Technology Commercialization Fund | OTT Office of Technology Transitions

U.S. Department of Energy
Office of Technology Transitions
Technology Commercialization Fund
Base Annual Appropriations

National Laboratory Call for Proposals
Core Laboratory Infrastructure for Market Readiness (CLIMR)

DE-LC-000L110

Fiscal Year 2024

This lab call is being issued as part of the Technology Commercialization Fund Base Annual Appropriations by the U.S. Department of Energy's (DOE's) Office of Technology Transitions, the Office of Cybersecurity, Energy Security, and Emergency Response, Office of Electricity, Office of Fossil Energy and Carbon Management, Office of Nuclear Energy, and the Office of Energy Efficiency and Renewable Energy, in particular: Advanced Materials and Manufacturing Technologies Office, Bioenergy Technologies Office, Buildings Technologies Office, Geothermal Technologies Office, Hydrogen and Fuel Cell Technologies Office, Industrial Efficiency and Decarbonization Office, Solar Energy Technologies Office, Vehicle Technologies Office, Water Power Technologies Office, and Wind Energy Technologies Office. This call solicits proposals from National Laboratory Technology Transfer Offices, in collaboration with partners across the DOE National Laboratory complex, to develop and implement programming to facilitate an improved and more impactful lab commercialization process as well as advance technology-specific laboratory intellectual property to market.

Table of Contents

Lab Call Modification History

Modifications will appear here as well as being [HIGHLIGHTED] in the body of the Lab call. Modifications will be distributed via email to the points of contact in Appendix C.

Mod. No.	Date	Modification Description
1	2/29/2024	Document modified to reflect an updated full application deadline of March 18, 2024, at 3 p.m. ET.

I. Lab Call Description

A. Background and Context

This lab call represents the combined effort of fourteen distinct U.S. Department of Energy (DOE) program offices and the Office of Technology Transitions (OTT). The DOE Technology Commercialization Fund (TCF) was established by Congress through the Energy Policy Act of 2005 (EPAct05)[1] and reauthorized by the Energy Act of 2020 (EA 2020) to "promote promising energy technologies for commercial purposes."[2] The DOE TCF is a primary component of DOE's ongoing effort to commercialize the cutting-edge technologies in which DOE invests. These technologies, developed with taxpayer funding, comprise a portfolio of energy related technologies that have the potential to improve the lives of Americans and solve many of our country's most pressing economic, environmental, energy and national security challenges.

Within DOE, OTT is charged with leading policy and programs related to technology commercialization, including TCF. The goal of TCF is to improve America's energy competitiveness and security by accelerating commercialization and shepherding critical energy technologies from the lab to the market, where the private sector will continue to innovate.

Tackling today's toughest energy problems requires a comprehensive approach to technology research, development, and commercialization. The research, development, demonstration, and deployment (RDD&D) continuum comprises a pipeline of innovation that connects cutting edge energy technologies to the marketplace. Leveraging the power of compounding, continuous government support of commercialization enabling programs is crucial to mitigate the adoption risks posed by innovation processes, otherwise known in industry as the valley of death. Developing the necessary innovation avenues, resources, and programming to support the energy technology ecosystem is critical to ensure the U.S.'s position as a global power setting precedent for the future of energy security. By pulling strategic programmatic levers, the government can support U.S. industrial players willing to collaborate on the development and commercialization of National Lab-developed technologies.

[1] Energy Policy Act of 2005, Public Law 109–58, 109th Cong. (August 8, 2005), *Improved technology transfer of energy technologies*, 42 U.S. Code § 16391 (a).
[2] Consolidated Appropriations Act, 2021, Public Law 116–260, 116th Cong. (December 27, 2020), 134 Stat. 2597, Sec. 9003. https://www.congress.gov/116/plaws/publ260/PLAW-116publ260.pdf.

This solicitation offers an opportunity for private industry to partner with DOE's National Labs to advance energy-related National Lab-developed technology[3] toward commercialization and to reduce the barriers to commercializing lab-developed energy-related technologies and IP. The intent is to increase the volume and speed to which energy-related lab-developed technologies make it to market from an improved lab commercialization ecosystem.

i. Vision for FY24 TCF Base and Moving Forward

For Fiscal Year 2024 (FY24), DOE continues to implement the previous year's (FY23) approach for TCF Base Annual Appropriations addressing persistent barriers, bridging known gaps that deter the commercialization of laboratory technologies, and identifying where improvements are still needed. The intent of the Commercialization Enabling Topics (Topics 1, 2, 3, 5, and 6 of this lab call) is to fill in missing infrastructure pieces and strengthen those already there by addressing core commercialization challenges, barriers, and gaps, as well as their root causes (inside and outside of the labs). Additionally, the lab call will seek proposals from DOE's National Labs to advance the commercialization of individual energy-related technologies (Topic 4). DOE TCF funding for this lab call is directly distributed to DOE National Laboratories and DOE plants and sites to enable the promotion and commercialization of National Laboratory technologies. Examples of projects funded in FY23 can be found on DOE's TCF homepage here.

The goal for FY24 is to identify opportunities to amplify what has worked and continue to make progress on improving the lab commercialization ecosystem. The topic areas included in the FY24 Joint Core Laboratory Infrastructure for Market Readiness (CLIMR) Lab Call are the following:

1. Topic 1: Market Needs Assessment
2. Topic 2: Curation of IP
3. Topic 3: Matchmaking
4. Topic 4: Technology Specific Partnerships
5. Topic 5: Enhancing Laboratory Processes
6. Topic 6: Increasing Partnerships with External Commercialization Parties

[3] To be considered a "Lab-developed technology," at least 50% of the R&D have been developed at a National Lab or Facility.

This lab call is being issued by DOE's OTT, Office of Cybersecurity, Energy Security, and Emergency Response (CESER); the Office of Electricity (OE); the Office of Fossil Energy and Carbon Management (FECM); the Office of Nuclear Energy (NE); and the Office of Energy Efficiency and Renewable Energy's (EERE's) Advanced Materials and Manufacturing Technologies Office (AMMTO), Bioenergy Technologies Office (BETO), Building Technologies Office (BTO), Geothermal Technologies Office (GTO), Hydrogen and Fuel Cell Technologies Office (HFTO), Industrial Efficiency and Decarbonization Office (IEDO), Solar Energy Technologies Office (SETO), Vehicle Technologies Office (VTO), Water Power Technologies Office (WPTO), and Wind Energy Technologies Office (WETO).

Moving forward, OTT and all DOE program offices expect to learn from this FY24 approach and will incorporate lessons learned into future fiscal year TCF approaches and lab calls. The goal for the TCF lab calls and resulting projects or programs, as set forth in TCF's authorizing statute, will continue to be "promoting promising energy technologies for commercial purposes."[4]

B. Timeline and Communications

Timeline

KEY DATES	
Lab call release date	November 14, 2023
Informational webinar for lab call overview	November 15, 2023, 2 p.m. (ET)
PROPOSAL DEADLINE AND DECISION DATES	
Submission deadline for concept papers (see Section II.A.i.)	January 16, 2024, 3 p.m. (ET)
Encourage/Discourage decisions on concept papers back to Labs	February 16, 2024
Submission deadline for full applications (see Section II.A.ii.)	March 18, 2024, 3 p.m. (ET)
Expected date for selection notifications	Q3 FY24

[4] Energy Policy Act of 2005, Public Law 109–58, 109th Cong. (August 8, 2005), *Improved technology transfer of energy technologies*, 42 U.S. Code § 16391 (a).

Communications

All communications to DOE including questions regarding this lab call must use TCF@hq.doe.gov. Answers to frequently asked questions (FAQs) for this lab call can be found at https://ott-exchange.energy.gov. Answers to frequently asked questions for the Exchange system can be found at https://eere-exchange.energy.gov/FAQ.aspx. To view announcement-specific questions, applicants must first select the specific lab call number. DOE will attempt to respond to a question within three business days unless a similar question and the answer have already been posted on the website. It is the expectation of DOE that applicants to this lab call will review the FAQs before submitting a question. Questions related to the registration process and use of the website should be submitted to EERE-ExchangeSupport@hq.doe.gov. Please include the lab call title and number in the subject line. To ensure fairness for all lab participants, any questions directed to individual DOE staff will be forwarded to TCF@hq.doe.gov for processing.

C. Key Considerations and Requirements

i. Available Funding and Number of Selections

At the time of this solicitation release, Congress has not yet passed a full FY24 DOE appropriated budget. The estimated budget below is based on FY23. The total funding amount available for FY24 will be applied once an official FY24 DOE budget is passed. Based on FY23, approximately $37.7M–$44.7M is expected to be available to fund all projects solicited in this lab call pending FY24 appropriations and program direction.

Estimated DOE funding available: $37.7M–$44.7M

Program	Estimated Funding Range (Millions)
Office of Electricity	$1.9 – $2.3
Office of Cybersecurity, Energy Security, and Emergency Response	$0.4 – $0.5
Office of Energy Efficiency & Renewable Energy	$15.8 – $19.3
Advanced Materials and Manufacturing Technologies Office	$1.1 – $1.3
Bioenergy Technologies Office	$2.1 – $2.6
Building Technologies Office	$1.3 – $1.6
Geothermal Technologies Office	$0.8 – $0.9
Hydrogen and Fuel Cell Technologies Office	$1.2 – $1.5

Industrial Efficiency and Decarbonization Office	$1.5 – $1.9
Solar Energy Technologies Office	$2.0 – $2.5
Vehicle Technologies Office	$3.2 – $3.9
Water Power Technologies Office	$1.3 – $1.5
Wind Energy Technologies Office	$0.9 – $1.2
Office of Fossil Energy and Carbon Management	$11.4 – $12.6
Office of Nuclear Energy	$7.7 – $9.4

Budget per project: For the Commercialization Enabling Topics (Topics 1, 2, 3, 5, and 6), there is not a budget limitation and all technology offices involved in this lab call are contributing funds. For Topic 4, proposals should not request funding that is greater than the available program office(s) budget. Additionally, select program offices have included a funding limit within the Topic 4 Areas of Interest (AOI), see Section I.D.iv.

Estimated number of projects: 25 – 50

Estimated project duration: 1 – 3 years

The number of selections will depend on the number of meritorious proposals and the availability of congressionally appropriated funds in DOE program offices participating in this lab call. The budget level, tasks, scope, and duration of proposed projects can be adjusted by DOE during selections and negotiations but should be submitted and considered finalized at the time full applications are submitted.

ii. Partners

Partners can be any nonfederal entity, including private companies, state or local governments (or entities created by a state or local government), colleges, universities, tribal entities, or nonprofit organizations. Partners must agree to engage in activities that focus on commercializing or deploying technologies in the marketplace and are highly encouraged to provide cost-share.

All partnerships between the labs and outside partners must comply with individual lab requirements under their management and operating (M&O) contracts.

iii. Cost-Share

This lab call is subject to Section 988 of the Energy Policy Act of 2005 regarding cost-share, which requires 50% cost-share for demonstration and commercial application

projects.[5] Cost-share, sometimes referred to as "match" and "nonfederal share," is the portion of the costs of a federally assisted project or program not borne by the Federal government. As an example, a proposal with 20% cost-share commits to a nonfederal cost-share of 20% of the total budget; if the total project budget is $1M, the cost-share from the nonfederal partner is $200K and the federal funds requested is $800K. For additional information on cost-share see Appendix A. DOE prefers all funded projects to meet the 50% cost-share requirement; however, DOE acknowledges that some potentially high-impact proposed projects may not be able to do so. As a result of this, DOE has approved a cost-share waiver so that National Labs may apply with less than 50% cost-share following the requirements by topic below. The scoring criteria reflect that providing cost-share will increase the likelihood of selection.

Cost-Share for Topics 1, 2, 3, 5, and 6

Subtopic	Cost-Share	Description
A	50% or more	Proposals commit to meet at least 50% cost-share of total project costs.
B	Less than 50%	Proposals seek less than 50% cost-share of total project costs.

Cost-Share for Topic 4

Subtopic	Cost-Share	Eligibility
A	50% or more	All applicants are eligible.
B	20%	To be eligible for this subtopic, National Labs must be partnered with a small business(es) as defined by the U.S. Small Business Administration.
C	10%	To be eligible for this subtopic, National Labs must be partnered with domestic institutions of higher education; domestic nonprofit entities; U.S. state, local, or tribal government entities; or small businesses that are also certified as veteran-owned; women-owned; lesbian, gay, bisexual, transgender (LGBT)-owned; or otherwise, disadvantaged businesses by the U.S. Small Business Administration; members of the National LGBT Chamber of Commerce; or verified Veteran-Owned by the Veterans Administration.

[5] Energy Policy Act of 2005, https://www.federalregister.gov/documents/2019/04/01/2019-06263/cost-sharing-energy-policy-act-of-2005

DOE will evaluate the level of external industry engagement and collaboration as evidence by cost-share to ensure maximum impact of the selected projects. The selection official may determine that a subtopic (b) proposal would be selected except that the proposal does not provide adequate cost-share given the commercial nature of the project activities. In addition, the selection official may establish a negotiation strategy that involves increasing cost-share for subtopic (b) applicants that lack adequate cost-share given the commercial nature of the project activities. In such cases, applicants would be provided the opportunity to increase their cost-share to the default level, and project selection would be contingent on the lab(s) committing to 50% cost-share for the project. If the lab(s) decline, DOE may not fund the project. This does not apply to subtopics 4.b and 4.c.

Cost-share amounts agreed upon at the time of awarding must remain at least the established amount for all subtopics by the end of the award. When there is more than one budget period, DOE requires that the nonfederal cost-share minimum required percentage is met by the end of the budget periods preceding the last budget period. DOE recommends having a consistent cost-share percentage over the life of the project or having higher cost-share percentage at the beginning of the project and lower percentage at the end. The final cost-share requirements for each project will be set at the time of award and can only be adjusted following modification process which requires DOE approval.

For topics 1.b, 2.b, 3.b, 5.b, and 6.b, DOE may negotiate the cost-share amount, which may be any percentage at or under 50%.

For topics 4.b, and 4.c where multiple partners are involved in a project, if any partner is involved that does not qualify for the lower than 50% cost-share limits, then the entire proposal's required cost share defaults to the required 50% cost-share.

iv. Community Benefits Plan

DOE is committed to investing in the research, development, and commercialization of innovations from DOE National Laboratories and DOE plants and sites, that deliver benefits to the American public and lead to technologies and products that foster sustainable, resilient, and equitable access to clean energy. Further, DOE is committed to supporting the development of more diverse, equitable, inclusive, and accessible workplaces to help maintain the nation’s leadership in science and technology.

To support the goal of building a clean and equitable energy economy, projects funded under this lab call are expected to (1) support meaningful community and labor

engagement, (2) advance diversity, equity, inclusion, and accessibility (DEIA); (3) support Justice40[6] priorities; and (4) invest in America's workforce.

To ensure these objectives are met, applications for Topic 4 must include a Community Benefits Plan (CBP) that addresses the four objectives stated above, and applications for Topics 1, 2, 3, 5, and 6 must incorporate a CBP addressing the applicable objectives for the proposed project. Applicants are encouraged to develop a creative and thorough CBP.

The CBP will be 15% of the scoring criteria of the full application. See Section II.A.iii, Section II.B.ii, and Appendix B for the more information on the CBP.

v. National Laboratory Collaboration

DOE strongly encourages projects under Topics 1, 2, 3, 5, and 6 that bring together multiple National Labs to meet the strategic goals of this lab call to leverage multiple lab capabilities and to scale successful commercialization programs throughout all DOE labs. To expedite multi-lab partnerships, Appendix C includes all National Lab Technology Transfer Office (TTO) Points of Contact (POCs).

vi. Teaming Partner List

To the extent possible and appropriate, DOE also seeks projects that involve industry engagement or industry partners to enhance the market pull aspects for commercialization.

To expedite external partnerships in support of this lab call, DOE is compiling a Teaming Partner List (TPL) to facilitate the formation of new project teams. The TPL allows organizations that may wish to participate on an application to express their interest to explore potential partnerships with National Labs.

The TPL will be regularly updated to reflect new teaming partners who provide their organization's information. Updates to the TPL will be available on the Exchange website as requesting parties are approved.

Submittal Instructions: Any organization that would like to be included on this list should find the TPL for this solicitation (TPL-0000027) on Exchange and submit the following information: organization name, organization type, website, contact name, contact address, contact email, contact phone, area of expertise, brief description of capabilities, and applicable topic and subtopic. Please refer to the Manuals section on Exchange for more detailed instructions on using the TPL.

[6] Justice40 Initiative | Department of Energy

Disclaimer: By submitting a request to be included on the TPL, the requesting organization consents to the publication of the submitted information. By enabling and publishing the TPL, DOE is not endorsing, sponsoring, or otherwise evaluating the qualifications of the individuals and organizations that are identifying themselves for placement on this TPL. DOE will not pay for the provision of any information, nor will it compensate any applicants or requesting organizations for the development of such information.

D. Topic Area Descriptions

i. Topic 1: Market Needs Assessment

DOE investments in research, development, demonstration, and deployment (RDD&D) activities at the National Laboratories generate a large quantity of energy-related technologies. The National Lab complex's maintenance of a deep understanding of market and industry needs and perspectives on the commercialization pathway for specific energy technologies is critical to maximize the impact of the National Lab IP portfolios, benefit to the American people, and pursuit of DOE mission.

Successful commercialization and scale-up of new technologies requires deep understanding of numerous dynamic and interacting issues that include:

1. Technology development, which leads to improved unit economics as technologies move down the cost curve.
2. End-use market characteristics and drivers, and the price that customers are willing to pay at the application level. Examples include: electric vehicles competing in the consumer market, energy storage competing in wholesale electricity markets, and low-emissions steel and cement production techniques competing in low-margin, highly commoditized global industrial sectors; supply chain dynamics that include global supply chain stacks with asset-level unit economics and demand stacks by application.
3. The policy/regulation landscape; and public and private investment trends.

We define the analytical thread through these as Commercialization Analysis.

Three Core Components of Commercialization Analysis:

- Analysis of end-use application dynamics *tested via deep industry engagement* with a range of market-relevant stakeholders (customers, investors, regulators, equipment manufacturers, etc.).
- Development of a *shared understanding across the DOE* of the state-of-play in particular market sectors (via relevant real-world data, causal relationships, etc.).

- Development of "killer visualizations" (Aha-inducing charts, slides, whitepapers etc.) that effectively communicate and sharpen DOE's understanding of the market dynamics and drivers that interact to create likely commercialization pathways.

Topic 1: Market Needs Assessment seeks proposals to build, augment, and coordinate market and commercialization analytical capabilities across the National Lab complex to ensure maximum success in pursuing DOE's mission as it relates to bringing new technologies to market.

Proposals should focus on approaches to develop, maintain, and leverage a robust analytical capability that *both* harmonizes existing market analysis expertise across the DOE complex *and* supports capacity-building across the lab complex. This capability would support increased and faster commercialization of technologies out of DOE labs as well as enable successful outcomes for current DOE priorities.

Proposals could look to the recently released *Pathways to Commercial Liftoff*[7] as an example of the type of work that could be coordinated and conducted via this mechanism.

Ideal proposals will outline an innovative, forward-thinking approach to conducting commercialization analysis across the National Lab complex. Proposals should include opportunities to maximize learning from commercialization analysis best practices across the National Labs, as well as opportunities to scale up capabilities across the lab complex.

Areas of interest under this topic would include development of:

- Commercialization analysis collaboration and coordination mechanism across National Labs.
- Tools and methodologies that build on methodologies and approaches in the DOE Liftoff Reports[8] to identify technology gaps and market needs.
- Frameworks for identifying market opportunities for emerging energy-technologies.

Outcomes of proposed projects could inform DOE and lab policies and programs that accelerate the commercial adoption of technologies that address important markets and sectors. Systematically identifying strategic priorities and developing a robust

[7] https://liftoff.energy.gov/
[8] https://liftoff.energy.gov/

market-pull understanding would strengthen the DOE and National Lab complex's ability to support market-needed innovation.

Scalability, adaptability, and sustainability should be clear considerations for proposals in this topic area, as the innovation ecosystem is expected to continuously expand and evolve.

Subtopic 1.a: Proposals commit to meet the 50% of total project cost-share funds requirement.

Subtopic 1.b: Proposals meet less than the 50% of total project cost-share funds requirement.

ii. Topic 2: Curation of Intellectual Property

Once emerging markets and industry needs have been identified, potential promising energy technologies for commercial purposes can be identified and pursued. A streamlining process for curating relevant Lab IP to support and enhance developing technologies is a key element of promoting promising energy technologies for commercial purposes in a timely, market-relevant manner, such as in support of DOE's Energy Earthshots Initiative.

This topic will seek bold ideas and significant improvements in how National Labs bring their technology to market. Ideas could include:

- Enhanced information sharing to bring awareness to the extensive suite of Lab IP
- A novel approach to categorize Lab IP based upon use cases
- Innovative Lab IP marketing strategies

This topic seeks to innovate how National Labs connect lab IP with private sector partners. Proposals shall consider leveraging the Adoption Readiness Level (ARLs) framework[9] to evaluate technology risks, ecosystem economics, and private sector uptake potential.

Proposed projects could build on and expand successful, existing activities and programs already underway by labs' TTOs, such as Pacific Northwest National Laboratory's exploratory license option. Proposals in this topic area are sought for programs and activities above and beyond existing lab efforts and/or to expand successful programs across the entire National Laboratory complex.

