cadmium Telluride (CdTe)
- Perovskites
- Tandem (multijunction) Cells and Modules
- Organic
- Hardware enabling improved system performance

CONCENTRATING SOLAR POWER:

SETO supports the development of novel concentrating solar thermal technologies that will lower cost, increase efficiency, and improve reliability compared to current state-of-the-art technologies. The CSP subprogram funds the development of improved system operations and innovative concepts in the collector, receiver, thermal storage, heat transfer media, and power cycle subsystems that decrease the cost or improve the value of solar thermal energy that can be utilized at any time of day or night.

Particularly of interest are technologies that integrate concentrating solar thermal technologies with non-electricity applications, including industrial processes and production of chemicals and fuels.

SYSTEMS INTEGRATION:
SETO supports research that advances the reliable, resilient, secure, and affordable integration of solar energy onto the U.S. electric grid through its systems integration subprogram. The systems integration subprogram collaborates with other program offices as part of the Department of Energy's Grid Modernization Initiative crosscutting research efforts to ensure our country's grid is capable of introducing much more solar generation. The systems integration subprogram focuses on five research areas to enable seamless integration of solar energy onto a modernized electric grid:

- Planning and Operation – Understanding the impacts of increasing penetration of solar energy on grid reliability and power quality and addressing the variability of solar generation and two-way power flows.
- Solar + X – Developing best practices for interconnecting and integrating solar with energy storage and synergistic distributed energy resource technologies to achieve higher asset and utilization and value.
- Power Electronics – Researching power electronic technologies such as smart photovoltaic inverters for flexible power flow control.
- Sensing and Communication – Enhancing situational awareness of solar generation at the grid edge using advanced information, communication, and data analytic technologies.
- Codes and Standards – Informing the standardization of interconnection, interoperability, and cybersecurity for photovoltaics and other distributed energy resource systems.

Solar Energy Soft (Non-Hardware) Costs:
SETO reduces the soft costs of PV and removes barriers to the adoption of solar energy technologies. The soft costs subprogram works in the following strategic areas: data and analysis, process improvements, technical assistance, and workforce training. The subprogram develops data and tools to improve information access and transparency and identifies successful and efficient models and processes that can be widely used. Technical assistance helps solar stakeholders test and refine solutions to meet their solar-related goals. Through solar workforce training, the subprogram reduces soft costs by ensuring that the industry can hire the range of expertise it needs to grow and adopt updated technologies. SETO is particularly interested in the transition of tools, capabilities or knowledge to private sector entities that may be able to increase the reach or impact of previously funded lab research to drive down soft costs at the local level.

7. Vehicle Technologies (EE-VTO)
The Vehicle Technologies Office (VTO) supports high impact research to develop more energy efficient and environmentally friendly highway transportation technologies that enable America to use less petroleum. To strengthen national security, enable future economic growth, support energy dominance, and increase transportation energy affordability for Americans, VTO funds new innovations in electrification, including advanced battery technologies; advanced combustion engines and fuels, including co-optimized systems; advanced materials for lighter-weight vehicle structures and better powertrains; and energy efficient mobility technologies and systems, including connected and autonomous vehicles as well as innovations in connected infrastructure for significant systems-level energy efficiency improvement. VTO is strongly committed to partnerships with industry to help ensure the eventual market acceptance of the technologies being developed. VTO's research portfolio generates knowledge that industry can advance to deploy innovative energy technologies to support affordable, secure, reliable and efficient transportation systems across America.

The following VTO technology areas are eligible to receive TCF funding in FY 2021:

BATTERY AND ELECTRIFICATION:
The Battery and Electrification Technologies subprogram focuses on transportation electrification through three technology areas. Battery R&D focuses on high-energy and high-power battery materials and battery systems that will lead to a significant reduction in the cost, weight, volume, and charge-time of plug-in electric vehicle (PEV) batteries. Research for fast, secure, and resilient PEV charging is the focus of the Electrification R&D activity, and extreme high power density motor and power electronics for PEV traction drive systems is under the Electric Drive R&D activity. These activities focus on generating knowledge and addressing technology barriers for batteries, electric drive systems, and electrification technologies that can enable transportation electrification and support the mass adoption of PEVs. Specific subprogram goals include: (1) reducing the cost of battery packs to less than $100/kWh while increasing vehicle range to 300 miles and decreasing charge time to less than 15 minutes by 2028, and (2) reducing the cost of electric drive systems to less than $6/kW by 2025.

