



U.S. DEPARTMENT OF
ENERGY

Technology Transfer Execution Plan Fiscal Years 2021 to 2025

Report to Congress
July 2024

United States Department of Energy
Washington, DC 20585

Message from the Chief Commercialization Officer and Director of the Office of Technology Transitions

Since I began work as OTT's fourth appointed Director and DOE's second Chief Commercialization Officer in January 2021, much has changed. The passage of the Bipartisan Infrastructure Law (BIL), Inflation Reduction Act (IRA), and CHIPS and Science Act (CHIPS) marks a watershed moment for DOE's commercialization mission and OTT's role within that broader mission. Since its inception, DOE has largely been funded to conduct basic and applied research, national security missions, as well as support technology-push pathways. This new trifecta of laws harkens to Robert Frost's poem, *The Road Not Taken*, since it propels our agency to transform its commercialization approach.

The launch of the historic BIL/IRA/CHIPS missions together represent roughly a half-trillion additional dollars to transform our energy economy. However, transformation requires activating the \$23 trillion investments in the private sector. This new portfolio of programs funded through this landmark legislation extended our mission to functionally span the full research, development, demonstration, and deployment (RDD&D) continuum. As the primary facilitator of commercialization for DOE, OTT embraced this as an opportunity to complement our technology-push mindset with new market-pull thinking. To guide the agency, including our DOE National Laboratories, plants, and sites (herein "DOE Laboratories"), on this less traveled commercialization path requires close partnership with the private sector and an extension of DOE's mindset to connect technologies more effectively to markets.

By design, we are a leverage office, in which our core function is to empower and activate others, both funders and practitioners, to launch technologies more effectively into the real world. OTT's annual appropriation as a portion of the DOE's total non-defense budget is measured in fractions of a percentage point (~0.1 percent in fiscal year [FY] 2023). We have built a top-notch team and an innovative commercialization programs portfolio (see Goal 1 in this report). For instance, we have created a suite of commercialization tools and capabilities that are highly valued within DOE and beyond, such as our portfolio of programs under the Technology Commercialization Fund (TCF). We have also launched an innovative combined prize authority and financial assistance approach for the Energy Program for Innovation Clusters (EPIC) program, which supports incubator networks across the Nation. We are effective at catalyzing ecosystems that include all of DOE, DOE Laboratories, the interagency, and the private sector; and by any measure, the return on our program investments is high.

Examples of this include the Commercial Adoption Readiness Level (ARL) framework and Pathways to Commercial Liftoff series of reports (see Goal 2 in TTEP)—both serving internal and external customers to better characterize and create a common fact base for the decision landscape that drives capital allocation decisions. These tools build on and complement DOE's existing and extensive suite of available tools and resources (e.g., Technology Readiness Levels) that provide insight into relative technology maturity and define technology development

roadmaps. OTT's focus is to ensure that market-pull thinking is part of any discussion around how to best progress promising technologies along the RDD&D continuum.

OTT's origin story is deeply rooted in catalyzing DOE Laboratory technology transfer, and this remains core to our program and policy mission. OTT is well-positioned to understand challenges and help reduce barriers to commercialization in coordination with other relevant DOE offices through various approaches, including convening key technology transfer stakeholders, collecting, and analyzing DOE Laboratory technology transfer metrics, and contributing to DOE commercialization policy (see Goal 3). OTT is also leading the Department's efforts to identify, assess, and conditional upon availability of funding, test new approaches and mechanisms to make it easier for America's almost infinite pool of talented students, entrepreneurs, and technologists to do business with DOE. Ongoing efforts include establishing a DOE-related Foundation for Energy Security and Innovation and piloting the DOE's first Partnership Intermediary Agreement (PIA) (see Goal 3).

It is important to walk our own talk, and OTT does this by maintaining an active portfolio of direct partnership development. Federal agencies like the DOE can be difficult to navigate; however, public-private partnerships are critical to launch entirely new technology sectors, since these sectors must be private sector led but government enabled. In addition to the marquis funding, our DOE Laboratories offer a unique, world-class portfolio of technologies, expertise, and facilities that can help mature technologies developed in-house or validate and advance technology developed externally. Our Lab Partnering Service, in service since FY 2019, provides a one-stop access point to this trio of DOE Laboratory assets and describes numerous stories of commercialization successes enabled through DOE investments.