[9] https://www.energy.gov/technologytransitions/adoption-readiness-levels-arl-complement-trl

If building on and expanding existing programs, any proposal covering this topic will need to provide an overview on how the proposed program differs from existing activities and/or how it will be expanded across labs. Additionally, proposed programs should help address root causes (inside and outside of the labs) of existing National Lab technology commercialization challenges and barriers, such as (but not limited to) complex technology access and/or barriers in finding partners. Applications that address barriers in finding partners should reference the requirements outlined in topic 6, Increasing Partnerships with External Commercialization Parties. Proposals should consider leveraging existing resources developed in this space, such as the Lab Partnering Service[10] and/or tools that utilize artificial intelligence (AI), machine learning (ML), natural language processing (NLP). Thus, proposed projects that find ways for these tools to be used in more impactful ways will likely better address the scoring criteria in Section II.B. than those proposing tools that are redundant or duplicative to tools already in existence.

Creativity is highly encouraged. DOE encourages the labs to work together to connect across programs and across labs, when possible, to provide a more united and consistent approach to readying lab IP for external partners. DOE strongly encourages applicants to partner with external organizations on proposals for this topic, in particular, for applications that incorporate AI, ML, NLP, or open-source solutions. A tool that identifies low Technology Readiness Level (TRL) and ARL technologies that have the potential to address critical gaps in U.S. energy infrastructure would be of interest.

It is envisioned that programs under this topic would include, at a minimum:

- Assessing the relevant cross-lab IP opportunities.
- Understanding the level of historical and present knowledge at the labs relevant to these inventions.
- Gauging the interest level of the inventors in engaging in commercialization activities as well as the relative maturity and risk profile of the lab IP.
- Vetting with external industry, such as (but not limited to) via an advisory board or with industry partners under the program.
- With an informed understanding of industry needs, identifying the assets that are most relevant to these industry needs and their IP protection status.

Under this topic, proposed program lab IP reporting to the relevant DOE program offices will be required on a periodic basis, which could include, but not be limited to, updates

[10] https://www.labpartnering.org/.

on the following: overviews of the industry sectors and partners interested in the curated IP, possible applications of the IP both within and outside of the program office that funded its development, possible improvements requested by industry for full adoption of the IP, and feedback on the potential workforce needs that may result from implementing such IP at scale.

Proposals should incorporate this topic-specific required reporting and feedback mechanism into the proposed project plan to improve processes and matchmaking effectiveness over time. These topic-specific reporting requirements are in addition to all impact-tracking requirements for all topics and proposals under this lab call.

Subtopic 2.a: Proposals commit to meet the 50% of total project cost-share funds requirement.

Subtopic 2.b: Proposals meet less than the 50% of total project cost-share funds requirement.

iii. Topic 3: Matchmaking

Successful technology commercialization is never simply about having the right technology; it requires having a team with the right vision, skills, and ambition to bring that technology to market.

Once multiple technology portfolios have been developed and vetted against market needs and industry interest, teams must be built to commercialize the selected technology and then take the necessary actions to bring the new technology-integrated product to market. This topic will seek proposals to create or expand business incubation programming that will result in the creation of teams that will move National Lab-developed technologies to market. Programming could include recruitment of talent outside of the National Lab, matchmaking programs to connect entrepreneurs with lab staff and resources, and additional support that will yield commercialization of promising, Lab-developed technology.

However, matching and building the team alone is not sufficient. Proposals should also address the additional needed programming and services such as business plan support, funding, business expertise and mentoring, investor and corporate connections, etc., that teams need as they bring their new product to market. DOE strongly encourages applicants to partner with external organizations on proposals for this topic.

Competitive proposals in this space would seek to leverage and learn from previous and existing relevant DOE programs as well as existing programs outside of DOE, such as the

Defense Advanced Research Projects Agency's Embedded Entrepreneurship Initiative[11] and Energy I-Corps[12], and may involve scaling programs across multiple National Labs. There are several external-to-lab programs in this area that could also be leveraged, built on, and expanded across the National Laboratory complex.

Proposed projects could include new and innovative initiatives that accelerate the process of matching external teams with labs and their respective developed technologies to commercialize the selected technologies as well as new and innovative programming and services that these matched teams would need.

Subtopic 3.a: Proposals commit to meet the 50% of total project cost-share funds requirement.

Subtopic 3.b: Proposals meet less than the 50% of total project cost-share funds requirement.

Areas of interest for this topic include but are not limited to the following:

AOI 3.1 Supplemental funding for maturation and commercialization of National Lab-developed technology that leverages the Lab Embedded Entrepreneurship Program (LEEP): Proposed funding aids the continued development of a previously funded, National Lab-developed technology maturation and commercialization project leveraging the LEEP. If there is no cost-share proposed for the project, the work must be directed at technology development and not yet at demonstration stage. All applications for new funds must focus on how the project will further the commercialization of lab-developed technology, ideally through new scope beyond the base project. Cross-office overlap is highly preferred. The proposed activities should integrate with and leverage the existing LEEP node programs, but applications are not limited to the labs which have existing LEEP node programs. All DOE/National Nuclear Security Agency (NNSA) National Laboratories/DOE plants and sites are eligible to submit proposals as prime awardees. A single fellowship, as per how LEEP currently exists, is a paid two-year fellowship for one person involved in the leadership of the associated start-up that participates in the program. TCF funds can only be used to fund the National Lab and cannot be used to fund the innovator's associated start-up company. A recommended total budget for projects applying to this AOI is $250,000–$500,000.

AOI 3.2 Entrepreneurial matchmaking: Akin to the medical field's residency hospital match programs, proposed projects could identify how to best curate applications from

[11] https://eei.darpa.mil/.

[12] Energy I-Corps | Department of Energy

interested entrepreneurs at a national level and then match the applicants to the most relevant lab physical assets, lab principal investigators (PIs), and lab IP. These matched teams could then be provided the programming and services needed to bring their new IP-integrated product to market. Proposed programs to find qualified entrepreneurs who have the right experience (e.g., in scaling energy hardware technology) and then provide the programming and services, such as business plan support, funding, business expertise and mentoring, investor and corporate connections, etc., for these entrepreneurs to take the needed actions to move the new IP-integrated product to market.

AOI 3.3 Incubators, accelerators, and other entrepreneurial support programs: A program that is designed to help innovators and small businesses further develop their technologies and products toward market adoption, incorporate and grow their businesses, help in attracting capital, and provide networking and support. Proposed projects could consider how to better leverage these networks and develop a program for pairing lab-developed technology with commercialization partners (e.g., qualified entrepreneurs, corporate partners, manufacturers, industry leaders, and natural language processing tools).

AOI 3.4 Other ideas: Any other ideas that involve matchmaking to bring National Lab-developed technologies to market. For example, a fellowship program that is not LEEP.

iv. Topic 4: Technology Specific Partnerships

This topic will seek proposals from National Labs to advance the commercialization of individual energy-related National Lab-developed technologies. Projects funded under this topic will need to incorporate lab-developed technology, including software and data, that are at a stage that will generate private sector interest and should be at a higher TRL.

Applications must demonstrate clear evidence of commercial potential that combines technology progress with market pull or interest. Examples of evidence of technology progress include:

- Demonstrated analytical and experimental proof of concept in a laboratory environment.
- Experiments or modeling and simulation validating the functional performance of the technology.

Examples of evidence of market pull or interest include:

- Market analysis demonstrating the technology's current or expected future cost and/or performance advantages vis-a-vis incumbent or competing technologies.

- Demonstrated interest from private industry partners or investors.

Ideal applications will include technologies with identified utility and potential impact to industry, market viability, and a clear commercialization path forward. Applicants should work with Lab partners to address any lab IP requirements. Key milestones for applications under this topic must be commercialization focused, not technology focused, and demonstrate a clear understanding of barriers to commercial adoption (e.g., market entry barriers, regulatory barriers, supply chain barriers) and how they can be overcome.

The application must address what the project intends to accomplish in terms of advancing the technology's readiness for commercialization, including current and end project targeted ARL and TRL. Applications must clearly demonstrate the market need the technology will meet, differences that make the technology more competitive than similar technologies, and the feasibility of moving the technology to market. The pathway for the technology beyond TCF funding should also be clearly identified for proposals in this topic. Applications should identify any risks associated with commercializing the technology and the ways the proposed project will mitigate the risks involved. Proposals shall consider leveraging the ARL framework[13,14] to evaluate technology risks, ecosystem economics, and private sector uptake potential.

There must be a clear articulation that the project team, industry partners, and resources are qualified and capable of successfully completing the project. This includes articulating both the facility and private-partner roles, tasks, and activities throughout the project.

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 any technical challenges and unanswered technical questions that must be addressed to reach commercialization 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.

Applications including team members who have completed Energy I-Corps or similar programs are strongly encouraged.

[13] https://www.energy.gov/technologytransitions/adoption-readiness-levels-arl-complement-trl
[14] ARL training recording: Adoption Readiness Levels - Overview - YouTube

Applicants with active projects seeking additional funding to complete their original scope of work are excluded from applying under this topic unless a new scope of work is proposed that meets the intent of this lab call. Determining what that could mean (a phase II effort, a different market, etc.) is at DOE's discretion, but the intention is that applicants cannot use this lab call to ask for additional funding on an existing project.

Areas of interest for this topic are limited to applications that address one or more of the technology missions listed below. Applicants should consult the mission statement for the program(s) they are seeking funding from. Applications from labs centered on technologies developed under DOE consortia are encouraged but not required.

Crosscutting technology applications are encouraged**.** Applications must fully demonstrate direct relevance to two or more technologies. Crosscut applications must fully demonstrate how the proposed project addresses each listed technology area. DOE reserves the right to move crosscut concepts to a single technology area or to move concepts submitted for a single technology area to the crosscut category.

Proposals should apply to one of the following subtopics, unless otherwise stated in each AOI.

Subtopic 4.a: Proposals commit to meet the 50% of total project cost-share funds requirement.

Subtopic 4.b: Proposals commit to cost-share at least 20% of total project cost. To be eligible for this subtopic, labs must be partnered with a small business(es) as defined by the U.S. Small Business Administration.[15]

Subtopic 4.c: Proposals commit to cost-share at least 10% of total project cost. To be eligible for this subtopic, labs must be partnered with domestic institutions of higher education; domestic nonprofit entities; U.S. state, local, or tribal government entities; or small businesses that are also certified as veteran-owned; women-owned; lesbian, gay, bisexual, transgender (LGBT)-owned; or otherwise disadvantaged businesses by the U.S. Small Business Administration;[16] members of the National LGBT Chamber of Commerce;[17] or verified Veteran-Owned by the Veterans Administration.[18]

[15] U.S. Small Business Administration, "Size Standards." https://www.sba.gov/federal-contracting/contracting-guide/size-standards.
[16] U.S. Small Business Administration, "Welcome to certify.sba.gov." https://certify.sba.gov/.
[17] National LGBT Chamber of Commerce, "LGBT-Owned Business Enterprise Certification." https://www.nglcc.org/get-certified.
[18] U.S. Department of Veterans Affairs, "Vets First Verification Program." https://www.va.gov/osdbu/verification/.

Skip to Topic 5: Enhancing Laboratory Processes

Areas of Interest (AOI)

AOI 4.01: Office of Cybersecurity, Energy Security, and Emergency Response (CESER)

Overview of Major Mission Areas:
The CESER Office focuses on creating and ensuring a secure, reliable, and resilient energy sector for the American people. CESER Office's mission is: Strengthen the security and resilience of the U.S. energy sector from cyber, physical, and climate-based risks and disruptions.

Outline of Eligible Technology Areas:

1. **Tools and Technologies for Threat Mitigation and/or Response**

Summary of Technology Area #1: This topic area is specifically focused on commercializing technologies that have direct impacts on the areas of cyber security, energy security, and emergency response that were developed at DOE facilities. The proposed solution may address one or more of the following functions associated with the program funding to be used in support of this TCF project:

- Projects that have direct impacts on the **mitigation of threats** to cyber security, energy security, and emergency response.
- Projects that have direct impacts on **the commercial/industrial sectors ability to respond to threats** to cyber security, energy security, and emergency response.

Applications must demonstrate both technological and commercialization progress. Priority will be given to projects with a Technology Readiness Level of 4 or higher. At a minimum the proposed component and/or process has been validated in a laboratory environment.

Key Challenges in the Technology Area:
Key challenges are:

- Adoptability of tools and technologies.
- Scalability of tools and technologies.
- Interoperability of tools and technologies.

AOI 4.02: Office of Electricity (OE)

Overview of Major Mission Areas:
The Office of Electricity (OE) leads the Department's efforts in developing new technologies to strengthen, transform, and improve electricity delivery infrastructure so

consumers have access to resilient, secure, and clean sources of electricity. OE provides solutions to technical, market, institutional, and operational failures that go beyond any one utility's ability to solve. To accomplish this critical mission, OE engages stakeholders throughout the sector on a variety of innovative technology solutions to modernize the electric grid and enhance key characteristics of the U.S. electric transmission and distribution systems:

- Resilience—the ability to cope with and quickly recover from disruptions and maintain critical function, while maintaining capacity for adaptation and transformation.
- 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.

Outline of Eligible Technology Areas:

1. **Summary of Technology Area #1: Grid Scale Energy Storage-Using Earth Abundant Materials: "Seawater Batteries"**

   Commercialization of energy storage technologies that use seawater (composed of elements including sodium and chloride) as a cathode that facilitates transfer of sodium ions to enable electrical charge and discharge[1]. Projects funded by the AOI will mature these storage systems towards commercial deployment and will present advantages over incumbent storage technologies including being a low cost long duration storage technology, having minimal safety hazards, and using earth abundant, domestically sourced materials.

   Key Challenges in the Technology Area:
   Commercialization of tools and technologies that enable the financing and mass deployment of novel (nonlithium) long-duration energy storage technologies. Storage is emerging as an integral component to grid modernization to provide a diverse range of services, including energy management, backup power, load leveling, frequency regulation, voltage support, and grid stabilization.

[1] Rechargeable Seawater Battery and Its Electrochemical Mechanism - Kim - 2015 - ChemElectroChem - Wiley Online Library

2. Summary of Technology Area #2: Risk-Informed Resilience Analytics

Commercialization of technologies, tools, and analytical platforms to enable risk-informed resilience-enhancing investment decisions. Proposed analytics should illustrate or inform value of investments across all phases of resilience including preparation, response, recovery, adaptation, and transformation. Impacts to system resilience could include, but are not limited to, slow-onset hazards (e.g., extreme temperatures, droughts, sea level rise, etc.) and rapid-onset hazards (e.g., hurricanes, tornados, floods, etc.). Consideration of compound weather and climate risks are encouraged.

Key Challenges in the Technology Area:
In developing commercial technologies to enhance grid resilience, work must be done to address the following challenges:

- Conducting credible treatments of uncertainty (both aleatory and epistemic).
- Communicating the sensitivity of results to the core assumptions of the technology.
- Considering and assessing evolving interdependencies within the energy sector.

3. Summary of Technology Area #3: Microgrid Planning and Design Tools (MPDTs)

A suite of MPDTs has been developed by DOE's National Laboratories to determine how and where to deploy microgrids and, once installed, use them most effectively. These tools are developed to meet various objectives for use of the microgrid. MDPTs generate alternative design considerations, help planners to improve or optimize their designs while considering tradeoffs between different objectives, and guide use of the designed microgrids. While these objectives may vary, most fall within six broad categories: sustainability, efficiency, resilience, flexibility, reliability, and security. A representative list of MPDTs is documented in the DOE Microgrid Program Strategy White Paper, titled "Integrated Models and Tools for Microgrid Planning and Designs with Operations,"[19] along with descriptions of their capabilities and uses. Commercialization efforts sought in this topic include refining, combining, simplifying, or otherwise making accessible existing MPDTs, so these tools can be used more broadly in the real world of microgrid deployments to provide near-term value to stakeholders. Technology validation, via partnered demonstrations with commercial entities (industry and vendors) in real field environments, should be a key part of the proposed commercialization effort.

Key Challenges in the Technology Area:
Key challenges to be addressed in this topic include:

[19] https://www.energy.gov/sites/default/files/2022-12/Topic6%20Report.pdf

- Having the seamless ability of MPDTs to interact with one another and achieving capabilities and applications that are beyond the scope of an individual tool; and
- Combining new and existing capabilities that span and support coupling across the multiple time, spatial, and domain scales of planning and design for different performance metrics, requirements, and environments of microgrids.

Technology validation on real use cases or scenarios must demonstrate both blue-sky and black-sky valuation approaches, provide concrete examples of a tool's value, and provide immediate support and recommendations on microgrid planning, designing, and use.

4. **Summary of Technology Area #4: Grid Enhancing Technologies (GETs)**

Grid Enhancing Technologies (GETs) are hardware and software solutions that help increase the capacity, efficiency, and/or reliability of our nation's transmission grid. These technologies may come in the form of dynamic line ratings, power flow controllers, or topology optimization that reduce congestion or other constraints at important locations on the grid. While the use of GETs is situational and often unique to a utility, these technologies can assist in getting needed renewable energy to customers for the upcoming electrification age.

Key Challenges in the Technology Area:
In applying GETs, utilities are often faced with the following challenges:

- Higher initial costs with uncertain return on investment.
- Newer technologies with uncertain lifetime performance.
- The holistic integration of grid enhancing technologies into system planning. including an understanding of how GETs could impact market dispatching mechanisms.
- Equipment installation requirements, estimated schedule, as well as any supply chain challenges.
- Uncertainty on the quantitative and qualitative impact of GETs on system efficiency and reliability.

AOI 4.03: Office of Fossil Energy Carbon Management (FECM)

Overview of Major Mission Areas:
The mission of the Office of Fossil Energy and Carbon Management is to minimize the environmental impacts of fossil fuels while working towards net-zero emissions. The Office's programs use research, development, demonstration, and deployment approaches to advance technologies to reduce carbon emissions and other environmental impacts of fossil fuel production and use, particularly the hardest-to-

decarbonize applications in the electricity and industrial sectors. Priority areas of technology work include point-source carbon capture, hydrogen with carbon management, methane emissions reduction, critical mineral production, and carbon dioxide removal to address the accumulated CO2 emissions in the atmosphere. The Office recognizes that global decarbonization is essential to meeting climate goals and works to engage with international colleagues to leverage expertise in these areas. The Office is also committed to improving the conditions of communities impacted by the legacy of fossil fuel use and to supporting a healthy economic transition that accelerates the growth of good-paying jobs.

Outline of Eligible Technology Areas:

1. **Advanced Technologies and Modeling Approaches for Forest Carbon Stocks and Fluxes Commercialization**

Summary of Technology Area #1:
The complex and regional nature of forest composition, management, as well as climate and weather variations have posed challenges to benchmarking and baselining forest carbon inventories at high spatial resolutions. To enhance and maintain carbon stocks in forest ecosystems across the United States, land managers, non-governmental organizations, and federal agencies will need advanced remote sensing and modeling technologies to provide timely and accurate assessment of forest carbon stocks and fluxes. The Advanced Technologies and Modeling Approaches for Forest Carbon Stocks and Fluxes Commercialization technology area will support efforts to improve, calibrate, and commercialize technologies coupled with forest growth and carbon cycle models to enhance the spatial and temporal resolution. Projects within this Technology Area should advance the commercial readiness of remote sensing, satellite, and other non-intrusive methods for forest carbon measurement and monitoring, while addressing and identifying key drivers in stock changes to improve forest carbon inventories and modeling methods. Technology and modeling projects to identify, assess and address economic drivers in forest management are also of interest, but should emphasize the carbon impact of these drivers (e.g., leakage, wood markets, and issues of management or practice additionality).

Key Challenges in the Technology Area:

- Regional variations in forest types and management practices pose challenges for assessing and projecting the short and long-term uptake or loss of carbon stocks.
- Climate change, wildfire, and invasive species have collectively made identifying and addressing potential risks to forest carbon stocks increasingly challenging and regional.

- Sustainable and climate beneficial biomass sourcing for bioenergy, long-lived wood products, and other commercial applications relies on an understanding and anticipating regional forest growth and harvest dynamics.
- Forest growth and carbon cycle models rely on accurate inputs from inventories, yet the accuracy of these inventories will likely require improved granularity for accurate projections.

2. Blue Carbon Measurement and Quantification Technology Commercialization

Summary of Technology Area #2:
Blue carbon, coastal ecosystems sequestering carbon in biomass such as mangroves or macroalgae, can provide important carbon removal and ecosystem service benefits. By removing carbon dioxide from the atmosphere and oceans and providing important adaptation benefits, including protection from extreme weather events, these ecosystems can mitigate climate change while helping coastal communities adapt. However, technologies and models to measure, quantify, and project the carbon and ecosystem service impacts of ecosystem protection and enhanced restoration approaches are underdeveloped and will be crucial for science-driven decision makers to balance climate impact and ecosystem services quickly and effectively. Investment in remote sensing technologies, passive and active sensors, and novel sampling methods, coupled with improved modeling technologies will be crucial for scaling blue carbon approaches and enhancing the ecosystem services provided by these approaches.

Key Challenges in the Technology Area:

- Sensors for high spatial and resolutions in harsh environments are challenging to design, whether active or passive.
- Remote sensing technologies and methods, including accompanying allometric equations and root:shoot ratios require direct and destructive sampling that is costly and intrusive.
- The adaptation benefits of blue carbon ecosystems are not well understood, and best practices for implementation and ecosystem service quantification are not well established.
- Deployment of technologies that effectively measure gas exchanges at high spatial resolution are costly and difficult to maintain in field environments, meaning experiments remain hyper-localized and may not reflect broader ecosystem changes.