ADVANCED COMBUSTION AND ENGINES:
The Advanced Combustion Engines and Fuels subprogram generates the knowledge and insight necessary for industry to develop the next generation of engines and fuels through improved understanding of combustion processes, fuel properties, and emission control technologies. A science-based understanding of how engine efficiency and emissions are impacted by fuel properties, and conversely, how the combustion process can be modified to take advantage of desirable fuel properties, can enable further efficiency improvements. Alternative fuels such as natural gas, and renewable fuels such as drop-in biofuels, frequently have technical barriers that impede their implementation in traditional, petroleum-fuels equipment and infrastructure. Work to overcome these barriers will include support for alternative-fuel engine research, development and evaluation of the emissions impact of novel alternative fuels. The lower exhaust temperatures of advanced combustion engines make conventional aftertreatment systems unsuitable. Research on exhaust aftertreatment systems for these advanced combustion engines will be on catalyst technologies that are active at lower exhaust temperatures of 150°C and provide greater than 90% conversion efficiency. Market introduction of co-optimized high-performance fuels and advanced engines with novel emission controls will reduce petroleum use for passenger and commercial vehicles over the next several decades, during which time the Energy Information Administration reference case forecasts that the vast majority of vehicles sold will still utilize an engine.

MATERIALS TECHNOLOGY:
The Materials Technology subprogram supports R&D of advanced materials to enable increased vehicle fuel efficiency. Advanced internal combustion engines are operating at increasingly high peak cylinder pressures to achieve the targeted increases in efficiency. The combination of high temperature and pressure may exceed the operational parameters of existing materials for internal combustion engines. The propulsion materials research portfolio seeks to develop higher performance materials that can withstand increasingly extreme environments and address the future property needs of a variety of high-efficiency powertrain types, sizes, fueling concepts, and combustion modes. Advanced lightweight materials enable improvements in fuel economy by providing properties that are equal to or better than traditional materials at a lower

weight. Because it takes less energy to accelerate a lighter object, replacing cast-iron and traditional steel components with lightweight materials such as advanced high-strength steel, magnesium, aluminum, and polymer composites can directly reduce a vehicle's energy consumption. To enable use of these materials, the Materials Technology subprogram focuses on reducing cost of materials, improving prediction of properties, and enabling high volume manufacturing of components and multi-material assemblies. The Materials Program goals are to reduce the weight of a vehicle's structural components by 25% at a cost of less than five dollars per pound saved.

ENERGY EFFICIENT MOBILITY SYSTEMS:
The Energy Efficient Mobility Systems subprogram envisions an affordable, efficient, safe, and accessible transportation future in which mobility is decoupled from energy consumption. Through EEMS, VTO works to realize a maximum-mobility, minimum-energy future that provides affordable, reliable, and convenient transportation choices that operate efficiently using secure, domestic energy resources. EEMS conducts early-stage R&D at the vehicle, traveler, and system levels, creating knowledge, insights, tools, and technology solutions that increase mobility energy productivity for individuals and businesses. This multi-level approach is critical to understanding the opportunities that exist for optimizing the overall transportation system. This approach informs the development of tools and capabilities to evaluate the energy impacts of new mobility solutions and will lead to the creation of technologies that provide economic benefits to all Americans through enhanced mobility.

8. Water Power Technologies (EE-WPTO)
The Department of Energy's (DOE) Water Power Program conducts early-stage research and development (R&D) to strengthen the body of scientific and engineering knowledge enabling industry to develop new technologies that increase U.S. hydropower and marine and hydrokinetic (MHK) generation. To accomplish its objectives, the Program supports the National Laboratories, industry, and academia to conduct R&D though contracts, cooperative agreements, and other innovative partnerships and approaches such as the Technology Commercialization Fund (TCF). As part of the FY 2021 TCF Solicitation, WPTO seeks to fund projects that align with its two subprograms:

HYDROPOWER:
The Hydropower subprogram is aligned to the roadmap in the Hydropower Vision, which set forth priority pathways identified by industry, environmental groups, and other hydropower stakeholders as the necessary steps to realize the full potential benefits of hydropower in the U.S. These pathways involve strengthening the body of knowledge that supports industry efforts to develop and deploy new technologies, reducing the levelized cost of energy from non-powered dams and new stream reaches, quantifying the value of grid reliability services, addressing regulatory requirements, and maintaining and improving the sustainability of U.S. hydropower assets. The hydropower subprogram targets both critical information and technology development challenges currently limiting hydropower generation, as well as research and analysis to improve understanding of any long-term costs — and potential technology solutions—associated with operating hydropower so as to maximize its long-term contributions to the grid.

MARINE AND HYDROKINETIC:
The Marine and Hydrokinetic (MHK) subprogram conducts early-stage research that advances the development of reliable, cost-competitive technologies and reduces barriers to technology deployment. Industry deployment of MHK technologies for bulk power generation is nascent, and significant research and development is required to realize cost-competitiveness at the utility scale for MHK technologies. Non-utility scale applications, including power for remote coastal communities with high electricity costs, charging for ocean-based sensors and underwater vehicles, and non-electric uses like desalination provide

industry with opportunities to develop and deploy MHK technologies in the near-term. Successfully serving these markets simultaneously reduces costs for larger utility-scale markets that are still developing – by providing real in-water experience that drives down learning curves – and increases near-term investment in the sector. In addition, cost-effective energy provision at sea enables major advances in scientific understanding of the ocean and technology innovation and commercial opportunities in the ocean.