3. Development of Carbon Dioxide Removal Performance Models to Identify Optimal Deployment Locations

Summary of Technology Area #3:

Emerging carbon dioxide removal (CDR) technologies cannot exist in isolation, but rather must be integrated with the broader carbon management ecosystem, which includes access to reliable and low-carbon energy sources, CO2 transport infrastructure and coupling with secure forms of CO2 storage or equivalent. Additionally, due to the nature of removing CO2 directly from the atmosphere or the upper hydrosphere, the performance of many of these technologies will be significantly affected by the ambient environmental conditions existing at the deployment location. Thus, when developing CDR technologies from an early stage, it is imperative to consider these potential deployment barriers. The Development of Carbon Dioxide Removal (CDR) Performance Models to Identify Optimal Deployment Locations technology area will promote efforts to identify suitable deployment regions for CDR technologies based on local environmental conditions (e.g., temperature, pressure, CO2 partial pressure, elevation, humidity etc.), feedstock source location, access to low-carbon energy, and/or proximity to durable CO2 storage reservoirs or conversion end-uses. The optimization of the CDR performance (e.g., rate and/or capacity of CO2 drawdown) should be confirmed through the completion of rigorous lifecycle (LCA) and technoeconomic analyses (TEA) across several promising deployment sites. Projects within this technology area should progress the commercial readiness of CDR by elucidating the technology-specific parameters and deployment considerations which have the greatest impact on net-negativity.

Key Challenges in the Technology Area:

- Identification of key process parameters and deployment considerations that affect the performance of CDR technologies.
- Mapping environmental conditions with an appropriate degree of spatial resolution to enable comprehensive analyses on impacts to CDR performance.
- Understanding impacts of real-world conditions on CDR technology performance.

4. **Upgrading Accelerated Stress Testing Capabilities for Rapid CO_2 Capture and Conversion Materials Screening and Development**

Summary of Technology Area #4:

Many point source CO_2 capture, CO_2 removal and/or CO_2 conversion process operate in a continuous fashion which will require the development of robust materials (e.g., sorbents, solvents, support structures, membranes, catalysts etc.) that can withstand a variety of process conditions with minor impacts to their performance. Before these materials can be deployed commercially, it is important to demonstrate that they do not degrade, as operating costs are typically strongly dependent on the material

replacement rates. Researchers, scientists, and engineers have highlighted that obtaining long-term performance (e.g., > 1000 hr) data for novel carbon capture and conversion processes is limited due to time and resource constraints. As a result, accelerated stress testing has been proposed as a solution to this challenge, whereby materials are subjected to conditions in excess of the expected normal operating conditions to more efficiently determine potential failure and/or degradation mechanisms. However, the exact relationship between the results obtained through accelerated stress testing and those that would be obtained via long-term testing under real-world conditions remains poorly understood. The Upgrading Accelerated Stress Testing Capabilities for Rapid CO_2 Capture and Conversion Materials Screening and Development technology area will advance efforts to develop testing protocols and models which can be used to rapidly predict the long-term performance of carbon capture and conversion materials under real-world conditions. Projects within this Technology Area should progress the commercial readiness of carbon capture and conversion technologies by enabling a significant reduction of experimental time and resource requirements for screening and developing effective and robust materials.

Key Challenges in the Technology Area:

- Developing accelerated stress testing protocols that can reduce experimental time for characterizing the stability of materials and/or reactors used in carbon capture and conversion technologies (e.g., point source CO_2 capture, CO_2 removal and/or CO_2 conversion).
- Identification of long-term failure and/or degradation mechanisms for materials and/or reactors used in carbon capture and conversion technologies.
- Prevention of failure mechanisms through process modification, materials engineering, or selection of alternative materials.
- Understanding relationship between the results obtained from accelerated stress testing and those obtained under real-world operating conditions.
- Construction of models to determine accelerated stress testing conditions which will mimic a well-defined set of real-world operating conditions.

5. **Artificial Intelligence and Machine Learning Applications for Monitoring Injection and Geologic Storage of Captured CO2**

Summary of Technology Area #5:

The FECM Carbon Transport and Storage (CTS) Program invests in advancing technologies for monitoring geologic CO2 storage sites for CO2 leakage and elevated risk of induced seismicity. Recent advancements in AI/ML based technologies have demonstrated that “noisy” data contains valuable information which can be extracted

and utilized for detecting subsurface dynamics that might otherwise go undetected. CTS program activities include application of AI/ML based approaches for enhancing visualization of the subsurface, creating virtual learning environments, and developing capabilities that enable real-time forecasting and prediction.

Key Challenges in the Technology Area:
To minimize the risks of leakage and/or induced seismicity, work must be done to address the following challenges:

- Improved capability to detect and locate transmissive leakage through application of AI/ML based approaches.
- Improved capability to accurately forecast induced seismicity risks through application of AI/ML based approaches.
- Improved ability to accurately process and integrate sparse datasets through application of AI/ML based approaches.

6. Capabilities Enhancements for Underground Hydrogen Storage (UHS) Evaluation

Summary of Technology Area #6:
The Natural Gas Decarbonization and Hydrogen Technologies (NGDHT) program seeks to identify underground storage infrastructure to handle high-volume fractions of hydrogen, while seeking demonstration opportunities for novel bulk subsurface storage mechanisms. Preliminary evaluations of long-term hydrogen storage potential will be coupled with future field-based research focused on the development of large-scale hydrogen hub projects. The hub projects are targeted towards the safe, efficient conversion of natural gas into hydrogen, the safe, emissions-free transportation of hydrogen using existing natural gas infrastructure to end-users and long-term subsurface storage facilities, and the injection, storage, and extraction of hydrogen from subsurface reservoirs with the greatest capacity for safety and efficiency by 2035. Critical to technology maturation and demonstration are ongoing challenges related to effective geomechanical, geochemical, and geophysical evaluations within subsurface storage systems to understand injection and withdrawal cycles and optimize gas recovery.

Key Challenges in the Technology Area:
By advancing geomechanical, geochemical, and geophysical assessment tools and technologies to:

- Improve characterization methodologies for the impact of hydrogen on formation fluids and reservoir rock on a laboratory scale to mitigate hydrogen losses.

- Enhance technical capabilities for assessing the potential of suitable depleted oil and natural gas reservoirs, saline formations, or salt structures for long-term storage in proximity to industrial or power sector end-users.
- Develop evaluation approaches that improve storage permanence and long-term hydrogen extraction potential within the subsurface.
- Provide more effective characterization pathways for commercial-scale evaluation of UHS reservoir performance.

7. Technologies for Converting Stranded and Underutilized Natural Gas to Sustainable Industrial Chemicals and Carbon Products

Summary of Technology Area #7:
This topic area focuses on developing technologies that are capable of transforming stranded natural gas or underutilized natural gas waste streams into marketable chemicals with a focus on low emissions and sustainability, with a particular focus on laboratory validation of technologies that can eliminate waste streams such as natural gas flaring and that enable the beneficial use of other sources of underutilized or stranded natural gas through sustainable conversion to industrial chemicals. This will require multidisciplinary breakthroughs in nanoscale material design for single-site catalysts, catalyst support structures, gas separation membranes, and sorbents. Developments in nano and microscale process intensification, advanced reactor equipment design and manufacturing methods, and the development of new chemical pathways and processes will also be needed. Programs should focus on component and full system validation in a laboratory environment that accelerates future commercialization efforts in collaboration with an industry partner.

Key Challenges in the Technology Area:
In maximizing the benefits of existing oil and natural gas resources including waste streams, work must be done to address the following challenges:

- Associated gas streams are intermittent, have large variation in total gas volume from well to well, and experience transient feed flow rates and field gas pressures over time.
- Rather than being pure methane that would be more idea for most conversion methods and catalysts, underutilized natural gas streams are typically minimally processed casinghead gas streams that contain higher chain hydrocarbons, other nonhydrocarbon gases, moisture, and other contaminants.
- Modular systems deployed at well sites do not have the “economy of scale” or the supporting infrastructure that centralized natural gas to liquids conversion

facilities benefit from allowing them to successfully compete in existing commodity markets.

- Economic pressure motivates natural gas flaring when oil is present in high volumes and is produced in areas where no infrastructure is in place to transport the associated gas, severely limiting the adoption of modular conversion technologies with even moderate capital and operating costs.
- Locations where these technologies would be most beneficial can be remote, with limited or no access to utilities, make-up water, and other services.
- Typical products created from methane conversion methods like pyrolysis may have limited market size or require high purity, such as carbon nanotubes, or suffer from potential market saturation, like amorphous carbon black.
- Catalytic approaches that directly convert methane to other chemicals typically suffer from low catalyst activity or fast catalyst deactivation, create unwanted side products, or require high severity of operation.
- Oxidative chemical pathways for converting methane typically require the costly operation of an air separation unit and can suffer from overoxidation.

Areas **not of interest** for this technology area include:

- Biological conversion based on gas fermentation.
- Processes that utilize single function catalysts and require multiple steps to convert methane into a sustainable chemical.
- Processes that are limited to laboratory-scale operation without potential for future field-based validation and commercialization for use at well sites as an alternative to non-safety related flaring.
- Natural gas processing technologies that do not include chemical conversion, such as condensate removal, NGL separation, and contaminant removal.
- Technologies centered on hydrogen production as the primary product and do not create a marketable carbon product or hydrocarbon chemical.

8. Low Temperature Production of Graphite

Summary of Technology Area #8:

Graphite can be synthesized from either coal or petroleum coke at very high temperatures of 3000 – 4000°C. These high temperatures make the production of synthetic graphite an expensive and environmentally damaging endeavor. The United States has over four billion tons of waste coals, scattered in over one thousand impoundments. The DOE is seeking proposals for production of graphite from abundant waste coals, at temperatures below 1800°C. This would facilitate clean-up of the waste coal sites and spur production of domestic graphite in a more environmentally friendly

manner. These concepts will have already been demonstrated successfully at lab-scales and will be ready for larger-scale demonstration such as bench or small pilot-scales.

Key Challenges in the Technology Area:
Work must be done to address the following key challenges:

- The impact of impurities in the waste coals on the formation of the graphite product.
- Disposition and mitigation of release of toxic elements within the coal such as mercury, arsenic, selenium, cadmium, phosphorus, antimony, sulfur, nitrogen, and halogens.
- Economics of the process versus the current commercial processes for production of graphite from coals and petroleum cokes.
- Verification of the final synthetic graphite product being highly suitable for use in batteries.
- Producing a brief techno-economic analysis showing creation of a significant number of stable domestic jobs.
- Demonstration of enhancing environmental justice for communities negatively impacted by the waste sites.

Areas **not of interest** for this Topic Area include:

- Proposals involving the mining of natural graphite.

9. Engineering Solutions to Control Secondary Emissions Associated with Point-Source Carbon Capture

Summary of Technology Area #9:
Wide-scale deployment and public acceptance of transformational carbon capture technologies installed at industrial or electric power generation facilities will require adequate control of emissions associated with the host site and with the carbon capture technology. If it is found that installing a proposed carbon capture technology will result in secondary emissions (e.g., nitro-amines, aldehydes, fine particulates or PM2.5, and nitroso-amines), engineering control technologies and approaches will be required to prevent their release. Applications are sought for engineering solutions that demonstrate capabilities to reduce secondary emissions sufficiently to meet the current air permits (e.g., for PM2.5 and hazardous air pollutants) upon installing the proposed

carbon capture technology at a reference industrial[20] or electric power generation[21] facility.

Key Challenges in the Technology Area:
Work must be done to address the following key areas:

- Bench-scale or pilot-scale validation of engineering solutions to control secondary emissions for the proposed carbon capture technology, including but not limited to pre-treatment, post-control advanced wash systems, upstream filters, electrochemical methods and aerosol controls.
- Fundamental understanding of formation mechanisms of different degradation products for a given carbon capture technology and effectiveness of the proposed engineering control in preventing degradation.

10. Modeling Emissions from Point Sources with Carbon Capture

Summary of Technology Area #10:
Wide-scale deployment and public acceptance of transformational carbon capture technologies installed at industrial or electric power generation facilities will require quantification of changes in pollutant emissions associated with the host site and with the carbon capture technology. Applications are sought to develop modeling tools that can forecast emissions of carbon capture media (e.g., solvents) and their degradation products, including air dispersion models that predict their ultimate fate in the atmosphere.

Key Challenges in the Technology Area:
Work must be done to address the following key areas:

- Development of modeling tools (e.g., machine learning based models, deterministic models), including air dispersion models, that can forecast emissions of carbon capture media and their degradation products into the

[20] S. Hughes and A. Zoelle, "Cost of Capturing CO_2 from Industrial Sources," National Energy Technology Laboratory, Pittsburgh, July 15, 2022. https://www.netl.doe.gov/projects/files/CostofCapturingCO2fromIndustrialSources_071522.pdf

[21] T. Schmitt, S. Leptinsky, M. Turner, A. Zoelle, M. Woods, T. Shultz, and R. James "Fossil Energy Baseline Revision 4a," National Energy Technology Laboratory, Pittsburgh, October 14, 2022. https://netl.doe.gov/projects/files/CostAndPerformanceBaselineForFossilEnergyPlantsVolume1BituminousCoalAndNaturalGasToElectricity_101422.pdf; Case 31B.95

atmosphere upon installing the proposed carbon capture technology at a reference industrial or electric generation facility. [22,23]

- Real-time prediction of future emissions given historical test-campaign data of the proposed carbon capture technology.

11. Solvent Reclaiming Approaches for Post-Combustion Carbon Capture Technologies

Summary of Technology Area #11:

Solvent management is one of the key challenges of post-combustion carbon capture. In addition to engineering controls to minimize solvent degradation, solvent reclaiming may be necessary to enable long term operation of solvent-based CO_2 capture and secondary-emissions control. Solvent reclaiming can reduce the cost associated with solvent make-up ("bleed and feed") and the consequences associated with solvent waste management. However, unanswered questions remain with regards to solvent reclamation due to the complex array of degradation products that may be present. Thus, new approaches to solvent reclaiming should be tailored to specific solvent chemistries. Applications are sought that develop and validate reclamation processes for different solvent-based technologies in the point source capture portfolio and develop new approaches to reclaiming, including thermal, ion exchange, electrodialysis and hybrid approaches.

Key Challenges in the Technology Area:

Work must be done to address the following key areas:

- Development of new continuous approaches to thermal reclaiming, ion exchange, electrodialysis and solvent extraction, or hybrid approaches combining multiple methods.
- Fundamental understanding of mechanisms governing different solvent reclaiming methods and optimizing conditions to maximize reclaiming efficacy.
- Demonstration of improvements over conventional approaches to reclaiming, such as thermal integration with carbon capture process to reduce energy requirements and cost associated with the reclaiming process and tailored reclamation approaches for next-generation capture-specific solvents.

---

[22] S. Hughes and A. Zoelle, "Cost of Capturing CO_2 from Industrial Sources," National Energy Technology Laboratory, Pittsburgh, July 15, 2022. https://www.netl.doe.gov/projects/files/CostofCapturingCO2fromIndustrialSources_071522.pdf

[23] T. Schmitt, S. Leptinsky, M. Turner, A. Zoelle, M. Woods, T. Shultz, and R. James "Fossil Energy Baseline Revision 4a," National Energy Technology Laboratory, Pittsburgh, October 14, 2022. https://netl.doe.gov/projects/files/CostAndPerformanceBaselineForFossilEnergyPlantsVolume1BituminousCoalAndNaturalGasToElectricity_101422.pdf; Case 31B.95

AOI 4.04: Office of Nuclear Energy (NE)

Overview of Major Mission Areas:
The Office of Nuclear Energy (NE) focuses on four major mission areas: enabling the continued operation of the nation's existing nuclear fleet, accelerating development and deployment of advanced nuclear reactor concepts, securing and sustaining the global nuclear fuel cycle, and expanding international nuclear energy cooperation.
Minimum Recommended Technology Readiness Level (TRL): 5

Outline of Eligible Technology Areas:

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

Summary of Technology Area #1:
The Reactor Concepts Research, Development, and Demonstration (RD&D) program supports conducting RD&D on existing and advanced reactor designs and technologies to enable industry to address technical and regulatory challenges associated with maintaining the existing fleet of nuclear reactors, promoting the development of a robust pipeline of advanced reactor designs and technologies and associated supply chains, and progressing these advanced reactor designs and technologies towards demonstration when deemed appropriate. Program activities are focused on addressing technical, economic, safety, and security enhancement challenges associated with the existing commercial light water reactor fleet and advanced reactor technologies, covering large, small, and micro-sized designs and an array of reactor types including fast reactors using liquid metal coolants and high temperature reactors using gas or molten salt coolants.

Key Challenges in the Technology Area #1:
To maximize the benefits of nuclear power, the following challenges need to be addressed:

- Improving affordability of nuclear energy technologies.
- Enhancing safety and reducing technical and regulatory risk.
- Minimizing proliferation risks of nuclear materials.
- Improving the economic outlook for the United States (U.S.) nuclear industry.

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

Summary of Technology Area #2:
The Fuel Cycle Research and Development (FCR&D) program presently has three focus areas. In the first, the program conducts 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 U.S., further enhancing U.S. energy independence and economic competitiveness. In the second area, the program conducts system analyses of advanced fuel cycle options to help guide decision-making and prioritization of R&D activities. In the third focus area, the FCR&D program also contributes to the Department's policies and programs for ensuring a secure, reliable, and economic nuclear fuel supply for both existing and future reactors.

Key Challenges in the Technology Area #2:

To support the enhanced availability, economics, safety, and security of nuclear-generated electricity in the U.S., the following key challenges need to be addressed:

- Enhancing fuel cycle safety and reducing technical and regulatory risk.
- Improving resource utilization and energy generation.
- Reducing waste generation.
- Limiting proliferation risk.

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

Summary of Technology Area #3:

The Used Nuclear Fuel Disposition (UNFD) R&D program 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.

Key Challenges in the Technology Area #3:

To support spent nuclear fuel disposition for the current and future inventories, the following challenges need to be addressed:

- Long-term storage.
- Transportation.
- Disposal.

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

Summary of Technology Area #4:

The Nuclear Energy Enabling Technologies (NEET) program conducts R&D and makes strategic investments in research capabilities to develop innovative and crosscutting nuclear energy technologies to resolve nuclear technology development issues. The Crosscutting Technology Development subprogram focuses on innovative research that directly supports the existing fleet of nuclear reactors and enables the development of advanced reactors and fuel cycle technologies, including topical areas such as advanced sensors and instrumentation, nuclear cybersecurity, advanced materials and manufacturing technologies, integrated energy systems, and other stakeholder-identified research areas. Also, NEET invests 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. In addition, NEET-sponsored activities support the goals, objectives, and activities of the Gateway for Accelerated Innovation in Nuclear initiative to make these technology advancements accessible to U.S. industry through private-public partnerships. Collectively, NEET-sponsored activities support the Department's priorities to combat the climate crisis, create clean energy jobs with the free and fair chance to join a union and bargain collectively, and promote equity and environmental justice by delivering innovative clean energy and advanced technologies for nuclear energy systems.

Key Challenges in the Technology Area #4:
To support the existing fleet and the development of advanced reactors, the following challenges need to be addressed:

- Advanced sensors and instrumentation.
- Nuclear cyber security systems.
- Advanced materials and manufacturing technologies.
- Integrated energy systems for heat transport and hydrogen production.
- Modeling and simulation tools for development.

AOI 4.05: EERE Advanced Manufacturing and Materials Technologies Office (AMMTO)

Overview of Major Mission Areas:
The Advanced Manufacturing and Materials Technologies Office (AMMTO) plays a strategic role in building a strong, revitalized domestic manufacturing sector through investments in research, development, and demonstration (RD&D) activities. AMMTO's activities are focused in three major mission areas:

- Next Generation Materials & Processes: AMMTO pursues novel materials and manufacturing processes to support the clean energy transition and

manufacturing competitiveness. AMMTO focuses on advanced materials, processes, and digital systems that enhance material and energy efficiency of manufacturing and deliver benefits throughout the economy. These advances can also improve the resiliency of domestic supply chains for all products, including for clean energy technologies.

- Energy Technology Manufacturing and Workforce: AMMTO invests in manufacturing innovations for key energy system-enabling technologies, such as semiconductors, batteries, and power electronics, to improve performance, improve lifecycle energy efficiency, reduce manufacturing costs, and accelerate market deployment. It also more broadly advances the manufacturing enterprise for energy technologies and materials by investing in education and workforce development and entrepreneurial ecosystems.

- Secure and Sustainable Materials: AMMTO makes strategic investments to advance the material supply chains and product lifecycles that support a robust manufacturing sector, supply chain security, environmental sustainability, and economy-wide decarbonization. This includes developing the mineral and material resources necessary to manufacture clean energy technologies and supporting design for recyclability and innovative recycling processes.

These three mission areas drive an interest in work to commercialize innovations in the following technology areas.

Outline of Eligible Technology Areas:

1. **Cost-Effective Sensor Development Enabling Smarter and Improved Composite Materials Manufacturing**

Summary of Technology Area #1:
The use of artificial intelligence (AI), machine learning (ML), and smart manufacturing is the focus of much attention and is a key AMMTO priority. The production of composite materials and their subsequent conversion into manufactured parts that support the Nation's clean energy goals is an area ripe for greater deployment of AI/ML and smart manufacturing. This creates a growing need for new sensors supplying input data across any of a broad range of materials and manufacturing processes.

Key Challenges in the Technology Area:
This technology area addresses applicant defined, relevant sensor technology that can provide input data enabling the greater use of AI/ML and smart manufacturing of composite materials and parts to:

1) Overcome barriers to widespread deployment such as excessive cost – an example might be controlling and providing feedback data on reinforcing filament tension where the number of filaments to be instrumented in the manufacturing process currently creates CAPEX challenges to deployment.
2) Provide feedback data not presently collected that leads to improved quality, reliability, and performance of composite materials and parts – an example might be adding sensors to resin infusion manufacturing processes that can enable early detection of manufacturing flaws and cheaper in-factory repair.
3) Improve the cost-competitiveness of U.S. industries producing and using composite materials – an example might be built-in sensors that enable the more efficient identification and recycling of end-of-first-life composite materials so they can be used in subsequent applications, thus reducing overall life cycle embodied energy and production costs.

2. Advanced Sintering Technologies

Summary of Technology Area #2:
To increase productivity and reduce the energy consumption of processes for harsh environment materials and components, AMMTO is interested in integrated sintering technologies for difficult to sinter powder compacts utilizing a combination of Electric Field Assisted Sintering (EFAS) and forging. This can be accomplished simultaneously, as in Electro-Discharge-Sintering (EDS) where a mechanical pulse and a high-density electric current, or pulse, are superimposed in a die previously loaded with the powder, or sequentially, as in Powder Forging, or with variants of these combinations. Such techniques blend the advantages of sintering technology like component design possibilities, good material utilization, and narrow tolerances with the high strength of forged components. Therefore, the main goal is to achieve full density. Potential applications include: die tooling, abrasive tools, composites, hard metal carbides, high-temperature thermal energy storage devices, and steels, among others.

Key Challenges in the Technology Area:
Key challenges include:

- Ability to process complex geometries (shapes need to be relatively simple).
- Size and materials limitations.
- Throughput (process times are lengthy).
- Equipment cost and availability.

3. Open Software and Hardware Innovation for Smart Manufacturing Platform Technology

Summary of Technology Area #3:
The U.S. economy is digitalizing at an extremely rapid pace and creating new jobs and job transitions. The manufacturing sector is undergoing a major digital transformation - the process of deploying new enterprise-wide applications for making better decisions through automating both engineering and business processes through digital models. As part of this digital transformation, Smart Manufacturing (SM) enables a complete integration of manufacturing across lifecycle for optimizing system productivity – energy, material, and water productivity to address industrial decarbonization.

SM includes many crosscutting technologies such as:

- Convergence of computing, communication, and smart sensors.
- Digital Thread; Digital Twin/Clone; AI/ML; large language models (LLMs) and Generative AI; Cybersecurity; Industrial Control Systems (ICS); Distributed Control Systems (DCS); data acquisition systems (DAQ); Augment/Virtual, mixed reality (AR/VR/MR), High Performance Computing (HPC).
- An operating system (OS) for industrial internet – Platform for cyber-physical system (CPS) for manufacturing.
- Standards and protocols.

To realize the full potential of this transformation in the U.S. manufacturing sector, we need to create an innovation ecosystem through open software and hardware innovation for smart manufacturing platform technology. Platform can also be viewed as a technology and business model that creates value by bringing together end-users and producers. This open innovation ecosystem will also build and strengthen advanced connectivity for the manufacturing industry. The program activities are focused on establishing a software foundry for:

- Information fusion.
- Applied and general AI for manufacturing industry.
- Upgrading legacy manufacturing systems for digital transformation.
- Digital thread and digital twin capabilities for connecting product, process, and manufacturing assets.
- Building a secure digital supply network model for resiliency.
- Building and strengthening advanced sensors, data acquisition systems, and related semiconductor chips (hardware focus) for smart manufacturing deployment.
- Industry exemplar use cases to showcase potential impacts.
- Workforce training and skills development.

4. Eco-Friendly and Cost-Efficient Manufacturing of Lithium Metal Products

Summary of Technology Area #4:

Lithium metal is the key component in high-energy rechargeable lithium metal batteries and has been broadly used in primary lithium metal batteries and for pre-lithiation in advanced lithium-ion batteries. Lithium metal is obtained by extracting lithium from lithium-containing brines and minerals. Technical challenges include those generally related to mining operations such as costs related to equipment and energy consumption, carbon emission, the need for water, and water and air pollution. Specific challenges associated with the electroextraction of lithium metal from molten salts include a high demand for electricity and the production of chlorine gas. Additionally, the final product, lithium metal, is very reactive and requires processing under an inert, anhydrous atmosphere, and effective packaging of the metal for shipping. AMMTO seeks projects that focus on novel, sustainable, and scalable manufacturing to accelerate lithium metal production.

Key Challenges in the Technology Area:

New methods need to address the key challenges below:

- Reduce the cost of state-of-art industrial processes of Li metal production.
- Minimize or eliminate the generation of toxic gas during electrolysis to produce Li metal.
- Increase the energy efficiency of the electrolysis by decreasing the working temperature and or voltage applied.
- Improve the sustainability of Li metal production and ease of use by industry.

5. Interfacial Engineering of Anode-Free (or Li Metal-Free) High Energy Batteries

Summary of Technology Area #5:

Removal of graphite or lithium metal from Li-ion/Li metal batteries will considerably increase their volumetric and gravimetric energy densities. Anode free (or Li metal-free) batteries developed to that end, however, have suffered from poor cycle life in general. Attempts to address these problems have been directed toward modifications to the electrode materials, current collectors, liquid electrolytes, and addition of electrolyte additives. Replacing liquid electrolytes with solid state electrolytes has also been attempted. Efforts have also been pursued towards designing better separators, battery architecture, and battery management systems. One major challenge limiting the development of the battery is a lack of knowledge about the interfacial reactions on the host-free anode side. AMMTO seeks projects that increase the cycle life and commercial success of anode free lithium-ion batteries beyond niche markets such as military and single use research applications.

Key Challenges in the Technology Area:
Proposed work needs to address the key challenges below:

- Increasing both gravimetric and volumetric energy densities of anode-free cells (compared to its Li metal battery counterpart).
- Improving the cycling stability of anode-free batteries for certain applications.
- Enhancing safety attributes of the anode-free battery technology.
- Accelerating domestic manufacturing of new battery technology cost efficiently.

6. **Circular Economy of Consumer Products**

Summary of Technology Area #6:
A circular economy is an alternative to a traditional linear economy (make, use, dispose) in which we keep resources in use for as long as possible, extract the maximum value from them while in use, then recover and regenerate products and materials at the end of each service life. Potential circular pathways include reuse, refurbishment, repair, remanufacturing, and recycling. Material circularity enhances manufacturing competitiveness, reduces the embodied energy and carbon in materials, and can bolster domestic supply chains for materials essential to clean energy manufacturing. AMMTO conducts R&D that addresses the technical, logistical, and economic barriers to material circularity.

Key Challenges in the Technology Area:
For this lab call, AMMTO is interested in solving the challenges related to logistics, collection, sorting, characterization and/or disassembly of waste streams that are composed of a mixture of components, such as:

- E-waste.
- Textiles.
- Construction materials.
- Clean energy technologies such as wind nacelles and blades, solar panels, and energy storage devices.

7. **Automated Control Strategies for Stiffness-Limited Robotics and Structures**

Summary of Technology Area #7:
In order to maintain high reliability, manufacturing systems such as robotic arms must maintain high and repeatable precision, everywhere they function within a process. However, robotic arms, for example, tend to be heavy, relatively large systems, with many degrees of freedom and coordinated moving parts. In addition to this, robotic arms must support end-effectors and other process capabilities such as Computer

Numerical Control (CNC) subtractive machining capabilities that are themselves heavy and may include rotational torque or other forces. All this mass and inertia interacts dynamically throughout the structure of the robotic arm, leading to dynamic instabilities that reduce the accuracy and precision of the robot in use. The ultimate effect, as a practical matter in manufacturing, is that the process windows, performance envelope, cost-effectiveness, and system efficiency of robotic automation processes are all compromised when the dynamics of these systems are assumed too complicated to understand.

However, it is reasonable to re-evaluate these assumptions in the context of modern advances in modeling and computational approaches. Dynamic instability in a robotic arm represents a challenging modeling problem due to multiple many, heavy masses and inertia interacting over time and complex toolpaths. On the other hand, the problem is not so complex that a modest amount of modeling and simulation with today's computing capabilities could produce information and insight that could dramatically improve performance and efficiency, even if only applied to the existing, installed tool-base. The primary criteria targeted with this topic is the ability to model and validate digital twins or physical prototypes of uniform, high stiffness (as measured at the toolhead and its toolpath location), and end-effector control over a space that is 150% or more than what is swept by current commercial, baseline, robotic controllers for an existing commercial robotic system. Additional benefits from work under this topic could be wider ranging, to include improving the simulation of discontinuous process envelopes or advanced process optimizations.

8. **Microelectronics Energy Efficiency Scaling for 2 Decades (EES2)**

Summary of Technology Area #8:

Ever since the slowing of automatic energy efficiency increases (due to Moore's Law/Dennard Scaling) began in the mid 2000's, as physical limits have been reached, there has been an urgent need to develop a new energy efficiency paradigm that would prevent computing and communications energy use from reaching unsustainable levels. "Energy efficiency scaling for two decades" (EES2) refers to AMMTO's goal, announced in January 2022, to double microelectronics' energy efficiency every two years for two decades or until the net energy efficiency increase exceeds 1000x. AMMTO commissioned an EES2 RD&D Roadmap set to be released in January 2024 and recruited 58 organizations (as of October 2023) that have signed the EES2 pledge to spread the word about the benefits of the EES2 goal and work with AMMTO on the EES2 R&D Roadmap. This technology area builds on the recommendations of that roadmap specifically for DOE National Laboratories. A multi-lab proposal is preferred.

Key Challenges in the Technology Area:

For this funding call, we are interested in solving the challenges related to 1) EES2 research needs, 2) EES2 education and workforce development and 3) EES2 innovation ecosystem. These include:

1) Research needs
   - Expansion of 2.5D/3D System-in-a-Package and Other Integrated Systems for efficiency.
   - Use of bio-inspired circuits and architectures for energy efficiency.
2) Education and workforce development
   - A U.S. workforce ecosystem that involves National Labs, industry, and academia.
   - Programs that leverage foreign talent and invest in domestic talent.
   - Increased investment and/or leveraged efforts that don't required increased investment across the ecosystem in workforce and talent development.
3) Innovation ecosystem
   - Improved collaboration between the R&D community and end users to understand efficiency related integration issues and system perspective.
   - Non-competitive forum for tracking research activities to identify opportunities for moving technology across the valley of death.
   - Improved sharing of simulations, modeling, and internal test protocols among manufacturers.
   - Improved sharing of IP to aid integration. IP needs protection but better lines can be drawn around how to enhance community and generate unique products.

AOI 4.06: EERE Bioenergy Technologies Office (BETO)

Overview of Major Mission Areas:
BETO within the U.S. DOE's EERE supports the research, development, and demonstration (RD&D) of technologies aimed at mobilizing domestic renewable carbon resources for the reduction of greenhouse gas (GHG) emissions across the U.S. economy.

BETO recognizes the urgency of developing low-emission solutions for hard-to-decarbonize modes of transportation, including aviation, marine, and heavy-duty long-haul transport and prioritizes work on the scale-up of biofuels that can address those needs in the near term. BETO balances these priorities along with investments in technologies that have longer-term potential, such as algae-based fuels and products while also pursuing uses of biomass that will have positive impacts sooner, such as producing carbon-negative electricity and clean hydrogen.

These bioenergy technologies can enable a transition to a clean energy economy, create high-quality jobs, support rural economies, and spur innovation in renewable energy and chemicals production – the bioeconomy. The activities funded through Area of Interest (AOI) will mobilize public clean energy investment in the biofuels, chemical and agricultural industries, accelerate the deployment of bioenergy technologies, and support achieving economy-wide net-zero emissions by 2050. In addition, this AOI will emphasize increasing diversity of research staff, increasing diversity of voices in research design, and or increasing quantification and emphasis on supporting underserved communities.

Outline of Eligible Technology Areas:
The research and development (R&D) activities to be funded under this AOI will support the government-wide approach to the climate crisis by driving the innovation that can lead to the deployment of clean energy technologies, which are critical for climate protection. Specifically, this AOI focuses on developing technologies that convert domestic biomass and other waste resources (e.g., municipal solid waste, biosolids) into low-carbon biofuels and bioproducts.

Projects selected under this AOI will aim to commercialize technologies that will lower the carbon intensity of the transportation, industry, and/or agriculture sectors. Projects will focus on technologies with identified utility and potential impact to industry, market viability, and a clear commercialization path forward. Priority will be given to proposals that if ultimately successful would enable significant sector-wide carbon emission reductions. Examples include sustainable aviation fuel (SAF), fuels in the diesel or marine range, chemicals, or other products with the potential for near-term commercialization and significant greenhouse gas (GHG) reductions, and biomass-mediated soil carbon storage.

Technology maturity under this AOI may range from TRL 4–6. Thermochemical, biochemical and hybrid pathways are acceptable, and a wide variety of feedstocks are allowed including traditional agricultural and forestry wastes, other lignocellulosic resources, algae, organic wet waste, sorted municipal solid waste, construction and demolition waste, food waste, biogas, grain starch, oilseed crops, industrial waste gases, and CO2 by direct air capture. SAF production pathways should deliver a 70% GHG reduction relative to the petroleum basis and have the potential to achieve cost-effective deployment.

Consideration will be given to proposals under this AOI that align with BETO subprogram goals as follows:

RENEWABLE CARBON RESOURCES:

- 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.
- Development of cost-effective, reliable, and efficient harvest, collection, storage, preprocessing, and transportation of renewable carbon sources.
- Identification of key feedstock quality and preprocessing technologies that contribute to efficient conversion performance.
- Development of algae logistics operations include harvesting, dewatering, and producing and stabilizing biofuel intermediates products, such as algal-derived lipids or sugars.
- Production of algae-based fuels and products that enable sector-wide carbon intensity reductions.
- Strategies for commercially relevant ecosystem services, including landscape design and algae-based wastewater treatment.

CONVERSION:

- Mid-stage technology R&D to develop cost-effective conversion technologies for producing low-carbon bioenergy and bioproducts from a variety of feedstocks and waste.
- Innovations to reduce the cost and carbon intensity 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.

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.

Proposals for the BETO AOI must meet a cost share of at least 50% of the total project costs, which must come from a non-Federally appointed funds. Therefore, applicants for this AOI may only apply to Subtopic 4.a.

1. **Early Maturation of Technologies to Enable Decarbonization of the Transportation, Industrial, and/or Agricultural Sectors**

   Summary of Technology Area #1:
   Technology area 1 projects focus on DOE Facility-developed technologies that have commercial promise and have the potential to attract a private partner with the end goal that will lower the carbon intensity of the transportation, industry, and/or agriculture sectors. Technology area 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 future application under technology area 2.

   Technology area 1 proposals must provide strong supporting evidence of technology maturity, market impact, and economic feasibility/benefit. 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 technology area 1 have a performance period of 6–18 months. The target technology 1 award amount is $100,000–$250,000 of federal funding.

2. **Cooperative Development and Commercialization Efforts for Technologies Enabling Decarbonization of the Transportation, Industrial, and/or Agricultural Sectors**

   Summary of Technology Area #2:
   Technology area 2 projects focus on technologies for which DOE facilities have already identified a commercial partner willing to execute a partnership agreement. This Technology area 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 a technoeconomic analysis (TEA), intellectual property patent mapping, market opportunity analysis, participation in the Energy I-Corps program, or other relevant activities. There must be a clear explanation of the current or anticipated market for the technology, and the extent to which the proposed technology will result in a commercially successful product.

Eligible projects for technology area 2 must involve currently existing DOE 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 concept paper. 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 six 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 technology area 2 have a performance period of 12–36 months. The target technology area 2 award amount is $250,000–$1,500,000 in federal funding.

AOI 4.07: EERE Buildings Technologies Office (BTO)

Overview of Major Mission Areas:
The Building Technologies Office (BTO) develops, demonstrates, and accelerates the adoption of cost-effective technologies, techniques, tools, and services that enable high-performing, energy-efficient and demand-flexible residential and commercial buildings in both the new and existing buildings markets, in support of an equitable transition to a decarbonized energy system by 2050, starting with a decarbonized power sector by 2035.

Outline of Eligible Technology Areas:

1. **Window Technologies**

Windows are responsible for over 3 quads of energy loss, and there is the potential for passive energy and daylight harvesting that brings the energy impact to over 4 quads. The International Energy Conservation Code (IECC) 2021 residential building codes have made significant progress on the opaque envelope, with walls requiring R30 and roofs R60 performance, yet windows are only around R3.3. In a typical home being built to the IECC 2021 requirement in a cold climate, windows represent approximately 45% of the thermal loss but only 8% of the surface area of the home. Recent DOE R&D success has achieved innovative thin-triple pane windows that are now commercialized by multiple manufacturers, and market transformation of these products are on the cusp of wide-spread market adoption through the issuance of the ENERGY STAR v7 criteria (R4.5) where DOE and LBNL played a key role in supporting EPA. However, a major gap

exists between market viable R5 windows and the R13 residential and R10 commercial goals published in the Research and Development Opportunity (RDO) Report – Pathway to Zero Energy Windows[24]. The following topics are aimed at removing key barriers to improve window performance and to reduce cost, along with tools that are focused on making window replacement more viable.

a. Dynamic Solar Control Optimization and Ease of Installation

Summary of Technology Area:
Development of advanced control systems that imbeds model predictive control with interoperability to enable the communication of a wide array of devices used in advanced facades. The goal would be to develop these control systems to allow for cross-brand products to be used that can enable more market competition and lead to lower cost, while also maximizing energy savings and carbon emission reduction by the optimization of controls based on grid pricing, weather, occupancy, behavior, and a wide range of other drivers that impact effectiveness of dynamic façade systems. Successful submitters will also outline how such systems will be validated while maintaining a budget consistent with the TCF program.

Key Challenges in the Technology Area:
A key challenge is to allow for interoperability of a series of devices that currently function on individual proprietary control systems. The ultimate solution will likely be a master control system that is non-proprietary that communicates and can be optimized by interfacing with a series of proprietary systems.

b. Occupant Behavioral Guidance for Window and Shade Operation

Summary of Technology Area:
The most sophisticated buildings can have automated shades, advanced facades, and even windows that open and close automatically for ventilation. These technologies can lead to large savings, but they also are fundamentally expensive and mostly applicable to new construction and major renovation. DOE is seeking the development of consumer personal tools or cell phone apps that inform occupants on how to control their window and window systems. An example might be to ensure that all blinds are closed due to a peak cooling day, or to ensure that all blinds are open to harvest passive heating. Opening and closing operable windows can be challenging due to unexpected latent loads, while at certain times opening windows will be the least carbon intensive way of cooling a building space. Any general consumer tool that leads to lower energy consumption and greater

[24] Pathway to Zero Energy Windows: Advancing Technologies and Market Adoption (nrel.gov)

occupant comfort is of interest, including approaches that address severe temperature events. Expanding this topic to include very low-cost products to be deployed during emergency severe weather and power outage event, may also be of interest.

Key Challenges in the Technology Area:
This topic will require extensive evaluation of historic weather files including severe weather events and how they may change in the future. Furthermore, to address market conditions, multiple tools may be needed, and an overarching guide may be needed to inform consumers and/or efficiency practitioners on how to utilize the tools. Assessing consumer demand for tools will be essential to ensure they are widely adopted.

2. Heat Pumps/Heat Pump Water Heaters

This subtopic solicits proposals for innovative solutions in heat pump technology and other supporting technologies. There are three subtopics focusing on heat pumps in cold climates, cost compression of heat pumps and heat pump water heaters, and building integration of heat pumps and heat pump water heaters. Please note that awards may not be made in all areas, and the distribution will depend on the number and quality of proposals received.

All applications should provide metrics relevant to their proposals. These may include, but are not limited to, cost reduction, performance improvement, emissions reduction, size/weight reduction, power-reduction, and market scaling targets (with supporting information) that are in line with BTO's goals. All applications should also provide program plans with milestones (that are SMART); explicitly describe how their technology differs from existing commercially available technologies/solutions (and technologies already receiving federal support); describe how it advances the state of the art; and provide rationale for why the applicant is qualified to carry out this work. Strong applicants will also provide letters of support for from industry and community partners. Submissions accounting for the unique position of low-income occupants are strongly encouraged.

a. Heat Pump Systems for Cold Climates

Summary of Technology Area:
Heat pump adoption is a major priority for BTO. In many locations there are challenges to adoption including but not limited to: efficiency/capacity degradation at lower temperatures, high electricity prices, misaligned replacement cycles between existing heating and AC systems, etc. A systems-based approach to heat pumps can allow for major decarbonization of space conditioning while creating

solutions for some of these issues (for example, dual fuel systems that enable operation at very cold temperatures, controls for advanced cold climate heat pumps).

BTO is primarily interested in heat pump systems involving an existing system and they thus require complex installations as two technologies from different eras need to function together seamlessly. This requires well-designed equipment, controls that can integrate the use of the two separate systems in a way that provides continuous comfort to the occupant (and allows for users to prioritize their switchover temperature based on cost, carbon intensity, and/or other relevant metrics), and an installation process that isn't overly burdensome.