9. Wind Energy Technologies (EE-WETO)

The Wind Energy Technologies Office (WETO) focuses on enabling industry growth and U.S. competitiveness by supporting early-stage research on technologies that enhance energy affordability, reliability, and resilience and strengthen U.S. energy security, economic growth, and environmental quality. WETO provides global leadership in fundamental wind energy science research and innovation focused on reducing the cost of energy, decreasing environmental impacts, and advancing systems integration. The office pursues opportunities across all U.S. wind sectors—offshore wind, land-based utility-scale wind, and distributed wind to supply low-cost energy for American consumers and businesses.

Building on U.S. wind industry success to date, several key opportunities remain for the federal government to invest in wind energy science to drive technological innovation across all wind applications offshore and on land. Particularly, in addressing siting and environmental challenges; in finding a leadership role for wind to provide a full range of grid services, in addition to power; and in continued innovation with scaling, light-weighting, automated manufacturing, end-of-life recycling, and floating offshore wind innovations in deep water.

WETO seeks projects that align with the following program areas for TCF funding in FY 2021:

OFFSHORE WIND

Offshore wind (OSW) development provides a significant opportunity to expand and diversify the U.S. energy portfolio and help meet future electricity demand. In order to meet its OSW objectives of reducing LCOE and facilitating competitive development along all coasts of the United States, including the Great Lakes, WETO activities focus on several key topic areas:

a. R&D to evaluate and develop technological solutions to conditions unique to U.S. OSW installations such as specific seabed and current conditions, resistance to hurricanes and other extreme weather events, and deep waters
b. Advancements in the commercial readiness of floating OSW platform design and installation processes
c. Advanced materials and manufacturing R&D to enable next-generation turbines that are lighter weight, with improved mechanical properties such as higher strength and durability, and are cost effective for the full life-cycle of the turbine. This includes but is not limited to research for composite materials research, advanced coatings, and lubricants; and advanced manufacturing techniques to enable automation, reduce costs cycle time, and address challenges and opportunities in support of U.S. OSW supply chain development
d. Research to optimize operations and maintenance functions, decrease unplanned maintenance, and reduce life-cycle operational costs. This includes, but is not limited to: autonomous inspection and repair technologies; and prognostic operating health assessment and management tools that may draw on machine learning, big data analytics, and other advances to decrease O&M costs by reducing the need for expensive hands-on operations at offshore sites

e. Research on offshore wind project siting barriers, with specific interest in the development of technical solutions to assess and mitigate, if necessary, offshore wind impacts on wildlife and on radar systems.

LAND-BASED WIND

Land-based wind energy technology has demonstrated the ability to deliver affordable and reliable electricity that creates economic opportunities across electricity markets. WETO prioritizes reducing costs, improving wind turbine designs, enhancing wind system reliability, optimizing wind plant performance, supporting grid integration and reliability, and mitigating environmental and community impacts. Achieving WETO's goals requires a combination of science, engineering, and technology innovation in the following key areas:

a) Wind energy science and system design engineering, such as the Atmosphere to Electrons (A2e) Initiative, which includes studying wind-related atmospheric science (e.g., complex terrain) in order to optimize energy output through active control of the entire wind plant
b) Materials and manufacturing R&D to enable scaling of next-generation wind turbine components that are lighter weight; stronger; and cost-effective for the full life-cycle of the turbine. This includes but is not limited to research in composite materials research, other novel materials, advanced coatings, and lubricants; component end-of-life solutions, and re-design for recyclability ; advanced manufacturing techniques to enable automation, cut cost, cycle time; and R&D to overcome LBW transportation and logistics constraints
c) Research to optimize operations and maintenance, decrease unplanned maintenance, and reduce life-cycle operational costs. This includes, but is not limited to: autonomous inspection and repair, prognostic and health management tools, machine learning, big data analytics, and O&M data collection and analysis
d) Research on wind siting barriers, with specific interest in the development of technical solutions to land-based wind impacts on wildlife and on radar systems.

DISTRIBUTED WIND

Wind energy technology is poised to become a reliable and affordable distributed generation resource. Wind technology applied in distributed applications can strengthen distribution and micro grid operations and provide local economic benefits. WETO investments are focused on enabling wind technology as a complementary and cost-effective distributed energy generation option. WETO supports distributed wind research in the following key areas:

a) Research to reduce balance-of-plant and installation capital costs
b) Research to cost effectively increase energy production of small and medium-scale wind technology
c) Research to increase the accuracy of low-cost distributed wind energy production forecasting tools
d) Research to advance wind-specific control and communication technologies for hybrid distributed energy system integration
e) Research to enable wind technology as a rapidly deployable generator in defense and disaster response applications.

SYSTEMS INTEGRATION

The future U.S. electric grid faces increasing complexities in planning and operation due to an evolving generation mix, demand-side behavior changes, advancement in new technologies such as energy storage, prevalent digitalization and communications, and more. To ensure cost-effective, cyber-secure, reliable, and resilient system operation with increasing levels of

wind, WETO supports the R&D in systems integration in the following areas:

a) Research to enable advanced control functions for wind turbines to provide a wide range of grid services
b) Research on design and control of wind hybrid systems
c) Research on models and tools that facilitate grid studies with increasing levels of wind
d) Research to address wind plant cybersecurity needs, in particular, wind plant cyber security assessment tools and best practices
e) Research on innovative electrical hardware for land-based and offshore wind plants.

OFFICE OF FOSSIL ENERGY (FE)

The Office of Fossil Energy Research and Development (FER&D) advances transformative and innovative technologies that enable the reliable, efficient, affordable, and environmentally sound use of fossil fuels. Fossil energy sources constitute over 80% of the country's total energy use, and are important to the nation's security, economic prosperity, and growth. These efforts encompass the development of advanced energy systems, crosscutting fossil energy research, advanced Carbon Capture Utilization and Storage (CCUS) technologies. Additionally, FER&D conducts research related to the prudent and sustainable development of domestic oil and gas resources, with a focus on natural gas technologies and unconventional resources.

The following FER&D areas are eligible for TCF funding in FY 2021:

1. **Advanced Energy Systems (FE-AES)** includes new technology applications (i.e., pulse combustion, flameless combustion, toping cycles) at both new and existing plants. Also included is research on advanced turbines that can withstand new stresses placed on the sector by the need for demand-res1onse performance, and on materials for solid oxide fuel cells and advanced modular gasification systems.

2. **Cross-cutting Research (FE-CCR)** includes work in advanced materials, computational science, and advanced analytical tools, with particular attention to high pressure/high temperature applications. R&D consists of low-cost and reliable multi-sensing sensors capable of detecting temperature, gas species and pressure that—with additional development and scale-up by industry—could ultimately be capable of providing real-time measurements critical to the operation, optimization, reliability and efficiency of the next-generation of fossil fueled power systems. Crosscutting Materials focuses on efforts to use computational tools to discover and design novel materials for fossil fuel applications.

3. **Carbon Capture (FE-CC)** includes transformational carbon capture technologies such as, but not limited to, non-aqueous solvents, advanced membranes, sorbents, and cryogenic systems that can significantly reduce the cost of capture from coal and natural gas-fired power plants and industrial facilities. Transformational capture systems are considered to be a set of disruptive technologies that can significantly reduce the cost of capture. In addition to post-combustion capture, it also supports pre-combustion R&D that focuses on CO_2 separation from syngas. Applications are sought that develop CO_2 capture technologies in a form that can be then transferred *directly* (without regeneration) to a carbon utilization process which creates a product from the captured CO_2. This pathway is often referred to as "reactive capture" and offers energy savings as a result of not employing a CO_2 regeneration step.

4. **CO_2 Utilization (FE-CU)** includes transformational technologies that convert CO_2 to valuable products and or commodities including, but not limited to, building products, chemicals and fuels, and polymers. Technologies such as mineral carbonation, catalysis, or bio-mediated pathways to reduce CO_2 to CO or convert directly to products are of interest. Carbon Utilization technologies could revolutionize the manufacturing industry to capitalize the vast resource of carbon dioxide available from the power and industrial sector. Applications can address CO_2 emissions from any gaseous waste stream, however technologies that use atmospheric CO_2 are nonresponsive. Technologies must be able to create carbon based products that are economically competitive, have an overall carbon lifecycle better than conventional products in the market and be environmentally

sustainable. Applications shall not assume free renewable electricity and hydrogen as part of their lifecycle and economics. Market prices for energy and other feedstocks such as hydrogen must be assumed to be purchased from the existing markets. Applications are sought that develop CO_2 utilization technologies which can *directly* (without regeneration) convert captured CO_2, i.e. in the form of loaded capture solvent, to a value-added product. This pathway is often referred to as "reactive capture" and offers energy savings as a result of not employing a CO_2 regeneration step.