Key Challenges in the Technology Area:

To better facilitate the uptake of heat pumps in cold climates, work must be done to address the following challenges:

- Creation of heat pump systems that physically fit in the available space and can be integrated seamlessly with the existing system.
- Improving the controls logic of heat pumps systems in cold climate.
- Allowing for easier installation/set-up of the physical systems.
- Other opportunities for improvement, not identified here.

b. Cost Compression of Heat Pump and Heat Pump Water Heater Systems

Summary of Technology Area:

Heat pump adoption is a major priority for BTO. Our research and broad stakeholder engagement has identified heat pump and heat pump water heater (HP/HPWH) system price reductions as one of the largest opportunities in this space, especially in cold climates. These reductions can be found in a variety of places throughout the HP/HPWH lifespan including, but not limited to, the improvement of components, the system assembly/design, the distribution, and the installation. All submissions are expected to (when relevant) minimize the global warming potential (GWP) of the associated refrigerant. Preference will be given to projects at or below 150 GWP. Submissions showing benefit to low-income occupants are strongly encouraged.

Key Challenges in the Technology Area:

To realize the necessary, broad adoption of HP/HPWHs required to achieve BTO's goals, work must be done to reduce costs in the following areas:

- System assembly/design spanning all types (including portable units, window units, mini splits, central systems, integrated/packaged and stand-alone/modular

thermal energy storage systems, etc.) and heating mediums (air-to-air, air-to-water, ground source, etc.).

- Distribution, including transportation and enhanced communication between major players (manufacturers, suppliers, distributors, big box retailers, contractors, and others not listed).
- Installation, including all system designs identified earlier and adjacent, connected equipment, and contractor training.
- Other opportunities for cost reduction, not identified here.

c. Building Integration of Heat Pump and Heat Pump Water Heater Systems

Summary of Technology Area:

Heat pump adoption is a major priority for BTO. Our research and broad stakeholder engagement has identified improving building integration with HP/HPWHs as one of the largest opportunities in this space. Space and water heating systems interact with many aspects of a building and ensuring smooth, coordinated interactions is key to realizing positive outcomes during broad heat pump deployment. Submissions accounting for the unique position of low-income occupants are strongly encouraged.

Key Challenges in the Technology Area:

To realize the necessary, broad adoption of HP/HPWHs required to achieve BTO's goals, work must be done in the following areas:

- Facilitating smooth, coordinated retrofit sequencing incorporating the relative ages, costs, and available discounts of equipment.
- Providing actionable information regarding the interactions between equipment selection/sizing and envelope performance, including the creation of mechanisms to allow for emergency replacements of equipment without losing load reduction opportunities.
- Providing alternative options to standard electrical panel upgrades, especially lower-cost versions.
- Other opportunities for improvement, not identified here.

AOI 4.08: EERE Geothermal Technology Office (GTO)

The Geothermal Technologies Office (GTO) works to reduce costs and risks associated with geothermal development by supporting innovative technologies that address key exploration and operational challenges. GTO seeks any proposal that fits the mission of its programs.

AOI 4.09: EERE Hydrogen and Fuel Cell Technology Office (HFTO)

The Hydrogen and Fuel Cell Technologies Office (HFTO) focuses on research, development, and demonstration of hydrogen (H2) and fuel cell technologies across multiple sectors enabling innovation; a strong domestic economy; and a clean, equitable energy future. HFTO seeks proposals in the topical area described below. Applications for continuation of projects previously awarded in this topical area are strongly encouraged.

Outline of Eligible Technology Areas:

1. **Commercialization of High-Efficiency, Low-Cost Intermediate Temperature Solid Oxide Electrolyzers (IT-SOEs)**

Summary of Technology Area #1:

Commercial High Temperature Solid Oxide Electrolyzers (HT-SOEs) are almost exclusively constructed using cells with Yttria Stabilized Zirconia (YSZ)-based electrolytes. These HT-SOE systems benefit from the high mechanical strength of the YSZ-based cells, and the nearly pure ionic (O2-) conductivity of the electrolytes but require operation at high temperature (>700°C, typically 800°C) to ensure adequate electrolyte conductivity and reasonable cell performance (1.0~1.5 A/cm2). These operating temperatures place strict materials requirements on the HT-SOE stack components and balance of plant (endplates, interconnects, manifolding, etc.), requiring high-cost, high-performance, and difficult to machine steel alloys to withstand high operating temperatures.

Recent advancements in Mixed Ionic Electronic Conducting (MIEC) ceramics have demonstrated dramatic improvements in ionic conductivity at lower temperatures, with sufficient ionic conductivities (H+, O2-) for electrochemical cells beginning at temperatures as low as 400°C.[25] Electronic conductivity, while present, is readily suppressed through careful operating point selection or inclusion of an additional thin electrolyte layer with high ionic but low electronic conductivity. Such MEIC electrolytes allow for intermediate temperature (400°C-600°C) operation and stack construction with low-cost steels. The improved low-temperature conductivity performance arises from fundamentally weaker intermolecular bonds than YSZ, requiring some process redesign to accommodate the lower mechanical strength of the MEIC materials. Deliberate selection and application of the electrolyte materials combined with recent advances in electrolyte/electrode interface engineering have demonstrated efficient

[25] See for example work with HydroGEN Advanced Water Splitting Materials Consortium Home Page (h2awsm.org) and Hydrogen from Next-generation Electrolyzers of Water (H2NEW) | H2NEW (energy.gov)

cells with high current densities (>3 A/cm2), creating an opportunity for high power density, lower cost IT-SOEC systems capable of exceeding the performance and costs of current commercial HT-SOE systems.[26]

This subtopic seeks applications for collaborative efforts that involve industrial partners working with national laboratories to incorporate recent advancements in materials composition, sintering behavior, multi-layer electrolytes, interface engineering, and/or other developments into commercially-viable Intermediate-Temperature Solid Oxide Electrolyzer (IT-SOE) systems. Such IT-SOE systems must offer hydrogen-production cost advantages over HT-SOE systems, aiming to achieve the Hydrogen Shot's cost target of $1/kg-H2 by 2031.

The proposed work is not restricted to a specific ionic species, and proposals for either proton (H+) or oxide ion (O2-) conducting electrolytes are acceptable. Proposals that include improving materials processability during manufacturing, improved thermal processing techniques during electrolyte sintering/densification, interface engineering and optimization, cell durability under operation, and cell/stack tolerance to changing operating conditions are encouraged. Proposed work should present in detail the current state of the art of the cell architecture being implemented, along with projected impacts on performance and cost from the proposed collaboration.

AOI 4.10: EERE Industrial Efficiency and Decarbonization Office (IEDO)

The Industrial Efficiency and Decarbonization Office (IEDO) accelerates the innovation and adoption of cost-effective technologies that eliminate industrial greenhouse gas (GHG) emissions. IEDO provides planning, management, and direction necessary for a balanced national program of research, development, demonstration, technical assistance, and workforce development to drive energy, materials and production efficiency, and decarbonization across the industrial sector.

IEDO's research, development, and demonstration (RD&D) priorities are organized along two thrusts:

- **Energy- and Emissions-Intensive Industries (EEII).** IEDO addresses the decarbonization challenges unique to specific subsectors, including chemicals, iron and steel, cement and concrete, food and beverage, and forest products. Many of these industries utilize specific, hard-to-decarbonize industrial processes that make full decarbonization more difficult than developing a clean source of electricity or heat. At the same time, these industries are indispensable, mass-producing the

[26] See for example: Revitalizing interface in protonic ceramic cells by acid etch | Nature

materials and products essential to modern life while also serving as the engines of our economy.

- **Cross-Sector Technologies (CST).** IEDO also pursues energy and emissions reduction challenges that are common across all industrial subsectors. For example, all industrial subsectors involve heating processes that have conventionally required fossil fuel combustion, leading to significant direct GHG emissions, as well as wasted heat lost to the environment. Similarly, nearly all industrial operations consume water and produce wastewater. Innovations in energy and water use represent significant opportunities to lower emissions and reduce manufacturing costs across the industrial sector.

For all technology areas, applications should include targets for improvements in energy intensity, GHG emissions intensity, and other relevant metrics (e.g., performance increases, cost savings, etc.). Applications should also provide a justified, quantitative estimate of the national-scale, long-term energy savings and emissions reductions that are expected as a result of the proposed work.

Outline of Eligible Technology Areas:

1. **EEII: Innovations in Safer Chemical Processes in Manufacturing**

Summary of Technology Area #1:
Historic redlining segregated minority communities into highly industrial sections of American cities, subjecting these communities to disproportionate risk to their environmental and human health. As the industrial sector transforms to meet the needs of decarbonization, there is an opportunity to develop technologies to replace equipment, processes, and chemical pathways to reduce adverse impacts on human health and the environment.

Key Challenges in the Technology Area:

- R&D on novel chemistries and processes to streamline chemical steps yielding less hazardous by-products are of interest. Processes that can reduce (>95%) or eliminate hazardous by-products from current typical processes including, but not limited to, naphthalene, benzene, and others.
- R&D to develop non-hazardous substitutes, reduce the magnitude, or eliminate the need for a solvent are of interest. Processes that can reduce (>95%) or eliminate the use of hazardous solvents from current typical processes including, but not limited to, toluene, xylene, and others.

2. **EEII: Advanced Low-Carbon Building Materials**

Summary of Technology Area #2:
Cement, concrete, and asphalt pavements are critically important materials for constructing the built environment. These materials are also energy and emissions intensive materials. As new low-carbon materials are developed and evaluated, it is critical to develop tools to predict material performance in different service environments and applications including understanding and predicting service life, durability, and failure mechanisms. This will aid safe use of materials and will also be crucial for materials development as well as new codes and standards to govern the safe and dependable use of these new materials. Achieving long service life is a critical aspect of decarbonization and sustainability. Predictive measurement techniques, sensors, and modeling are important tools for development and use of these new materials. The objective of this topic is to advance new low-carbon building materials.

Areas of interest:

- New and/or improved tools and techniques for characterizing cement, concrete, paving materials and predicting performance (including correlations to durability and service life predictions). This includes testing, measurements, modeling, sensors, instrumentation, etc.
- Non-destructive characterization tools and techniques and/or sensors for in situ/field monitoring of concrete and/or pavement structures.
- Better correlation of pavement materials to vehicle energy use and noise generation as well as durability.

3. **CST: Decarbonizing Industrial Drying**

Summary of Technology Area #3:
Process heating represents the largest energy use and the largest source of GHG emissions in the manufacturing sector. In 2018, process heating accounted for 31% of sectoral energy use (7.5% of economy-wide energy use) and 51% of sectoral energy-related GHG emissions (10% of economy-wide energy-related GHG emissions).

Drying processes account for a significant portion of process heating demand, and thermal dehydration steps can occur multiple times throughout a manufacturing process. Thermal efficiencies for drying processes range from 20% to 60%, and drying is often the most energy intensive process in industry, relying on numerous dryer types for many process and end product forms with different drying requirements. Drying is critical across the industrial sector, particularly in the chemicals, pulp and paper, and food processing industries.

Technology Area #3 seeks to advance thermal, non-thermal, and hybrid industrial drying approaches to optimize energy performance and increase overall thermal efficiency while reducing carbon impacts. Additionally, these approaches can lower associated costs while enabling the manufacture of improved materials, technologies, and products.

This Technology Area is not interested in applications related to steam-based drying approaches (e.g., use of biomass or hydrogen to generate steam for use in drying operations).

Key Challenges in the Technology Area:

- Development of non-thermal drying technologies, including those based on mechanical dewatering, ultrasonic vibration, electromagnetic energy-driven processes, spray drying, and supercritical fluid processing.
- Development of thermal drying technologies optimized for use with low-carbon fuels and energy sources.
- Advancement of other technologies to increase thermal efficiencies or reduce the amount of process energy required for drying.

4. **CST: Advanced Sensors, Controls, Platforms, and Models to Enable Decarbonization**

Summary of Technology Area #4:
A key challenge for emerging decarbonization technologies is competing with incumbent technologies that have benefited from decades of optimization and operator familiarity. To drive adoption of these decarbonization technologies, data support systems will be needed to collect, process, and use process data to ensure efficient and effective operation. These systems will encompass an integrated suite of technologies: sensors to collect and transmit real-time data, controls for dynamic process optimization and response, data platforms to process data and perform complex computations, and modeling for optimization and predictive control.

Technology area #4 seeks advanced sensors and controls that enable adoption of decarbonization technologies, particularly as part of an integrated system of sensors, controls, data platforms, and models.

Key Challenges in the Technology Area:

- Development of integrated systems of sensors, controls, data platforms, and models to enable decarbonization strategies such as:
  - Use of low-carbon fuels (e.g., clean hydrogen).
  - Application of advanced electro technologies (e.g., electromagnetic, magnetic, or plasma processing).

- Flexible industrial facilities that dynamically respond to signals from the electric grid.
- Development of noninvasive, reliable, real-time sensors capable of operating in realistic industrial environments (e.g., high temperature, high pressure, corrosive, etc.).

5. CST: Low-Cost, Carbon-Neutral Zero Liquid Discharge for Inland Brackish Water Desalination

Summary of Technology Area #5:
Zero Liquid Discharge (ZLD) is a cutting-edge water treatment process that recovers 100% of the water from a saline or wastewater source and reduces the residual contaminants to a dry form. ZLD holds particular advantage for inland desalination or wastewater treatment because these settings often lack a convenient or low-cost option for the disposal of the liquid residual from water treatment (called brine). Not only does ZLD recover 100% of the liquid water for reuse, but it creates the smallest physical volume of waste material in a dry, more manageable form as compared to a liquid waste, greatly lowering the cost of handling, transportation, and disposal.

Key Challenges in the Technology Area:

- Most current ZLD technologies utilize heat to physically concentrate and dry the liquid waste materials. This often requires large amounts of energy or abundant, high-grade waste heat.
- Options for reducing energy in ZLD include, but are not limited to:
  - Chemical desiccant methods such as solvent extraction.
  - High-performance membranes that can withstand high osmotic pressures.
  - Advanced, multi-step osmotic separation cycles that sequentially concentrate the brine waste stream.

AOI 4.11: EERE Solar Energy Technology Office (SETO)

Overview of Major Mission Areas:
The Solar Energy Technologies Office (SETO) accelerates the advancement and deployment of solar technology in support of an equitable transition to a decarbonized economy.

Outline of Eligible Technology Areas:

1. Acceleration of Photovoltaics (PV) Production

Summary of Technology Area #1:

SETO supports the movement of solar technologies to market by strengthening innovative concepts and increasing their readiness for greater private sector investment and scale-up to commercialization.

Key Challenges in the Technology Area:
SETO is seeking technologies that accelerate photovoltaics (PV) production and improve quality in the following topic areas:

a. Innovations that improve PV manufacturing:
    a. Reliability and/or reliability testing.
    b. Processes (including metrology).
    c. Quality (including systems and techniques).
b. Innovations focused on dual-use, application-, and climate-specific applications (e.g., agrivoltaics, building-integrated solar PV, floating solar PV, vehicle-integrated solar PV).

The below topic areas are not of interest to SETO as part of the FY24 CLIMR Lab Call:

a. Space, unmanned aerial vehicle, high-altitude spaceship applications.
b. Internet of things, wearables, consumer electronics.
c. Applications with product lifetimes below 10 years.

2. Systems Integration of Solar Technologies

Summary of Technology Area #2:
SETO funds research to address the evolving challenges for reliable, resilient, and cybersecure integration of solar energy, energy storage, and other inverter-based variable resources.

Key Challenges in the Technology Area:
SETO is seeking technologies in the following topic areas:

a. System resilience: System resilience refers to the ability of the power system to seamlessly adapt to and swiftly recover from disruptions or outages. Resilience primarily focuses on the ability of a power system to withstand and recover from disturbances or adverse events, such as natural disasters and equipment failures. Solutions are expected to integrate solar and energy storage technologies to serve critical loads.
b. Cybersecurity for solar and distributed energy resource (DER) systems: Cybersecurity for solar and DER systems refer to the security of critical power system infrastructure from unauthorized access, manipulation, and disruption by malicious actors. It encompasses measures and protocols designed to safeguard interconnected systems, such as power grids, from cyber threats and ensure the reliability and resilience of the energy supply. Solutions are expected to

incorporate technologies for detecting, identifying, and mitigating cyber threats, digital supply chain security, security by design, and risk assessment and evaluation tools.

c. Enabling technologies - power electronics, communication, sensing, artificial intelligence, and machine learning: Enabling technologies are foundational concepts, tools, techniques, or methodologies such as power electronics, communication, artificial intelligence, and machine learning that play a crucial role in enabling cost-effective, efficient, and reliable grid integration of solar energy systems. Power electronics devices need more advanced control capabilities to improve grid reliability and stability for high inverter-based resource (IBR) integration. Communication, sensing, artificial intelligence (AI), and machine learning (ML) technologies have great potential to improve the planning and operation of future power systems through precise measurement of system states and powerful data analytics for optimal decision-making. Solutions are expected to enable better utilization of these technologies in integration of IBRs.

3. Concentrating Solar-Thermal Power

Summary of Technology Area #3:
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.

Key Challenges in the Technology Area:
SETO seeks innovative concepts and improved system operations that decrease the cost or improve the value of solar thermal energy that can be utilized at any time of day or night, including in the collector, receiver, thermal storage, heat transfer media, and power cycle subsystems.

Other systems of interest include those enabling dispatchable electricity production and technologies that integrate concentrating solar thermal energy with non-electricity applications, including industrial processes and production of chemicals and fuels.

4. Interconnection Innovation e-Xchange (i2X)

Summary of Technology Area #4:
SETO and the Wind Energy Technologies Office (WETO) lead DOE's Interconnection Innovation e-Xchange (i2X) program, started in 2022, with the mission to enable a simpler, faster, and fairer interconnection of clean energy resources while enhancing the reliability, resilience, and security of our electric grid. The i2X program seeks

innovative solutions to be tested and piloted with distribution electric utilities to offer advanced grid hosting capacity and identify opportunities for cost sharing of related grid-network upgrades, especially for high volumes of commercial, industrial, and community-scale generators and resources (ranging from 100 kW to 5 MW).

Key Challenges in the Technology Area:
The i2X program seeks innovations to advance the quality and customer-facing interactivity of distribution electric utility grid hosting capacity maps. The goal is to help interconnection customers make informed decisions, with a high degree of confidence, about service availability and associated grid network upgrade costs. Dynamic hosting capacity map innovations which support flexible interconnection of variable energy generation resources (e.g., solar and wind) are an area of special interest.

The i2X program also seeks innovations for joint or unified hosting capacity maps for multiple utilities with neighboring service territories, especially in cases in which affected system studies are triggered and require coordination. Joint or unified hosting capacity maps are critical to bring consistency and simplicity to interconnection customers across larger geographical areas within the same regulatory conditions.

The i2X program is interested in testing these innovations with distribution electric utilities. Innovations that require utilities to replace their existing workflow and interconnection modeling solutions are not of interest.

AOI 4.12: EERE Vehicle Technologies Office (VTO)

Overview of Major Mission Areas:
Vehicles move our national economy. Annually, vehicles transport 12 billion tons of freight—more than $38 billion worth of goods each day —and move people more than 3 trillion vehicle-miles. Growing our economy requires transportation, and transportation requires energy. The transportation sector accounts for approximately 27% of total U.S. energy needs and the average U.S. household spends over 17% of its total family expenditures on transportation, making it, as a percentage of spending, the costliest personal expenditure after housing. Transportation is critical to the overall economy, from the movement of goods to providing access to jobs, education, and healthcare.

The Vehicle Technologies Office (VTO) funds research, development, demonstration, and deployment (RDD&D) of new, efficient, and clean mobility options that are affordable for all Americans. VTO leverages the unique capabilities and world-class expertise of the National Laboratory system to develop new innovations in vehicle technologies, including: advanced battery technologies (including automated and

connected vehicles as well as innovations in efficiency-enhancing connected infrastructure); innovative powertrains to reduce greenhouse gas and criteria emissions from hard to decarbonize off-road, maritime, rail, and aviation sectors; and technology integration that helps demonstrate and deploy new technology at the community level. Across these technology areas and in partnership with industry, VTO has established aggressive technology targets to focus RDD&D efforts and ensure there are pathways for technology transfer of federally supported innovations into commercial applications. Last year, vehicles transported 11 billion tons of freight, more than $32 billion worth of goods each day, and moved people more than 3 trillion vehicle-miles. The DOE Vehicle Technologies Office provides low cost, secure, and clean energy technologies to move people and goods across America.

Outline of Eligible Technology Areas:

1. **BATTERIES**

Summary of Technology Area #1:
The Batteries subprogram 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 electric vehicle (EV) batteries. These activities focus on generating knowledge and addressing technology barriers for batteries. Specific goals include 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.

Proposals are sought to advance towards commercialization any technology whose development as funded through the Battery Technologies program directly addresses critical needs in battery chemistry and production.

Key Challenges in the Technology Area:
To reduce the cost and improve the performance of EV batteries, work must be done to address the following challenges:

- Increasing the calendar and cycle life of near-term chemistries to at least 10 years and 1000 cycles, respectively.
- Overcoming the limits of extreme fast charge to enable charge within 10 minutes to 80% State of Charge (SOC).
- Understanding and improving lower-cost, higher energy-density chemistries and processing.
- Reducing or removing the critical material content in EV batteries.
- Improving the recovery and reuse of critical materials in end-of-life lithium-ion batteries.
- Improving lithium-ion battery safety electrochemically.