5. **Carbon Storage (FE-CS)** includes the development of technologies that ensure safe, secure, efficient and affordable CO_2 injection and containment in storage complexes in diverse geologic settings. Applications are sought in several areas of interest. Plume detection and storage efficiency technologies of interest include permanent sensor networks to track the plume and pressure front; methods to demonstrate plume stabilization; new seismic methods for high-resolution CO_2 saturation determination;
non-seismic technologies to augment/supplement seismic methods; and machine learning (ML) techniques to extrapolate local reservoir information to basin-scale for static (geologic) modeling. Secure storage technologies of interest include new sensors and methods to detect and quantify leaks; Reduced Order Models (ROMs) and other new computational methods to cost- effectively assess storage complex containment; and Intelligent monitoring system (IMS) platforms coupled with ML development to confirm containment. Subsurface stress technologies of interest include non-invasive in-situ stress measurement at the borehole; technologies to quantify stress over large areas; geomechanical simulators to determine fault slip and predict induced seismicity; new methods (including ML) to process/analyze passive seismic data for fault properties and stress state; and new high-sensitivity microseismic sensors. Wellbore integrity technologies of interest include technologies to locate legacy wells and assess legacy wellbore integrity; novel wellbore materials to remediate leaks; and embedded wireless sensor networks coupled with ML to assess wellbore integrity.

6. **Natural Gas Technologies (FE-NGT)** includes the development of Natural Gas infrastructure technologies to aid in safer and more efficient oil and gas development. R&D of technologies in targeted areas such as advanced pipeline materials and coatings, enhancing the operational performance of natural gas compressors, and inside the pipe sensor and in-line inspection research and sensor research and development that will improve the operational efficiency of natural gas transmission, distribution, and storage facilities. Additional efforts will support the research and development of modular natural gas conversion technologies.

7. **Unconventional Fossil Energy Technologies from Petroleum – Oil Technologies (FE-UFET)** research efforts focus on increasing ultimate recovery and operational efficiency of oil and gas resources both onshore and offshore. Project areas include field laboratories, fundamental shale research that address rock-fluid phenomena at pore and core scale, analytics, enhanced oil recovery, produced water, geologic characterization, maintain well control from drilling through producing operations and workovers, and met-ocean effects.

OFFICE OF NUCLEAR ENERGY (NE)

Nuclear energy is a key element of United States (U.S.) energy independence, energy dominance, electricity grid resiliency, national security, and clean baseload power. America's nuclear energy sector provides over 60 percent of the nation's annual clean electricity production and generates nearly 20 percent of U.S. electricity from a fleet of 99 operating units in 30 states. America's nuclear energy sector also plays key national security and global strategic roles for the U.S., including nuclear nonproliferation.

The Office of Nuclear Energy (NE) focuses on three major mission areas: the nation's existing nuclear fleet, the development of advanced nuclear reactor concepts, and fuel cycle technologies. Utilizing the Department's greatest strengths, NE emphasizes early stage research and development (R&D), mobilizing our unique national laboratory capabilities, and implementing targeted R&D partnerships with the U.S. nuclear industry.

The following NE Technology Areas are eligible for TCF funding in FY 2021:

1. Reactor Concepts Research, Development and Demonstration (Reactor Concepts RD&D) (NE-RCRDD)

The Reactor Concepts Research, Development and Demonstration (RD&D) program supports the conduct of early stage research and development (R&D) on existing and advanced reactor designs and technologies to enable industry to address technical challenges while maintaining the existing fleet of nuclear reactors and to promote the development of a robust pipeline of advanced reactor designs and technologies and supply chain capabilities. Program activities are designed to address technical, cost, safety, and security issues associated with the existing commercial light water reactor fleet and advanced reactor technologies, such as small modular reactors (SMRs), fast reactors using liquid metal coolants, high temperature reactors using gas or liquid salt coolants, and micro-reactors.

In maximizing the benefits of nuclear power, work must be done to address the following challenges:

- Improving affordability of nuclear energy technologies;
- Enhancing safety and reducing technical risk;
- Minimizing proliferation risks of nuclear materials; and
- Enabling the improvement of the economic outlook for the American nuclear industry.

2. Fuel Cycle Research and Development (FCR&D) (NE-FCRD)

The FCR&D program conducts early-stage applied research and development (R&D) on advanced fuel cycle technologies that have the potential to enhance safety, improve resource utilization and energy generation, reduce waste generation, and limit proliferation risk. Advancements in fuel cycle technologies support the enhanced availability, economics, safety, and security of nuclear-generated electricity in the United States (U.S.), further enhancing U.S. energy independence and economic competitiveness. The program conducts system analyses of advanced fuel cycle options to help guide decision-making and prioritization of R&D activities. The FCR&D program also provides technical support for the Department's uranium management policies to mitigate negative impacts on domestic producers from Departmental actions.

3. Used Nuclear Fuel Disposition (UNFD) R&D

The Used Nuclear Fuel Disposition Research and Development (R&D) subprogram conducts scientific research and technology development to enable long term storage, transportation, and disposal of spent nuclear fuel and wastes. The primary focus of this subprogram supports the development of disposition-path-neutral waste management systems and options in the context of the current inventory of spent nuclear fuel and waste.