2. CHARGING AND ELECTRIC VEHICLES

Summary of Technology Area #2:

The Electrification Technologies subprogram focuses on transportation electrification through two technology areas: (1) Research for fast, secure, and resilient Plug-in Electric Vehicle (PEV) charging that is effectively integrated with the electrical grid and other infrastructure through electrification R&D activities, and (2) extreme high power density motor and power electronics for PEV traction drive systems under electric drive R&D. These activities focus on generating knowledge and addressing technology barriers for electric drive systems, and high-power charging systems that can enable transportation electrification and support the mass adoption of PEVs. Specific subprogram goals include: (1) decreasing charge time to less than 15 minutes by 2028, (2) reducing the cost of electric drive systems to less than $6/kW by 2025 for 100-kW systems, (3) reducing the cost of on-board chargers to less than $20/kW by 2030 for a 19.2-kW system, (4) enabling 1+ MW charging for medium- and heavy-duty PEVs, and (5) technologies that provide ancillary energy services and effective vehicle grid integration, including bidirectional EVs (to enable charging and discharging to the grid).

Proposals are sought to advance the commercialization of energy-related technologies whose development was funded through the through the Electrification Technologies subprogram that directly addresses critical needs in charging technologies and vehicle electrification.

Key Challenges in the Technology Area:

- Smart Charge Management (SCM) systems capable of controlling wide-scale utilization of high-power charging at 400kW and above.
- Cybersecurity methodologies for EV charging, including Smart Charge Management.
- Electric vehicle charging equipment that enables seamless interoperability with variations in electric vehicle architecture.
- Components that can enable DC connected EV-charging that integrates with distributed energy resources, such as solar generation and battery storage.
- Components that can enable advanced charging concepts, including higher voltage charging installations with reduced component count and cost, bidirectional and wireless charging, and/or reduce supply chain constraints.
- Behind-the-Meter-Storage (BTMS) solutions that are safe, cost-effective, minimize the use of critical materials, and enable reduced operating costs for DC fast charging stations.

- Power electronics with reduced cost and voltage/power levels suitable for next generation electric vehicles, including heavy-duty and off-road commercial vehicles.
- Electric motors with reduced rare-earth content and elimination of heavy-rare-earth elements.
- Advanced cooling/thermal management strategies that reduce size, cost, weight, and reliability of key components.

3. ENERGY EFFICIENT MOBILITY SYSTEMS

Summary of Technology Area #3:

The Energy Efficient Mobility Systems (EEMS) program envisions an affordable, efficient, low-emission, and accessible mobility system future in which mobility is decoupled from energy consumption. Through EEMS, VTO works to realize a future that provides affordable, reliable, and convenient transportation choices that operate efficiently, acknowledging contributions from automation, connectivity, electrification, and sharing technologies.

EEMS conducts research, development, and demonstration at the vehicle, traveler, and mobility system levels, creating new knowledge, insights, tools, and technology solutions that increase mobility energy productivity and decrease greenhouse gas and criteria pollutant emissions 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.

Proposals are sought to advance the commercialization of energy-related technologies that have relevance to the EEMS program. This may include technology previously developed through EEMS, through National Lab projects, or other programs.

Key Challenges in the Technology Area:

- Increasing energy efficiency of the transportation system at scale to assist in achieving a net-zero future without reducing convenience or creating new barriers for adoption.
- Reducing barriers for the adoption of new mobility solutions.
- Providing high fidelity tools that are accessible, easy to use, and understandable to a broad stakeholder community.

4. DECARBONIZATION OF OFF-ROAD, RAIL, MARINE AND AVIATION PROGRAM

Summary of Technology Area #4:

The Decarbonization of Off-road, Rail, Marine and Aviation program supports research, development, and demonstration (RD&D) necessary for industry to develop efficient engines that can utilize renewable fuels, such as advanced biofuels, hydrogen, and e-fuels, to reduce GHG and criteria emissions from off-road vehicles including construction, agriculture and forestry, as well as rail, marine and aviation sectors. The Program supports the development of predictive, high-fidelity sub-models and simulation tools that are scalable and can leverage future exascale computing capabilities. These tools simulate and accurately predict the fundamental processes that occur inside engines, including fuel injection sprays, heat transfer, turbulence, flame propagation, and emissions formation, to achieve results that are comparable to detailed experiments. The program also supports experimental combustion projects that provide data to establish quantitative relationships between fuel properties and efficiency improvements potential for engines used in non-road vehicles. In combination with modeling, the knowledge from experimental research will help industry develop combustion engines that can utilize renewable fuels with higher efficiency and lower GHG and criteria emissions. The program conducts experiments using high-resolution microscopy and models chemical reactions at the atomistic level on catalyst surfaces and within the catalysts to determine the impact of renewable fuels on emissions.

Proposals are sought to advance the commercialization of energy-related technologies whose development was funded through the Decarbonization of Off-road, Rail, Marine and Aviation Program.

Key Challenges in the Technology Area:

- Increase efficient use of bio/renewable fuels (H2, biodiesel, ammonia, methanol, etc.) in combustion engines and improve catalyst to reduce criteria emissions.
- Improve computer models of bio/renewable fuel combustion and emission control.
- Improve understanding of contrails formation from sustainable aviation fuels.
- Increase electrification of non-road vehicles through hybrid/plug-in architectures.

5. MATERIALS TECHNOLOGY

Summary of Technology Area #5:

The Materials Technology subprogram supports R&D of advanced materials to enable increased vehicle efficiency. Materials play an important role in increasing the efficiency of electric vehicles through weight reduction as well as enabling additional

functionalities such as faster charging and new sensing technologies. Lighter weight vehicle structures and electric drivetrains will require fewer batteries to achieve the same driving range, which in turn reduces battery cost, material needs, and reduces the greenhouse gas emissions from battery production. Functional materials with improved properties such as electrical conductivity, thermal conductivity, and unique sensing capabilities will enable innovations in charging and autonomous vehicles. The materials and manufacturing methods used to make vehicles also contribute to greenhouse gases and the Materials Technology subprogram supports research, development, and deployment to increase recyclability and reduce the overall embodied energy of vehicles. To enable the use of materials such as advanced high-strength steel, magnesium, aluminum, and polymer composites, the Materials Technology subprogram focuses on reducing cost, improving prediction of properties, and enabling high volume manufacturing of components and multi-material assemblies. The Materials Program goal is to reduce the weight of a vehicle's glider by 25% at a cost of less than five dollars per kilogram saved.

Proposals are sought to advance the commercialization of energy-related technologies whose development was funded through the Powertrain Materials Core Program, Light Metals Core Program, Joining Core Program, or Composites Core Program.

Key Challenges in the Technology Area:

- Sustainable alloys (>20% recycled material) for large structural aluminum die casting.
- Reducing the energy content of sustainable materials for vehicle applications.

AOI 4.13: EERE Water Power Technology Office (WPTO)

The Water Power Technologies Office (WPTO) enables research, development, and testing of emerging technologies to advance marine energy as well as next-generation hydropower and pumped storage systems for a flexible, reliable grid. WPTO seeks proposals related to the commercialization of both marine energy and hydropower technologies, including energy generation systems like wave energy converters and turbines, as well as enabling technologies like cables, environmentally friendly coatings, etc. These are only examples and WPTO intends to support a wide range of related technologies.

To advance the state of marine energy and hydropower technologies and reduce costs of electricity and energy served by marine energy and hydropower, commercialization of technologies developed by the National Laboratories is critical. Technologies and products developed by the National Laboratories may seek to advance the industry at large and include applications that could be used by several developers. Additionally,

research and IP developed by the labs could help developers de-risk investments that could result in commercially relevant technologies. WPTO encourages lab researchers to pursue open-source commercialization pathways, including making technology development and validation data publicly available, through this funding opportunity. Lab researchers are strongly encouraged to work with external partners from industry, end users, communities where these technologies may be deployed, and other relevant groups towards commercialization.

AOI 4.14: EERE Wind Energy Technology Office (WETO)

The Wind Energy Technologies Office (WETO) invests in a diversified portfolio of wind energy research, development, demonstration, and deployment activities that enable and accelerate the innovations necessary to advance offshore, land-based, and distributed wind systems, reduce the cost of wind energy, drive deployment, and facilitate the integration of high-levels of wind energy with the electric grid. With continued innovation, wind energy has the potential to cost-competitively contribute between 35 and 45 percent of U.S. electricity in less than two decades, up from about 10 percent of all U.S. electric power in 2022. Wind energy can also contribute to grid reliability and resiliency, as well as the generation of clean fuels to help transition the U.S. economy to net-zero emissions in the transportation, buildings, industrial, and agricultural sectors, supporting growth in good-paying jobs and domestic manufacturing across all regions of the country. Progress on these fronts, arising from continued innovation in technology, grid systems integration, and unique solutions to deployment challenges, can position the U.S. as a global leader in wind energy development at home and abroad.

Overview of Major Mission Areas:

Across all its wind energy development objectives, WETO emphasizes three common and overarching themes:

- Reduce the cost of wind energy for all wind applications (offshore, land-based utility-scale, and distributed).
- Accelerate the deployment of wind energy through siting and environmental solutions to reduce environmental impacts, minimizing timetables for wind energy project development, and facilitating responsible, sustainable, and equitable development and delivery of wind energy resources.
- Enable and facilitate the interconnection and integration of substantial amounts of wind energy into the dynamic and rapidly evolving energy system that is cost-effective, cybersecure, reliable, and resilient, and includes systems integrated with other energy technologies and energy storage.

Outline of Eligible Technology Areas:

1. **Remote Sensing in Wind Energy**

   By measuring conditions across and above the turbine rotor, remote sensing technologies play a crucial role in the field of wind energy by providing accurate and detailed information about wind resources, wind turbine performance, and environmental impacts. WETO seeks proposals from National Laboratories to advance the commercialization of individual energy-related technologies that meet adoption readiness level[27] 5 or above and propose a maximum federal funding of $750K per project. Applications must demonstrate clear evidence of commercial potential that combines technology progress with market pull or interest. Examples of projects that address aspects of remote sensing in wind include:

   - **Weather forecasting in wind energy applications.** Remote sensing techniques like light detection and ranging (LIDAR) and radar are used in weather forecasting to monitor and predict wind patterns and severe weather events and in wind energy development to assess potential wind farm sites. These systems can provide valuable data for tracking the movement and intensity of storms and other weather phenomena and can also help developers determine feasibility and later, productivity, of a wind energy project.
   - **Wind and stability profiling.** Remote sensing can be used to create wind profiles in the atmosphere. This involves measuring wind speed and direction, temperature, and humidity at various altitudes to understand how wind conditions change with height. This information is crucial for applications in wind energy.
   - **Environmental monitoring**. Remote sensing can help wind farm developers assess and mitigate the environmental impact of their projects. By monitoring bird and bat activity and flight patterns, wind farms can implement curtailment strategies to reduce wildlife collisions.
   - **Energy storage integration**. Remote sensing can also assist in the integration of energy storage solutions within wind farms. By providing accurate data on wind conditions and energy generation, wind farms can better plan the charging and discharging of energy storage systems, improving grid stability and energy dispatch.
   - **Low power remote sensing systems**. Remote sensing capabilities that can be realized on smaller power budgets add new “in the field capabilities” for resource characterization and environmental monitoring. This includes their potential deploy-ability on small mobile platforms for sustained observation campaigns.

   Key Challenges in the Technology Area:

[27] Adoption Readiness Levels (ARL): A Complement to TRL | Department of Energy

While remote sensing plays a crucial role in optimizing wind energy production, there are several key challenges associated with its implementation in the wind energy industry. These challenges include cost, data quality and calibration, data availability and sensor robustness, data sparsity (lack of resolution), data integration, regulatory and environmental considerations, site specific challenges (e.g., offshore measurements), data processing and analysis, and privacy and security.

v. Topic 5: Enhancing Laboratory Processes

In addition to the above topics, DOE has identified that consistent processes are critical to enable and support activities that are vital to effective technology transition out of National Labs.

As such, individually and cumulatively, they present major barriers to external partners wanting to commercialize Lab-developed technology, particularly when each Lab has its own unique processes. Thus, external parties interested in working with more than one Lab must learn and work through multiple processes.

One of the largest perennial barriers to DOE National Laboratory commercialization are the limited mechanisms available to allow Lab staff to engage in entrepreneurial pursuits and/or partner with external entities. This topic will seek proposals from National Labs to streamline National Lab processes to move lab-developed, promising energy-related technologies toward commercial purposes, as well as to enable faster and simpler commercialization processes. Process improvements could focus on improvements to internal Lab contracting mechanisms, licensing of IP, and other ideas to streamline processes and catalyze synergies. Applicants could consider and incorporate cybersecurity in these processes as well.

DOE envisions that these improvements could connect and flow into the new or enhanced programming described in Topics 1 through 3 as well as Topic 6. DOE strongly encourages applicants to partner with external organizations on proposals for this topic.

Creativity is highly encouraged. DOE encourages the National Labs to work together to streamline cross-program, cross-lab connecting processes, and make them similar across Labs, when possible, to provide a more united and consistent approach to engaging external partners. Thus, proposed projects to create streamlined multi-Lab approaches will likely better address the scoring criteria in Section II.B. than single-Lab proposed projects.

Additionally, proposals should clearly describe how they are either building on existing infrastructure and programming or making changes or improvements. Redundant

infrastructure, programming, and projects are unlikely to address the stated scoring criteria in Section II.B. Proposed efforts should also help address any root causes (inside of the labs) of existing commercialization challenges and barriers.

Applications under this topic should seek input from their respective field office(s) and/or other interested DOE organization(s) and office(s), when applicable, regarding their proposal and potential impacts if the offices and/or organizations have oversight or ownership responsibility over those processes or procedures being addressed by their proposal.

Subtopic 5.a: Proposals commit to meet the 50% of total project cost-share funds requirement.

Subtopic 5.b: Proposals meet less than the 50% of total project cost-share funds requirement.

Proposed projects could include but are not limited to:

- Improvements and broader implementation of Lab Master Scopes of Work.
- Actions or infrastructure (e.g., websites) to make National Lab expertise or Lab IP widely available, such as providing fairness of opportunity through publication of an opportunity to collaborate or license.
- Streamlining of all steps to accelerate and reduce transaction costs of moving from lab to market.
- Development of new models of engagement to address business and technological realities impeding commercialization.
- Improvements to Lab cybersecurity processes in areas such as data creation, sharing, and protection.
- Enhancing National Lab programs, National Lab internal policy, and innovation culture (i.e., commercialization and entrepreneurial efforts such as staff charging time to support external company engagement, taking commercialization training, etc.).
- Streamlining and enhancing programs to allow National Lab staff to engage in entrepreneurial ventures and practices to mitigate conflicts of interest, etc.

vi. Topic 6: Increasing Partnerships with External Commercialization Parties

Increasing partnerships with external commercialization parties is critical for effective technology transition out of National Labs. Activities focused on partnering with

external parties and their related programs and efforts, such as but not limited to industry day events, industry advising on National Lab projects, and industry-led incubation or acceleration programs vary at each lab. Due to this variation across the Labs, it can be challenging for external partners to engage with National Labs.

This topic seeks to make it easier for the private sector to work with National Labs. Goals of this topic area are to decrease barriers to working with the labs, increase the number and diversity of private sector partners, and accelerate and deepen connectivity with external commercialization parties. These activities are meant to improve how Labs attract, recruit, and retain external partners to further develop and commercialize technologies. DOE envisions that these activities could connect and flow into the new or enhanced programming described in Topics 1 through 3 as well as Topic 5.

DOE strongly encourages applicants to partner with external organizations on proposals for this topic. Creativity is highly encouraged. DOE encourages the National Labs to work together to connect cross-program and cross-lab approaches, as well as make them similar across labs, when possible, to provide a more united and consistent approach to engaging external partners. Thus, proposed projects to create multi-lab approaches will likely better address the scoring criteria in Section II.B. than single lab proposed projects.

Additionally, proposals should clearly describe how they are either building on existing infrastructure and programming or making changes or improvements. Redundant infrastructure, programming, and projects are unlikely to address the stated scoring criteria in Section II.B. Proposed efforts should also help address any root causes (inside and outside of the Labs) of existing challenges and barriers.

Subtopic 6.a: Proposals commit to meet the 50% of total project cost-share funds requirement.

Subtopic 6.b: Proposals meet less than the 50% of total project cost-share funds requirement.

Proposed projects could include but are not limited to:

- Program to improve connections between a National Lab and industry partners and/or small businesses, for example, partners working alongside researchers to improve and commercialize lab-developed technologies.
- Streamlining the partnering process as well as efforts to standardize the partnering process across multiple labs.

- Industry-led and -funded incubation or acceleration programming to attract, recruit, and retain external partners to further develop and commercialize National Lab technologies.
- Industry-led and -funded commercialization-focused mentoring and advisor programming.
- Best practices guidance for how industry can engage with National Labs to license lab-developed technologies efficiently and effectively.
- Teaming events between National Lab(s) and external parties that tie into a larger project or series, such as offering potential industry partners opportunities for laboratory tours or vice-versa. Single, standalone events will not be considered.
- Organizing Lab-run, sector-specific demonstration or innovation days paired with relevant conferences, such as in support of DOE's Energy Earthshots Initiative[28].

II. Application Submission and Review Information

The application process will include two required phases: a concept paper phase and a full application phase. At each phase, DOE performs an initial eligibility review of the applicant submissions to determine whether they meet the eligibility requirements of the lab call. DOE will not review or consider submissions that do not meet the eligibility requirements.

DOE will not extend deadlines for applicants who fail to submit required information and documents due to server/connection congestion.

ELIGIBILITY: Only DOE National Laboratories and DOE Plants and Sites are eligible to receive funding from this lab call. All applications must be submitted to DOE from each lab's respective Office of Research and Technology Application (ORTA)[29] Technology Transfer Offices (TTOs). All other National Laboratory offices and programs must ensure to have their respective TTOs submit applications. **Concept papers and full applications must be submitted by a Lab TTO to be considered eligible.** Replies to reviewer comments may be submitted by someone other than a Lab TTO.

Only applicants who have submitted an eligible concept paper and received an encourage determination from DOE will be eligible to submit a full application.

[28] Energy Earthshots Initiative | Department of Energy
[29] 15 USC 3710.

There are no limits on the number of concept papers each National Laboratory ORTA TTO can submit.

For Topics 1, 2, 3, 5, and 6, National Laboratories are expected to coordinate internally and with other labs (when applicable) on the concept paper and full application submissions. If there is at least one lab partner on the project, the prime lab ORTA TTO can submit an unlimited number of full project applications. **When a project does not have any Lab partners, the prime lab ORTA TTO may submit no more than two full project applications.** Any submitted applications that exceed this limit will not be considered. Applications will be counted in the order in which they are received.

For Topic 4, there are no limits on the number of full project applications each National Laboratory ORTA TTO can submit.

The concept paper, full application, and reply to reviewer comments must conform to the form and content requirements described in Section II.A. If applicants exceed the maximum page lengths stated in Section II.A, DOE will review only the authorized number of pages and will disregard any additional pages. Submissions will be reviewed by technical staff from the applicable DOE program offices and OTT.

A. Process and Submission Details

i. Process

SUBMISSION: To apply to this lab call, ORTA TTO personnel must register and sign in with their Lab email address and submit application materials through Exchange, the online tool being used by OTT and the other program offices.

The concept paper, full application, and reply to reviewer comments must conform to the following requirements:

- Must be submitted via Exchange.
- Must be submitted by the applicable deadline.
- Must be written in English.
- Must be submitted in Adobe PDF format unless stated otherwise.
- A control number will be issued when an applicant begins the Exchange application process. The control number must be prominently displayed on the upper right corner of the header on every page.

- Documents must conform to this naming convention: "2024 TCF 'Name of File' [Control #]"
- All pages must be formatted to fit on 8.5 x 11-inch paper with margins not less than one inch on every side. Use Calibri typeface, black font color, and a font size of 12 point or larger (except in figures or tables, which may be 10-point font). A symbol font may be used to insert Greek letters or special characters, but the font size requirement still applies.
- All proprietary information must be marked clearly by highlighting the information in yellow and placing the information within brackets to clearly identify the sensitivity of the information.
- Page numbers must be included in the footer of every page.
- Must not exceed the specified maximum page limit when printed using the formatting requirements.

Applicants are strongly encouraged to submit their concept papers, full applications, and replies to reviewer comments at least 48 hours in advance of the submission deadline.

Additional Information on Exchange:

Exchange is designed to enforce the deadlines specified in this lab call. The "Apply" and "Submit" buttons will automatically disable at the defined submission deadlines. Should applicants experience problems with Exchange, the following information may be helpful to applicants that experience issues with submission *prior* to the deadline:

In the event that an applicant experiences technical difficulties with a submission, the applicant should contact the EERE Exchange helpdesk for assistance (EEREExchangeSupport@hq.doe.gov). The EERE Exchange helpdesk and/or the EERE Exchange system administrators will assist applicants in resolving issues.

ii. Concept Papers

Lab ORTA TTOs are required to submit the concept paper in Exchange no later than the date and time listed in the Section I.B. Timeline.

DOE will review the concept paper, and applicants will receive an official determination, encourage or discourage. The intent is to help the National Labs focus their efforts on the concepts with the highest potential under this lab call. Only labs that receive an encourage determination on the concept paper phase will be allowed to submit a full application.