4. Nuclear Energy Enabling Technologies (NEET) (NE-NEET)

The NEET program conducts early-stage research and development (R&D) and makes strategic investments in research capabilities to develop innovative and crosscutting nuclear energy technologies to resolve nuclear technology development issues. NEET is a key element of the Department's overall strategy to reverse the downward trajectory of our nation's nuclear energy sector and once again become dominant by fully implementing the President's June 29, 2017, announcement made at the Department of Energy to "begin to revive and expand our nuclear energy sector." The Crosscutting Technology Development (CTD) subprogram focuses on innovative research that directly supports and enables the development of new, next generation reactor and fuel cycle technologies, including topical areas such as sensors and instrumentation; cybersecurity, innovative manufacturing, fabrication and construction technologies; advanced cooling concepts; and other stakeholder-identified research areas. Also, NEET includes a strong investment in modeling and simulation tools for existing and advanced reactor and fuel system technologies. Further, the program provides U.S. industry, U.S. universities, and national laboratories access to unique nuclear energy research capabilities through the Nuclear Science User Facilities (NSUF). In addition, NEET includes the Transformational Challenge Reactor (TCR) subprogram to provide a revolutionary platform to reduce the deployment costs and timelines of nuclear energy systems. Collectively, NEET-sponsored activities support the goals, objectives, and activities of the Gateway for Accelerated Innovation in Nuclear (GAIN) initiative to make these technology advancements accessible to U.S. industry through private-public partnerships. In so doing, NEET promotes U.S. energy independence, electricity grid resiliency, national security and clean baseload power.

Appendix B: TCF Match and Non-Federal Match Information

MATCHING

The terms "matching" and "cost sharing" are often used synonymously and can create confusion. OTT uses the terms "matching" and "non-Federal match" to ensure consistency with Section 1001 of EPAct 2005, which authorizes the Technology Commercialization Fund (TCF). For the TCF, "match" or "matching funds" means that for each dollar of TCF funding provided, a dollar of non-Federal funds is required. Because there is a one-for-one match required for TCF funds, the TCF will never contribute more than 50% of the total cost of any project. It is possible for the non-Federal match to exceed the funding contributed by the TCF, if the DOE Facility or private partner(s) provide more than 50% of the total project cost.

Matching funds are subject to audit by the Department or other authorized government entities (e.g., GAO). A third party collaborator—not party to the CRADA or other approved partnership agreement—could provide matching funds. A written agreement may be advisable—either between the DOE Facility and the third party or between the CRADA partner and the third party—that requires the third party to provide the matching funds. Consult your DOE Facility legal staff for advice about how to obligate the third party to provide the matching funds, and to ensure the matching funds meet the requirements for in-kind contributions, if applicable. The lead DOE Facility is responsible for any funding gap should a TCF project fail to obtain from partners or other collaborators the statutorily required 50% of total project costs from non-federal sources.

By law, TCF funds cannot flow to a partner for work scope that is covered by a CRADA. Other types of agreements may be used with the prior approval of OTT. If a contract is used as a partnership vehicle, TCF funds applied to the contract could flow to the partner. The 50% match requirement remains regardless of the type of partnership agreement a lab uses.

OTT has no policy regarding foreign expenditures. Consult your DOE Facility's legal staff for advice about foreign partners and agreements with the DOE Facility.

Applicants should make sure their prospective partnership arrangements comply with all DOE and CRADA directives and conditions.

WHAT QUALIFIES FOR NON-FEDERAL MATCHING

Please consult the Federal Acquisition Regulations (FAR) or the rules for Federal Financial Assistance at 2 CFR § 200 including 2 CFR § 200.306 for information about which costs are allowable.

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. Only the value for the five years of donated maintenance that corresponds to the project period is allowable and may be counted.

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

DOE FINANCIAL ASSISTANCE RULES 2 CFR PART 200 AS AMENDED BY 2 CFR PART 910

As stated above, the rules about what is allowable are generally the same within like-types of organizations. The 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 non-Federal match 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.
    5. They are not paid by the Federal Government under another award unless authorized by Federal statute.
    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 means 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 non-Federal matching funds, 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 non-Federal 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 non-Federal match 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 C: TCF Final Report Template

Final TCF Report for
Click here to enter project title.

Click here to enter TCF tracking Number (TCF-XX-XXXXX).

Click here to enter name(s) of author(s).

Click here to enter month and year (of final report).

Prepared for the
U.S. Department of Energy
Office of Technology Transitions

Note: This template is current as of September 2020. Please contact OTT (TCF@hq.doe.gov) for an updated version before beginning a final report.

Click here to enter Project Title
Click here to enter TCF tracking Number (TCF-XX-XXXXX).

PROJECT INFORMATION

TCF Tracking Number: Click here to enter TCF Tracking Number (TCF-XX-XXXXX).
Start Date: Click here to enter a date. Completion Date: Click here to enter a date.
Point(s) of Contact at DOE Facility: Click here to enter name(s) of POC(s) at DOE Facility

Partner(s) and Point(s) of Contact (if applicable): Click here to enter name(s) of partner organization(s) and POC(s) there, if applicable.

Type of partnership agreement used (if applicable) (e.g., CRADA, ACT, contract): Click here to enter type of partnership agreement used (if applicable).

FUNDING TABLE

	TCF Funding		Matching Funding	
Year	Planned	Actual	Planned	Actual
1	$XXX,XXX	$XXX,XXX	$XXX,XXX	$XXX,XXX
2 (if applicable)	$XXX,XXX	$XXX,XXX	$XXX,XXX	$XXX,XXX
3 (if applicable)	$XXX,XXX	$XXX,XXX	$XXX,XXX	$XXX,XXX
Total	**$XXX,XXX**	**$XXX,XXX**	**$XXX,XXX**	**$XXX,XXX**

Click here to enter Project Title
Click here to enter TCF tracking Number (TCF-XX-XXXXX).

Source of TCF funding
Check box(es) to indicate which DOE Program Office(s) funded your project

Office of Cybersecurity, Energy Security, and Emergency Response (CESER)
☐ Cybersecurity for Energy Delivery Systems (FY19; FY21)

Office of Electricity (OE) (Office of Electricity and Energy Reliability FY16-FY18)
☐ Clean Energy Transmission and Reliability (FY16; FY17)
☐ Cybersecurity for Energy Delivery Systems (FY17)
☐ Energy Storage (FY16; FY17)
☐ Energy Storage (Grid Scale) (FY18-FY21)
☐ Resilient Distribution Systems (FY18-FY21)
☐ Smart Grid Research and Development (FY16; FY17)
☐ Transformer Resilience and Advanced Components (FY19; FY21)
☐ Transmission Reliability and Resilience (FY18-FY21)

Office of Energy Efficiency and Renewable Energy (EE)
☐ Advanced Manufacturing (FY16-FY21)
☐ Bioenergy Technologies (FY16-FY21)
☐ Building Technologies (FY16-FY21)
☐ Hydrogen and Fuel Cell Technologies (previously Fuel Cell Technologies) (FY16-FY21)
☐ Geothermal Technologies (FY16-FY21)
☐ Solar Energy Technologies (FY16-FY21)
☐ Vehicle Technologies (FY16-FY21)
☐ Water Power Technologies (FY16-FY21)
☐ Wind Energy Technologies (FY16-FY21)

Office of Fossil Energy (FE)
☐ Advanced Energy Systems (FY16-FY21)
☐ Carbon Capture (FY16-FY21)
☐ Carbon Capture and Utilization (FY18)
☐ Carbon Storage (FY16-FY21)
☐ CO2 Utilization (FY19; FY21)
☐ Coal R&D (FY16; FY17)
☐ Cross-cutting Research (FY16-FY21)
☐ Natural Gas Technologies (FY16-FY21)
☐ Supercritical Transformation Electric Power R&D (FY16; FY17)
☐ Unconventional Fossil Energy Technologies (FY16; FY17)
☐ Unconventional Fossil Energy Technologies from Petroleum – Oil Technologies (FY18-FY21)

Office of Nuclear Energy (NE)
☐ Fuel Cycle Research and Development (FY16-FY21)
☐ Used Nuclear Fuel Disposition R&D (FY21)
☐ Nuclear Energy Advanced Modeling and Simulation (FY18; FY19)
☐ Nuclear Energy Enabling Technologies (FY16-FY21)
☐ Nuclear Energy Enabling Technologies Crosscutting Technology Development (FY18; FY19)
☐ Reactor Concepts R&D (FY16; FY17)
☐ Reactor Concepts Research, Development and Demonstration (FY18-FY21)
☐ Supercritical Transformation Electric R&D (FY16; FY17)

Click here to enter Project Title
Click here to enter TCF tracking Number (TCF-XX-XXXXX).

SCOPE AND OBJECTIVE

Click here to enter text describing the project scope and objectives.

PROJECT ACCOMPLISHMENTS

Benefit to DOE

Click here to provide a brief summary of the benefits derived from the project (e.g., new subject inventions, new project partners, additional partner contributions).
Reference Appendix A as needed.

Market Viability

Click here to describe state of market viability at project inception and project completion.

Generated Data and Reports

Click here to list journal articles, reports, etc.

Path Forward

Click here to discuss anticipated next steps toward commercialization (12-18 month horizon).

Click here to enter Project Title
Click here to enter TCF tracking Number (TCF-XX-XXXXX).

APPENDIX A: CLOSEOUT CHECKLIST

Yes	No	N/A	**Check the appropriate response(s) to the following statements:**
☐	☐	☐	All proposed work identified under the project and all outstanding issues have been completed and/or resolved.
☐	☐	☐	Partner(s) (if applicable) has been notified of the completion of the project and established date of completion.
☐	☐	☐	Protected CRADA Information has been stamped, when appropriate, in accordance with the CRADA and DOE Facility policy.
☐	☐	☐	Funding Program Office notified of completion, and established date of completion
☐	☐	☐	Office of Technology Transitions notified of completion, and established date of completion
☐	☐	☐	Remaining funds dispositioned

CONSTRAINTS/EXTERNAL INFLUENCES

If the activity was unsuccessful, select one or more of the following reasons.