The concept paper must conform to the following content requirements:

Section	Page Limit	Description
Cover Page	1 page maximum	The cover page is required to include the template table provided in Appendix D.
Project Description	3 pages maximum	Applicants are required to: • Describe the project in enough detail that it may be evaluated for its innovation, impact, and relevance to the topic objectives. • Topic 4 applications must also state the project's starting and ending Adoption Readiness Levels (ARLs)[30] and TRLs. Please note the TRL requirements in each of the program office AOI descriptions, when listed. • Describe relevant background information that helps demonstrate the need for this project, including the problem statement or major challenges and barriers being overcome through the project and the approach to solving the problem. • Develop a commercialization plan that outlines the approach towards maximizing impact of DOE funding on the relevant field and application. • Describe how the proposed project, if successfully accomplished, would clearly meet the objectives stated in the lab call. • References must be included as footnotes or endnotes in a font size of 10 or larger. Footnotes and endnotes are counted toward the maximum page requirement.
Addendum	2 pages maximum	Applicants are required to describe succinctly the qualifications, experience, and capabilities of the proposed project team, including: • Whether the project team has the skill and expertise needed to successfully execute the project plan. • Whether the applicant has prior experience that demonstrates an ability to perform tasks of similar risk and complexity. • Whether the applicant has worked together with their teaming partners on prior projects or programs.

[30] https://www.energy.gov/technologytransitions/adoption-readiness-levels-arl-complement-trl

		• Whether the applicant has adequate access to equipment and facilities necessary to accomplish the effort and/or clearly explain how they intend to obtain access to the necessary equipment and facilities. • Applicants may provide graphs, charts, or other data to supplement their project description. These details will be counted toward the maximum page requirement.

iii. Full Applications

If labs receive an encourage determination from DOE at the concept paper stage, they are invited to further expand their encouraged concept into a full application. Only labs that receive an encourage determination on the concept paper phase will be allowed to submit a full application. Full applications are required to be eligible for award(s) under this solicitation. Lab ORTA TTOs are required to submit the full application materials in Exchange no later than the date and time listed in the Section I.B. Timeline.

Each full application shall be limited to a single concept. Unrelated concepts shall not be consolidated in a single full application.

Full applications must conform to the requirements below and contain a Technical Volume, Budget Spreadsheet, Statement of Work, Community Benefits Plan, and Summary Slide.

TECHNICAL VOLUME

Technical Volumes should be no more than 15 single-spaced pages total. Unless specified otherwise, the following components contribute toward the 15-page limit and must be included. It is preferred that applicants use the headings corresponding to the bullets below.

1. **Title page.** The title page is not counted in the 15-page limit and must include the template table provided in Appendix D. In addition, the title page must include a nonproprietary project summary (200-or-less-words) of the project suitable for public release if the project is funded.
2. **Executive summary.** This should include the following:
   - A short explanation of the proposed project.
   - Clearly defined, easily communicated, end-of-project goal(s).

- A high-level overview of the optimal project budget for each budget period and in total, including the federal funding requested and cost share amounts.
- A discussion on the impact that DOE funding would have on the proposed project, specifically explaining how DOE funding—relative to prior, current, or anticipated funding from other public and private sources—is necessary to achieve the project objectives.

3. **Project description.** This should include the following:
   - Describe the project in enough detail that it may be evaluated for its innovation, impact, and relevance to the topic/AOI objectives.
   - Describe relevant background information that helps demonstrate the need for this project, including the problem statement.
   - Describe the specific innovation of the proposed project, the advantages over current and emerging programs and/or processes, and the overall impact on advancing the baseline if the project is successful.
   - Describe major challenges and barriers being overcome through the project and the approach to solving them.
   - Clearly specify the expected outcome(s) of the project.
   - If applicable, indicate whether the project is related to other current or recently completed DOE-funded or lab-funded projects. Identify any next-stage commercialization, intellectual property, or resource factors, if appropriate.
4. **Potential commercialization advances**. This should include the following:
   - For Topics 1, 2, 3, 5, and 6, identify root causes (inside and outside of the labs) of the existing lab commercialization challenges and barriers that, if addressed, will result in significant advances for commercializing technologies.
   - For Topic 4, describe the expected path for the proposed project toward commercialization successes, including the anticipated timeline for market entry or increased market adoption for technologies involved in the proposal.
   - Topic 4 applications must also state the project's starting and ending TRLs and ARLs[31].
5. **Work plan.** This should include the following:

[31] https://www.energy.gov/technologytransitions/adoption-readiness-levels-arl-complement-trl

- List the key project tasks and provide brief descriptions for each task, including roles and responsibilities of any partners and expected timeline. Some applicants may find it helpful to include a Gantt chart.
- Define the key milestones to be addressed by the project, including Specific, Measurable, Attainable, Realistic, and Timely (SMART) milestones, and go/no-go decision point(s), with specific descriptions of what should be accomplished. There should be at least one milestone per quarter in the period of performance. Go/no-go decision points typically occur every 12–18 months and they are recommended to be present for projects when applicable from a technical and project length standpoint.
- Identify and address key risks to achieving stated goals and the steps to be taken to minimize or mitigate those risks.

6. **Impact tracking.** DOE has an obligation to report on TCF implementation and impact. As such, all projects must incorporate clear impact-tracking strategies. This section should include the following:
   - Describe how the proposed project would measure success during and after the period of performance.
   - Describe how the project team will implement and track impact metrics. Proposals must include outcome-focused metrics that are most applicable for the proposed project and describe how and when the team will track and report against those metrics. As appropriate, specific targets, including minimums, for identified metrics should be provided. Applicants should consider short, medium, and long-term goals when identifying metrics. Sample metrics are shown below and should be tailored to the nature of the submitted proposal. For example, for a metric of "partnerships," the nature of the engagement or partnership must be specified.
     - Acceptable metrics include but are not limited to: 1) number of commercialized technologies, 2) number of CRADAs or other partnering arrangements that come out of the Labs, 3) increase in number of licensed Lab technologies, 4) number of tangible improvements to Lab-related activities based on customer discovery, 5) qualitative data before and after activity measuring understanding or perspective shift, 6) number of Lab technology transfer professionals trained in areas outside of normal activities, 7) private funds invested in solutions, 8) number and value of established industry and incubator partnerships, 9) number of inquiries for

new partnerships, 10) innovation and IP generation, 11) annual revenue from commercialized technologies, etc.

- Unacceptable metrics include but are not limited to 1) general reports describing activities, 2) exploratory experiments that lack a goal, 3) unverifiable data, 4) time spent on project, and 5) other subjective, vague, and/or ambiguous metrics.

7. **Team and required resources.** This should include the following:
   - Describe the expected DOE and National Laboratory member resources, including proposed work areas, staff time, and any facility/equipment needs. Include specific locations and Laboratories to be used. Identify any areas where additional resources are required and the plan to address the gap(s).
   - For projects which include a partner (including other labs), a description of each performer's role and responsibility, as well as how individual efforts will be coordinated to achieve the overall project goal, should also be included.
8. **Budget discussion and cost-share.** This should include the following:
   - A high-level summary of the optimal budget including federal funding requested, cost-share, and total budget for the project which corresponds with the tasks and project scope outlined in the proposal. This should include justification discussion for the budget proposed.
   - A brief explanation of why DOE funding is necessary to achieve the objectives of the proposal.
   - A brief description of the minimum and maximum project budget (e.g., below and above the optimal level, respectively), with an explanation of the project scope changes that would occur for each when compared to the optimal budget scenario.
   - A detailed table describing any proposed cost-sharing, clearly articulating cash versus in-kind. This is required for all applications that propose cost-share. See Appendix A for additional cost-share information and requirements.
   - For any proposals applying to subtopics 1.b, 2.b, 3.b, 4.b, 4.c, 5.b, or 6.b provide reasoning as to why less than 50% cost-share is appropriate. See Appendix A for additional cost-share information and requirements.
9. **Appendix.** The appendix is not included in the 15-page limit. The appendix should be saved at the end of the Technical Volume pdf and include the following components:

- References.
- Team Resumes. Resumes of key project participants must be included and should not exceed one page per participant.
- Letters of Commitment. If applicable, provide letter(s) of commitment from all subrecipient and third-party cost-share provider(s) and project partner(s); 1-page maximum per letter.
- For any proposals applying to subtopic 4.b, provide evidence of the partner(s) being a small business(es) as defined by the U.S. Small Business Administration.
- For any proposals applying to subtopic 4.c, if applicable, provide evidence of the partner(s) being a small business(es) that are certified as veteran-owned; women-owned; lesbian, gay, bisexual, transgender (LGBT)-owned; or otherwise, disadvantaged business(es) by the U.S. Small Business Administration; members of the National LGBT Chamber of Commerce; or verified Veteran-Owned by the Veterans Administration.

BUDGET SPREADSHEET

For FY24, DOE is requiring that all applicants provide a low, optimal, and high budget level request with the associated tasks and scope outlined at each proposed budget level in order to expedite project awardee negotiations and allow program offices to select the funding level that best suits their available budget and technology goals.

The Budget Spreadsheet is a separate file which should be included in the application. There is a template that should be used for the budget spreadsheet, and it can be found on Exchange under this lab call, “Budget_Spend_Plan_Template.” All sections should be filled out according to the instructions in the spreadsheet.

During the review and selection process, DOE reserves the right to determine an award with a modified project scope and budget.

STATEMENT OF WORK

The Statement of Work (SOW) is a separate file which should be included in the application. There is a template that should be used for the SOW, and it can be found on Exchange under this lab call, “SOW_Template.” All sections should be filled out according to the instructions in the template.

COMMUNITY BENEFITS PLAN

The Community Benefits Plan (CBP) is a separate file which should be included in the application. The CBP sets forth the applicant's approach to ensuring the federal investments advance the following four objectives: (1) support meaningful community and labor engagement; (2) DEIA; (3) Justice40; and (4) investing in America's workforce. The information below sets forth the content requirements for the CBP, which addresses each of these objectives.

The applicant's CBP must include at least one SMART milestone per budget period to measure progress on the proposed actions. The CBP will be evaluated as part of the technical review process. If a project is selected, DOE will incorporate the CBP into the award and the recipient must implement its CBP when carrying out its project. DOE will evaluate the recipient's progress throughout the life of the award, including potentially as part of the Go/No-Go review process.

The CBP should be specific to the proposed project and not a restatement of an organization's policies. Applicants should describe the future implications or a milestone-based plan for identifying future implications of their project scope on CBP objectives. These impacts may be uncertain, occur over a long period of time, and/or have many factors within and outside the specific proposed research. Applicants are encouraged to describe the influencing factors and the most likely implications of the proposed project if it is successful. While some guidance and example activities are provided in Appendix B, applicants are encouraged to leverage promising practices and develop a plan tailored to their project.

The CBP should be at least one page. This Plan must address the technical review criterion titled "Community Benefits Plan." See Section II.B.ii of the lab call for the merit review criterion.

Applicants must address all four CBP objectives for Topic 4 applications, and applicants for Topics 1, 2, 3, 5, and 6 must incorporate a CBP addressing the applicable objectives for the proposed project. Below are the four sections of a CBP:

1. **Community and Labor Engagement:**
   Describe the applicant's actions to date and plans to engage with community partners, such as local and/or tribal governments, labor unions, and community-based organizations that support or work with underserved communities, including disadvantaged communities (DACs) as defined for purposes of the Justice40 Initiative. By facilitating community input, social buy-in, and accountability, such engagement can substantially reduce or eliminate stalls or slowdowns, litigation, and other risks associated with project implementation.

Community and labor engagement should lay the groundwork for the negotiation of Workforce and Community Agreements, which could take the form of one or more kinds of negotiated agreements with communities, labor unions, or both.

2. **Diversity, Equity, Inclusion, and Accessibility:**
   To build a clean and equitable energy economy, it is important that there are opportunities for people of all racial, ethnic, socioeconomic, and geographic backgrounds, sexual orientation, gender identity, persons with disabilities, and those re-entering the workforce from incarceration. This section of the CBP demonstrates how DEIA is incorporated in the project objectives. It should identify the specific action the applicant would take that integrates into the project goals and project teams. Submitting an institutional DEIA plan without specific integration into the project will be deemed insufficient.

3. **Justice40 Priorities:**
   Provide an overview of benefits to DACs that the project can deliver, supported by measurable milestones. The Justice40 Priorities section is recommended to include:
   - Identification of applicable DACs to which the anticipated project benefits will flow.
   - Identification and expected time of impact of benefits that are quantifiable, measurable, and trackable, including a discussion of the applicable DOE Justice40 benefits outlined below.
   - Benefits include (but are not limited to) measurable direct or indirect investments or positive project outcomes that achieve or contribute to the following in DACs: (1) a decrease in energy burden; (2) a decrease in environmental exposure and burdens; (3) an increase in access to low-cost capital; (4) an increase in high-quality job creation, the clean energy job pipeline, and job training for individuals; (5) increases in clean energy enterprise creation and contracting (e.g., minority-owned or disadvantaged business enterprises); (6) increases in energy democracy, including community ownership; (7) increased parity in clean energy technology access and adoption; and (8) an increase in energy resilience.
   - A discussion of anticipated negative and cumulative environmental impacts on DACs. Applicants should discuss any anticipated negative or positive environmental impacts associated with the project, and how they will mitigate any negative impacts. Within the context of cumulative impacts created by the project, applicants should use Environmental Protection Agency's EJSCREEN

tool to quantitatively discuss existing environmental impacts in the project area. See EJScreen: Environmental Justice Screening and Mapping Tool.

4. **Workforce:**

   Articulate the applicant's consideration of long-term workforce impacts and opportunities of the project. Identify how the project is designed and executed to include an understanding of the future workforce needs if it is successful. See Appendix B for more guidance.

SUMMARY SLIDE

The summary slide is a separate file which should be included in the application. It must not exceed one PowerPoint slide and it must be suitable for dissemination to the public. This slide 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 summary slide requires the following information:

- Project title, prime recipient, PI, and key participant information.
- A project summary.
- A description of the project's impact.
- Proposed project goals.
- Any key graphics (illustrations, charts, and/or tables).
- The project's key idea/takeaway with respect to TCF goals (commercialization).
- Requested TCF funds, proposed applicant cost-share (if applicable), and total project budget.

iv. Proprietary Information

Applicants should not include trade secrets or commercial or financial information that is privileged or confidential in their proposals, 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 (preceding the title page), 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 C.F.R. §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 DOE 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.
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.

B. Application Review and Selection

i. Concept Paper Merit Review

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

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

This criterion involves consideration of the following factors:

- The applicant clearly describes the project in enough detail that it may be evaluated for its innovation, impact, and relevance to the topic objectives.
- The applicant clearly describes relevant background information that helps demonstrate the need for this project, including the problem statement or major challenges and barriers being overcome through the project and the approach to solving the problem.
- The applicant has shown the impact that DOE TCF funding and the proposed project would have on the relevant field and application.
- The applicant clearly identifies the topic(s), subtopic(s), and AOI (if applicable) they are applying for and how they meet the required elements of the topic(s).
- The applicant has the qualifications, experience, capabilities, and other resources necessary to complete the proposed project.
- The proposed work, if successfully accomplished, would clearly meet the objectives as stated in the lab call.

ii. Full Application Merit Review and Selection Process

Selection of winning proposals will be determined based on available funding and input from DOE and external reviewers. In general, DOE 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.

Please note the weighting of the criteria below. The categories and relative ranking criteria used to evaluate full applications are as follows:

Criterion 1: Innovation and Impact (40%)

This criterion involves consideration of the following factors:

- How innovative and impactful is the project, assuming the stated outcomes can be achieved as written?

- Innovative—Extent to which the proposed project or solution is innovative. Degree to which the proposed project integrates market pull into its thinking and program design, forming a conduit of market insight and awareness.
- Impactful—Extent to which the proposed project or solution, if successful, impacts the core goals outlined in the lab call and/or the root causes (inside and outside of the Labs) of the existing commercialization challenges and barriers. Also includes the impact of forging collaborations on the challenges being addressed (e.g., multi-Lab and industry-leveraged effort), as well as the impact of collaboration on other interested and impacted stakeholders (e.g., through collaboration with stakeholders outside the National Labs). For Topics 1, 2, 3, 5, and 6, multi-Lab collaboration will be scored as inherently more impactful than single-Lab projects.
- Accelerates Speed of Commercialization—Degree to which the proposal has the potential to accelerate the speed of commercialization. Degree to which the proposal supports achieving the statutory requirement of the TCF to "promote promising energy technologies for commercial purposes."
- Long-Term Viability—Degree to which the proposal has the potential to continue to be impactful without long-term, continued, direct funding from DOE. Extent to which multi-year strategic partnerships are proposed or will be developed to continue the program beyond initial funding. Level of proposed cost-share for the project will be taken into consideration.
- Differentiated—Extent of differentiation with respect to existing commercialization programs or efforts. Potential to enhance commercialization activities at the National Laboratories.
- Scalable—Likelihood that the proposed solution, if successful, could be scaled to have a broader impact. Likelihood that the project could be scaled beyond the proposed multi-lab collaboration and to all Labs, even those not directly participating in the proposed project.
- Commercialization Outcomes—Likelihood of the proposed solution achieving the proposed commercialization outcome metrics. Likelihood of the proposed team tracking and reporting on the commercialization outcome metrics.
- Cost-Share Commitment–Extent to which partners' interest and level of involvement is reflected in appropriate levels of proposed cost-share for the project will be taken into consideration.

- Evidence of Commercial Potential–Degree to which Topic 4 proposal demonstrates both technology progress and market pull or interest. Extent to which the proposed technology will result in a commercially successful product and/or company. Extent to which the proposed technology can be successfully commercialized in a reasonable timeframe. Project starting and ending ARL will be considered.

Criterion 2: Quality and Likelihood of Completion of Stated Goals (30%)
This criterion involves consideration of the following factors:

- Are the stated goals of the project SMART, and are they likely to be accomplished within the scope of this project? Is there a likelihood of success for the proposed project?
  - Measurable—Degree to which the proposal is structured to produce a measurable result/impact. Extent to which the applicant shows a clear understanding of the importance of SMART, verifiable milestones and proposes milestones that demonstrate clear progress, are aggressive but achievable, and are quantitative.
  - Risks mitigated—Extent to which the applicant understands and discusses the risks, core barriers, and challenges the proposed work will face, and the soundness of the strategies and methods that will be used to mitigate risks. Degree to which the proposal adequately describes how the team will manage and mitigate risks.
  - Validated—Degree to which the proposed project fits within and builds on the National Laboratory ecosystem. Level of validation (letters of support/interest, partners, customer trials, data from prior work, report references, etc.).
  - Reasonable assumptions—Reasonableness of the assumptions used to form the execution strategy (e.g., Lab staff participation, costs, throughput at full scale, speed of proposed scale-up or adoption, and mode of long-term funding).
  - Reasonable budget—The reasonableness of the overall funding requested to achieve the proposed project and objectives. The reasonableness and clarity of the budget and scope options. Level of proposed cost-share for the project will be taken into consideration.

Criterion 3: Collaboration and Capability of the Applicant and Holistic Project Team (15%)
This criterion involves consideration of the following factors:

- Is the team well-qualified and positioned to successfully complete this project?
    - Collaboration—Extent to which there are multiple Labs engaged on the proposed project (this is particularly important for Topic 1, 2, 3, 5, and 6 applications). Degree to which the proposed project branches out, connects, and builds on the innovation ecosystem across the country. Extent to which connections and alliances are forged to harness the power of regional economies; state/local organizations; and other federal, state, or local agencies.
    - Capable—Extent to which the training, capabilities, and experience of the assembled team will result in the successful completion of the proposed project. Extent to which this team (including proposed subrecipients) will be able to achieve the final results on time and to specification.
    - Participation—The level of participation by project participants, as evidenced by letter(s) of commitment demonstrating cost-share and how well they are integrated into the work plan. Degree to which multi-lab, internal National Lab, and external collaboration is proposed.
    - Team Quality—Extent to which the final team required to complete this project is fully assembled and committed to the project (e.g., Are there any key members that are "to be hired" in the future?). Level of proposed cost-share for the project will be taken into consideration.
    - Past Performance—Extent to which the assembled team has shown success in the past. (Note: new performers will not be penalized.) DOE encourages new entrants and new ideas, but past successes and/or failures will be noted.
    - Access—Extent to which the team has access to facilities, equipment, people, expertise, data, knowledge, and any other resources required to complete the proposed project.

Criterion 4: Community Benefits Plan (15%)

This criterion involves consideration of the following factors:

- Community and Labor Engagement
    - Extent to which the applicant demonstrates community and labor engagement to date that results in support for the proposed project.
    - Extent to which the applicant has a clear and appropriately robust plan to engage—ideally through a clear commitment to negotiate enforceable Workforce & Community Agreements—with labor unions, Tribal entities, and

community-based organizations that support or work with DACs and other affected stakeholders.

- Extent to which the applicant has considered accountability to affected workers and community stakeholders, including those most vulnerable to project activities, with a plan to publicly share SMART CBP commitments.
- Extent to which the applicant demonstrates that community and labor engagement will lead to the delivery of high-quality jobs, minimal environmental impact, and allocation of project benefits to DACs.