☐Technical or manufacturing problems ☐Changes in market conditions

☐Funding Availability ☐Competing Technology

☐Personnel Changes ☐Legislative/Regulatory Impacts

☐Work Scope Changes ☐Changes in Partner Objectives

☐Other (please specify): Click here to enter text.

FOLLOW-ON ACTIVITIES

If applicable, check the box(es) below to identify follow-on activity that resulted from your project. In the adjacent column enter a number to indicate how many of each. (e.g., ☒CRADAs # 2 indicates that your project resulted in two follow-on CRADAs.)

Activity	**Number of instances**	**Activity**	**Number of instances**
☐CRADAs	#Click here to enter #.	☐Licenses	#Click here to enter #.
☐Cost-shared Contracts	#Click here to enter #.	☐Copyrights	#Click here to enter #.
☐Invention Disclosures	#Click here to enter #.	☐Reimbursable SPP	#Click here to enter #.
☐Technical Assistance	#Click here to enter #.	☐Use of Facilities	#Click here to enter #.
☐Patent Applications	#Click here to enter #.		

Did your project receive any awards (e.g., AAAS, SME, FLC?)? ☐No ☐Yes
Click here to list awards your project received.

ACKNOWLEDGEMENTS

Signatures below indicates the following:

- The Partner(s) (if applicable) has reviewed the final report and concurs with the statements made therein.
- The Partner (if applicable) agrees that any modifications from the initial proposal were discussed and agreed to during the term of the project.
- The Partner (if applicable) certifies that all reports either complete or in process are listed and all subject inventions and the associated intellectual property protection measures attributable to the project have been disclosed or are included on a list attached to this report.

Click here to enter PI's Name.		Click here to enter today's date
P.I. Name	Signature	Date
Click here to enter TTO's name.		Click here to enter today's date
Facility Technology Transfer Officer	Signature	Date

Appendix D: TCF Points of Contact (POCs) at DOE National Facilities

Facility	TCF Points of Contact
The Ames Laboratory	Melinda Schlosser melindas@ameslab.gov 515-294-1254 Julienne Krennrich jmkrenn@ameslab.gov 515-294-1202
Argonne National Laboratory	Hemant Bhimnathwala hbhimnathwala@anl.gov 630-252-2354 David McCallum dsm@anl.gov 630-252-4338 Ushma Kriplani Ushma@anl.gov 630.252.8111
Brookhaven National Laboratory	Poornima Upadhya pupadhya@bnl.gov 631-344-4711 Martin Schoonen mschoonen@bnl.gov 631-344-4014 Ivar Strand istrand@bnl.gov 631 344-7579
Fermi National Accelerator Laboratory	Mauricio Suarez suarez@fnal.gov 630-840-6947 Cherri J. Schmidt cherri@fnal.gov 630-840-5178
Idaho National Laboratory	Lisa Aldrich lisa.aldrich@inl.gov 208-569-0405 Jason Stolworthy jason.stolworthy@inl.gov 208-526-3437

Facility	TCF Points of Contact
Kansas City National Security Campus	Andrew Myers amyers@kcnsc.doe.gov816-488-4432 Michele Weigand mweigand@kcnsc.doe.gov816-488-6725
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Lawrence Livermore National Laboratory	Elsie Quaite-Randall quaiterandal1@llnl.gov 925-423-5210 Rich Rankin Rankin8@llnl.gov 925-423-9353
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National Renewable Energy Laboratory	Jennifer Fetzer jennifer.fetzer@nrel.gov 303-275-3014 Eric Payne eric.payne@nrel.gov 303-275-3166
Nevada National Security Site	Robert Koss kossrj@nv.doe.gov (702) 295-1213 Matthew Pasulka pasulkmp@nv.doe.gov (702) 295-2963

Facility	TCF Points of Contact
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Princeton Plasma Physics Laboratory	Laurie Bagley lbagley@pppl.gov 609-243-2425 Michelle DeAngelis mdangel@pppl.gov
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Savannah River National Laboratory	Matthew J. Biasiny matthew.biasiny@srnl.doe.gov 803-725-0406 Jennifer Holroyd jennifer.holroyd@srnl.doe.gov 803-725-8482
SLAC National Accelerator Laboratory	Susan Simpkins susans@slac.stanford.edu (650) 926-3766 Diana Creswell ddoon@slac.stanford.edu (650) 926-8608

Facility	TCF Points of Contact
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Y-12 National Security Complex	Jeremy Benton Jeremy.Benton@cns.doe.gov 865-241-5981