- Diversity, Equity, Inclusion, and Accessibility
  - Clear articulation of the project's goals related to DEIA.
  - Quality of the project's DEIA goals, as measured by the goals' depth, breadth, likelihood of success, inclusion of appropriate and relevant SMART milestones, and overall project integration.
  - Degree of project team commitment and ability to track progress toward meeting each of the DEIA goals.
  - Extent of engagement of organizations that represent DACs as a core element of their mission, including Minority Serving Institutions (MSIs), Minority Business Entities (MBEs), Disadvantaged Business Entities[32](DBEs), and nonprofit or community-based organizations.
- Justice40 Priorities
  - Extent to which the CBP identifies specific, measurable benefits for DACs, how the benefits will flow to DACs, and how negative environmental impacts affecting DACs would be mitigated.
  - Extent to which the project would contribute to meeting the goals of the eight Justice40 priorities: decrease energy burden in DACs; decrease environmental exposure and burdens for DACs; increase parity in clean energy technology (e.g., solar, storage) access and adoption in DACs; increase access to low-cost capital in DACs; increase clean energy enterprise creation and contracting (MBE/DBE) in DACs; increase clean energy jobs, job pipeline, and job training for individuals from DACs; increase energy resiliency in DACs; and increase energy democracy in DACs.
- Workforce Implications

[32] Small Disadvantaged Business | U.S. Small Business Administration (sba.gov)

- Clear and comprehensive workplan tasks, staffing, research, and timeline for engaging workforce stakeholders and/or evaluating the possible near- and long-term implications of the project for the U.S. workforce.
- Approach to document the knowledge, skills, and abilities of the workforce required for successful commercial deployment resulting from this project.
- Likelihood that the plan will result in improved understanding of the workforce implications related to the project output if successful.

iii. Selection for Award Negotiation

DOE carefully considers all information obtained through the selection process. DOE may select or not select a proposal for negotiations. DOE may also postpone a final selection determination on one or more proposals until a later date, subject to availability of funds and other factors. OTT will notify applicants if they are, or are not, selected for award negotiation.

Type of Award Instrument: TCF awards will be documented and funded through OTT's work authorization and funds management processes within the Program Information Collection System (PICS). DOE facilities will be required to track federal funds in accordance with normal departmental processes. DOE facilities will also be required to track nonfederal funds in accordance with established DOE facility accounting processes.

DOE will direct transfer funding to the prime and partner Labs; Lab-to-Lab transfers should not be needed. All partnerships between the Labs and outside partners must comply with individual Lab requirements under their M&O contracts.

iv. Selection Notification

DOE anticipates completing the selection and negotiation process by Q4 FY24 (subject to change). DOE will notify the prime National Lab TTO and PI electronically of selection results. All of DOE's decisions are final when communicated to applicants.

C. Project Administration and Reporting

Projects selected for award are managed by the DOE facilities in accordance with their requisite policies and procedures. OTT and participating DOE program offices will provide all required project oversight and engagement with TCF project recipients.

TCF project recipients will be required to report to PICS quarterly, at a minimum. DOE reserves the right to require more frequent reporting if necessary, depending on the project. Recipients will be required to submit a quarterly progress report and update

project spend in PICS. If multiple labs are participating in a project, then the prime lab will be responsible for all PICS reporting.

TCF project recipients will be required to meet quarterly with OTT and supporting DOE program offices to discuss project progress in addition to providing quarterly progress reporting, annual metrics reporting for a 5-year period starting at time of award, and a final report at the end of the project.

D. Questions and National Lab TTO Contacts

Specific questions about this lab call should be submitted via e-mail to TCF@hq.doe.gov. To ensure fairness across all National Labs, individual DOE staff cannot answer questions while the lab call remains open. OTT will post all questions and answers on Exchange.

Because only National Laboratory TTO staff are eligible to apply and are responsible for coordinating inter-Lab, across Labs, and with external partners, a list of lab TTO points of contact are provided in Appendix C.

E. Additional Information on Exchange

Exchange is designed to enforce the deadlines specified in this lab call. The "Apply" and "Submit" buttons will automatically disable at the defined submission deadlines. Should applicants experience problems with Exchange, the following information may be helpful to applicants that experience issues with submission *prior* to the deadline:

If an applicant experiences technical difficulties with a submission, the applicant should contact the EERE Exchange helpdesk for assistance (EEREExchangeSupport@hq.doe.gov). The EERE Exchange helpdesk and/or the EERE Exchange system administrators will assist applicants in resolving issues.

Appendix A: TCF Cost-Share and Nonfederal Cost-Share Information

This lab call is subject to Section 988 of the Energy Policy Act of 2005 regarding cost-share. DOE prefers all funded projects to meet this 50% of the total project cost-share fund requirement; however, DOE acknowledges that some potentially high-impact proposed projects may not be able to meet this requirement. In this case and following the requirements by topic below, Labs may still apply with less than 50% nonfederal cost-share so that DOE can see the full universe of high-quality proposals. The scoring criteria reflect that higher levels of cost-share mitigate the risk of commercializing earlier stage technologies.

DOE has approved a Cost-Share Waiver for topics 1.b, 2.b, 3.b, 4.b, 4.c, 5.b, and 6.b of this lab call (full topic descriptions above). This was done to ensure all project ideas can apply and the most impactful mix of projects can be selected.

Each proposal that applies to a subtopic (a) commits to meet the minimum 50% of total project cost-share funds requirement.

Each proposal that applies to subtopics 1.b, 2.b, 3.b, 5.b, and 6.b may propose to meet less than the 50% of total project cost-share funds requirement.

Proposals that apply to subtopic 4.b must cost-share 20% of total project cost. Proposals that apply to subtopic 4.c must cost-share 10% of total project cost. Further details on the criteria for subtopics 4.b and 4.c are listed in the Topic 4 description (see Section I.D.iv.).

DOE will evaluate the level of external industry engagement and collaboration as evidence by cost-share to ensure maximum impact of the selected projects. The selection official may determine that a subtopic (b) proposal would be selected except that the proposal does not provide adequate cost-share given the commercial nature of the project activities. In such cases, applicants would be provided the opportunity to increase their cost-share to the default level, and project selection would be contingent on the Lab(s) committing to 50% cost-share for the project. If the Lab(s) decline, DOE may not fund the project. This does not apply to subtopics 4.b and 4.c.

In addition, the selection official may establish a negotiation strategy that involves increasing cost-share for subtopic (b) applicants that lack adequate cost-share given the commercial nature of the project activities. Applicants would be provided the opportunity to increase their cost-share, and successful project negotiations could be contingent on the Lab(s) committing to an increased cost-share for the project. Labs will have the opportunity to accept or decline an adjustment in cost-share. If the Lab(s) decline, DOE may not fund the project. This does not apply to subtopics 4.b and 4.c.

For all topics, the nonfederal cost-share at the end of the award must be at least the established percentage agreed upon at the time of award. When there is more than one budget period, DOE requires that the nonfederal cost-share minimum required percentage is met by the end of the budget periods preceding the last budget period. The final cost-share requirements for each proposed project will be set at the time of selection and will not be changed during the life of the award. Cost-share requirements will be established on a budget-period-by-budget-period basis during project negotiations and prior to final project award.

Cost-share funds are subject to audit by the Department or other authorized government entities (e.g., General Accounting Office). 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 cost-share funds. Consult your DOE Facility legal staff for advice about how to obligate the third party to provide the cost-share funds, and to ensure the cost-share 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 the required cost-share from nonfederal sources (e.g., from partners or other collaborators) established at the time of award.

Subcontracting support services to a partner is allowable so long that cost-share requirements are met. If a cost-share partner is also the subcontractor, then the work being subcontracted will be evaluated during the application review to determine if the described subcontracted activities are sufficiently distinct from the activities supported by cost-share.

OTT has no policy regarding foreign expenditures. All relevant laws, DOE directives, and contractual obligations apply. Consult your DOE facility's legal staff for advice about foreign partners and agreements with the DOE facility.

Applicants must make sure their prospective partnership arrangements comply with individual Lab requirements under their management and operating (M&O) contracts.

WHAT QUALIFIES FOR NONFEDERAL COST-SHARE

Please consult the Federal Acquisition Regulations for the applicable cost-sharing requirements. In addition to the regulations referenced above, other factors may also come into play, such as timing of in-kind contributions and length of the project period. For example, the value of 10 years of donated maintenance on a project that has a project period of 5 years would not be fully allowable. Only the value for the 5 years of donated maintenance that corresponds to the project period is allowable and may be counted.

Additionally, DOE will not allow pre-award costs.

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 nonfederal 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 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 nonfederal cost-share funds, that full value must be the lesser of 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 the 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 nonfederal cost-share 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 in-kind contributions by third parties.

    a) Donated supplies may include such items as office supplies or laboratory supplies. Value assessed to donated supplies included in the nonfederal 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 B: Community Benefits Plan Guidance

DOE is committed to pushing the frontiers of science and engineering; catalyzing high-quality domestic clean energy jobs through research, development, demonstration, and deployment; and ensuring energy equity and energy justice[33] for disadvantaged communities. Therefore, and in accordance with the Administration's priority to empower workers and harness opportunities to create good union jobs as stated in EO 14008 (Executive Order on Tackling the Climate Crisis at Home and Abroad),[34] it is important to consider the impacts of the successful commercial deployment of any innovations resulting from this lab call on the current and future workforce.

The goal of the CBP is to allow the application to illustrate engagement in critical thought about implications of how the proposed work will benefit the American people and lead to broadly shared prosperity, including for workers and disadvantaged communities.[35] The four sections of the CBP are considered together because there may be significant overlap among audiences considered in workforce and disadvantaged communities.

For additional support with developing a CBP, please refer to the DOE's Community Benefits Plan webpage (https://www.energy.gov/infrastructure/about-community-benefits-plans). This new resource, though created primarily for BIL-funded demonstration and deployment projects, may be useful for TCF Base projects.

Example Community and Labor Engagement, DEIA, Justice40, and Workforce Plan Elements

Outlined below are examples of activities that applicants might consider when developing their CBP and further information about the four sections of the CBP. Applicants are not required to implement any of these specific examples and should propose activities that best fit their project goals, institutional environment, team composition, and other factors. Creativity is

---

[33] DOE defines energy justice as "the goal of achieving equity in both the social and economic participation in the energy system, while also remediating social, economic, and health burdens on those disproportionately harmed by the energy system" (Initiative for Energy Justice, 2019). Aligned with that definition, the remainder of this document refers to "energy equity" to encompass energy justice and DOE's efforts related to Justice40. https://www.energy.gov/diversity/articles/how-energy-justice-presidential-initiatives-and- executive-orders-shape-equity

[34] https://www.federalregister.gov/documents/2021/02/01/2021-02177/tackling-the-climate-crisis-at-home-and-abroad

[35] Pursuant to E.O. 14008, "Tackling the Climate Crisis at Home and Abroad," January 27, 2021, and the Office of Management and Budget's Interim Justice40 Implementation Guidance M-21-28, DOE recognizes DACs as defined and identified by the White House Council of Environmental Quality's Climate and Economic Justice Screening Tool (CEJST), located at https://screeningtool.geoplatform.gov/. DOE's Justice40 Implementation Guidance is located at https://www.energy.gov/sites/default/files/2022-07/Final%20DOE%20Justice40%20General%20Guidance%20072522.pdf.

encouraged.

Community and Labor Engagement

Registered apprenticeship programs, labor-management training partnerships, quality pre-apprenticeship programs, a card check provision, and local and targeted hiring goals are all examples of provisions that Workforce and Community Agreements could cover that would increase the success of a DOE-funded project.

Applicants could also provide Community and Labor Partnership Documentation from representative organizations reflecting substantive engagement and feedback on the applicant's approach to community benefits and the other objectives in this section (i.e., DEIA, Justice40 priorities, and workforce investment).

Diversity, Equity, Inclusion, and Accessibility

DOE strongly encourages applicants to involve individuals and entities from DACs. Tapping all the available talent requires intentional approaches and yields broad benefits.

Equity extends beyond diversity to equitable treatment. Equitable access to opportunity for members of the project team is paramount. This includes ensuring all members of the team, including students, are paid a living wage, provided appropriate working conditions, and provided appropriate benefits. In the execution of their project plan, applicants are asked to describe efforts in diversity, equity, inclusion, and accessibility. In this context, efforts toward DEIA are defined as:[36]

1) The practice of including the many communities, identities, races, ethnicities, backgrounds, abilities, cultures, and beliefs of the American people;
2) The consistent and systematic fair, just, and impartial treatment of all individuals, including protecting workers' rights and adhering to Equal Employment Opportunity laws;
3) The recognition, appreciation, and use of the talents and skills of employees of all backgrounds; and
4) The provision of accommodations so that all people, including people with disabilities, can fully and independently access facilities, information and communication technology, programs, and services.

Successful plans will not only describe how the project team seeks to increase DEIA but also will describe the overall approaches to retention, engagement, professional development, and career advancement. Specifically, they will demonstrate clear approaches to ensure all team

[36] https://www.whitehouse.gov/wp-content/uploads/2021/11/Strategic-Plan-to-Advance-Diversity-Equity- Inclusion-and-Accessibility-in-the-Federal-Workforce-11.23.21.pdf

members' strengths are meaningfully leveraged, and all members are provided opportunities and paths for career development, especially including paths for interns and trainees to secure permanent positions. Diversity should be considered at all levels of the project team, not just leveraging early career individuals to meet diversity goals.

DOE strongly encourages applicants to consider partnerships to promote DEIA, justice, and workforce participation. Minority Serving Institutions, Minority Business Enterprises, minority-owned businesses, disability-owned businesses, women-owned businesses, Native American-owned businesses, and/or veteran-owned businesses are encouraged to participate on an application as a proposed partner to the prime (National Laboratory) applicant.

When crafting the DEIA section of the CBP, applicants should describe how they will act to promote each of the four DEIA efforts above into their investigation. It is important to note that diversity, equity, inclusion, and accessibility are four different but related concepts that should not be conflated. For instance, you can achieve diversity without equity; all four should be addressed. Applicants could discuss how the proposed investigation could contribute to training and developing a diverse scientific workforce. Applicants could describe the efforts they plan to take, or will continue to take, to create an inclusive workplace, free from retaliation, harassment, and discrimination. Applicants could outline any barriers to creating an equitable and inclusive workplace and address the ways in which the team will work to overcome these barriers within the bounds of the specific project. The CBP could detail specific efforts to inform project team members in any capacity of their labor rights and rights under Equal Employment Opportunity laws and their free and fair chance to join a union.

Equal treatment of workers, including students, is necessary, but overcoming institutional bias requires intentionally reducing sometimes hidden barriers to equal opportunity. Applicants could consider measures like childcare, flexible schedules, paid parental leave, pay transparency, and other supports to ensure that societal barriers do not hinder realization of DEIA intentions. Some of these considerations may result in common approaches in different sections of the CBP, and that is acceptable as long as the submission is not a singular approach to all sections.

Specific examples include:

- Building collaborations and partnerships with researchers and staff at MSIs.
- Addressing barriers identified in climate surveys to remove inequities.
- Providing anti-bias training and education in the project design and implementation teams.
- Offering training, mentorship, education, and other support to students and early/mid-career professionals from DACs.
- Providing efforts toward improving a workplace culture of inclusion.
- Developing technology and technology integration innovations to meet the needs of DACs.

- Creating partnerships with local communities, especially under-resourced and DACs.
- Voluntary recognition of a union and informing employees of their rights, regardless of their classification.
- Making research products and engagement materials accessible in a greater variety of formats to increase accessibility of research outputs.
- Implementing training or distributing materials to reduce stigma towards individuals with disabilities.
- Designing technologies that strategically fit within the existing workforce for installation and maintenance of the potential innovation.

Justice40 Priorities

Justice40 includes investments in clean energy and energy efficiency; clean transit; affordable and sustainable housing; training and workforce development; the remediation and reduction of legacy pollution; and the development of clean water infrastructure – to flow to DACs.

The Justice40 section of the CBP should explain the Justice40 benefits associated with the project or project outcome. There are eight policy priorities for the Justice40 Initiative:

1. Decrease energy burden in DACs.
2. Decrease environmental exposure and burdens for DACs.
3. Increase parity in clean energy technology (e.g., solar, storage) access and adoption in DACs.
4. Increase access to low-cost capital in DACs.
5. Increase clean energy enterprise creation and contracting (MBE/DBE) in DACs.
6. Increase clean energy jobs, job pipeline, and job training for individuals from DACs.
7. Increase energy resiliency in DACs.
8. Increase energy democracy in DACs.

Workforce Investment

The Workforce section of the CBP should articulate the future workforce implications of the project outcome(s) or a milestone-driven plan for understanding those implications. This includes documenting the skills, knowledge, and abilities that would be required of workers installing, maintaining, and operating the technology that may be derivative of the project, as well as the training pathways and its accessibility for workers to acquire the necessary skills. There may be field-specific or relevant existing work that could be cited in this section. In addition, applicants could detail the process they will use to evaluate long-term impacts on jobs, including job growth or job loss, a change in job quality, disruptions to existing industry and resulting changes to relationships between employers and employees and improvements or reductions in the ability of workers to organize for collective representation, and anything else that could result in changes to regional or national labor markets.

Applicants will find section 2 of the DOE CBP FAQ[37] ("Investing in America's Workforce") particularly helpful for understanding key federal policies, terms, and concepts, as well as workforce development strategies relevant to examination of the workforce implications of applicants' proposed project.

Specific examples include:

- Outlining the challenges and opportunities for commercializing the technology in the United States.
- Creating a literature review of the workforce implications of the outcomes of the specific technology if the project is successful, or a plan with dedicated budget and expertise (staffing or subawardee) to evaluate the potential equity implications of successful project outcomes.
- Creating a plan and milestones for assessing how a successful project will have implications for job savings or loss, either at the macroeconomic level or within specific industries.
- Describing how the project will support workforce training to address needs for successful deployment.
- Voluntary recognition of a union and informing employees of their rights, regardless of its classification.
- Creating a plan to evaluate how a successful commercialization of the technology will result in potential workforce shifts between industries or geographies.

Inclusion of SMART milestones

The applicant's CBP must include one SMART milestone for each budget period. An exemplary SMART milestone clearly answers the following questions:

- What needs to be accomplished?
- What measures and deliverables will be used to track progress toward accomplishment?
- What evidence suggests that the accomplishment is achievable?
- Why choose this milestone?
- When will the milestone be reached?

[37] https://www.energy.gov/bil/community-benefits-plan-frequently-asked- questions-faqs

Appendix C: TCF Base Points of Contact at DOE National Lab TTOs

Facility	TCF Points of Contact
The Ames Laboratory	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
Brookhaven National Laboratory	Poornima Upadhya pupadhya@bnl.gov 631-344-4711 Erick Hunt ehunt@bnl.gov 631-344-2103 Ivar Strand istrand@bnl.gov 631-344-7579
Fermi National Accelerator Laboratory	Cherri J. Schmidt cherri@fnal.gov 630-840-5178 William A Pellico pellico@fnal.gov 630-840-8368
Idaho National Laboratory	Lisa Aldrich lisa.aldrich@inl.gov 208-569-0405 James Keating James.Keating@inl.gov 208-526-1455
Kansas City National Security Campus	Andrew Myers amyers@kcnsc.doe.gov 816-488-4432

Lawrence Berkeley National Laboratory	Shanshan Li shanshanli@lbl.gov 510-486-5366 Todd Pray tpray@lbl.gov 510-486-6053 Gail Chen gailchen@lbl.gov Jasbir (Jesse) Kindra jkindra@lbl.gov
Lawrence Livermore National Laboratory	Elsie Quaite-Randall quaiterandal1@llnl.gov 925-423-5210 Chris Hartman hartmann6@llnl.gov
Los Alamos National Laboratory	MaryAnn D. Morgan mary_ann@lanl.gov 505-667-5324 Andrea Maestas andream@lanl.gov 505-667-1230 Jerome Garcia jgarcia@lanl.gov 505-665-9090
National Energy Technology Laboratory	Steve Richardson Steven.Richardson@netl.doe.gov proposal-coordination@netl.doe.gov 304-285-4185
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	Matthew Pasulka pasulkmp@nv.doe.gov 702-295-2963 Matthew Fritz fritzmf@nv.doe.gov 702-295-1705
Oak Ridge National Laboratory	Michael J. Paulus paulusmj@ornl.gov 865-574-1051 Eugene Cochran cochraner@ornl.gov 865-576-2830 Jennifer Caldwell caldwelljt@ornl.gov 865-574-4180
Pacific Northwest National Laboratory	Christina Lomasney christina.lomasney@pnnl.gov 206-850-4987 Allan C. Tuan allan.tuan@pnnl.gov 509-375-6866
Pantex Plant	Caleb Heltenberg caleb.heltenberg@pxy12.doe.gov
Princeton Plasma Physics Laboratory	Laurie Bagley lbagley@pppl.gov 609-243-2425
Sandia National Laboratories	Mary Monson mamonso@sandia.gov 505-844-3289 Monica Martinez monmart@sandia.gov Lily Shain lshain@sandia.gov
Savannah River National Laboratory	Byron Sohovich

	Byron.sohovich@srnl.doe.gov Daren Timmons daren.timmons@srnl.doe.gov
SLAC National Accelerator Laboratory	Despina Milathianaki despina@slac.stanford.edu Jose Zavala jzavala@slac.stanford.edu
Thomas Jefferson National Accelerator Facility	Deborah Dowd dowd@jlab.org 757-269-7180 Marla Schuchman marla@jlab.org David Perkins dperkins@jlab.org
Y-12 National Security Complex	Daniel Riddick daniel.riddick@pxy12.doe.gov Grant Allard grant.allard@pxy12.doe.gov

Appendix D: Required Cover Page Table (Template)

Control Number	
Project Title	
Prime Lab	
Partner Lab(s)	
Sub-Topic (e.g., 1a, 4a, 4c, 6b, etc.)	
AOI Number (e.g., 3.1, 4.01, etc.) (only applicable for Topics 3 and 4)	
ARL Start and End (only required for Topic 4)	
TRL Start and End (only required for Topic 4)	
Principal Investigator(s) Name(s)	
PI Email(s)	
Cost-Share Partner(s)	
Cost-Share Type (cash, in-kind, both, none)	
Period of Performance	
Requested DOE Funding Amount	
Cost Share Amount	
Total Project Budget	