Telling these success stories is also a central responsibility of the office and one we have made great progress on over the last year, in particular. Our website also now features "Innovation Powered by DOE" an interactive dashboard of over 450 amazing DOE laboratory success stories that directly resulted from DOE investments as well as successful projects OTT has funded, ranging from job placements for new tech transfer professionals that have participated in OTT's career development programs to successful first demonstrations of technologies we have nurtured through our Lab and student entrepreneurship programs (see Goal 4).

We strive to fulfill Executive Order 14035, the President's diversity, equity, inclusion, accessibility, and sustainability objectives, both in the communities we serve with our programming and in the composition of our growing OTT team. Today's OTT includes an amazing collection of professionals with varied backgrounds, perspectives, and specialized skillsets to ensure OTT remains nimble and capable of meeting the fast-evolving needs of DOE's commercialization mission.

We also recognize the need to balance facilitating commercialization with ensuring that national and economic security are appropriately considered when translating potentially sensitive and strategic technology to the marketplace. These may seem to be dueling missions, but OTT is working closely with DOE and interagency colleagues to ensure that we chart a path

that enables a growth of commercialization opportunities and outcomes while remaining vigilant about keeping DOE-funded intellectual property out of the wrong hands.

Underpinning all our efforts in OTT is a commitment to remain vibrant by building out a robust strategy for developing evidence-building capacity and ensuring evidence is informing decision-making. This involves instilling a continuous improvement culture for the office that allows us to benefit from our experiences, understand what works well and why, as well as continually innovating to enhance our mission delivery.

Commercialization is a full contact sport—messy in its conception, with many pitfalls along the way, but beautiful when successfully executed. To increase the chances of success, DOE needs the right tools, the right catalyzing programs, and a willingness to pivot and pilot new ways of doing business. This TTEP provides a strategic roadmap and implementation plan for OTT to do just that. To return to and answer the central question in Frost’s timeless poem, OTT has no regrets about its chosen path and is excited to continue blazing a trail for DOE-wide commercialization impact.

Sincerely,



Vanessa Chan
Chief Commercialization Officer
Director, Office of Technology Transitions

Executive Summary

The U.S. Department of Energy plays a key role in moving innovative technologies developed by the National Laboratories, plants, and sites (herein “DOE Laboratories”) and the extramural research community into the commercial marketplace. It is imperative that DOE’s technology transfer and commercialization activities help maximize the returns on the taxpayer’s investments. This goal is further underscored by the unprecedented investments to commercialize clean energy technologies by advancement across the research, development, demonstration, and deployment continuum provided through the Bipartisan Infrastructure Law and the Inflation Reduction Act. In support of these goals, the *Technology Transfer Execution Plan* for fiscal years (FY) 2021 to 2025 outlines a strategic framework to support Department-wide coordination of technology transfer and commercialization activities.

Introduction

This report is intended to meet statutory requirements to describe the progress and implementation of select technology transfer and commercialization activities at DOE from FY 2019 through FY 2023 as described under the Energy Policy Act of 2005 and the Energy Act of 2020, many of which are activities managed under DOE’s Office of Technology Transitions, as well as articulate a strategy and plan of action through FY 2025.¹ This TTEP report primarily focuses on describing implementation updates from FY 2021 through FY 2023, while providing a summary of relevant programs and activities for FY 2019 to FY 2020 in Appendix C.

The Secretary of Energy established OTT in 2015 to develop and oversee delivery of DOE’s strategic vision and goals for technology transfer and commercialization and engagement with business and industrial sectors across the Nation. Congress further codified OTT’s mission in 2020 to expand the commercial impact of the research investments of the Department; and to focus on commercializing technologies that support the missions of the Department. OTT’s director is DOE’s Chief Commercialization Officer, with the charge to drive private sector uptake of clean energy technologies as the steward of commercialization activities across DOE. The TTEP provides an overview of the evolution in OTT as an organization and its programmatic offerings since its inception.

DOE intends that the TTEP—which mainly covers a five-year timeframe from FY 2021 to FY 2025—also meets the requirements under the explanatory statement to the Consolidated Appropriations Act of 2023 to provide a five-year roadmap for achieving OTT’s mission. As such, the focus of this annual TTEP is on OTT’s mission and goals. This TTEP is not intended to be comprehensive of the vital contributions from technology transfer and commercialization activities managed under other DOE program offices and DOE Laboratories. Future annual updates to the TTEP will continue our collaborative process that engages stakeholders

¹ DOE’s *Technology Transfer Execution Plan for FY2016 to FY2018* met statutory requirements for annual implementation updates through from FY 2016 to FY 2018.

supporting technology transfer and commercialization goals across DOE and the DOE Laboratories to describe progress and implementation of broader DOE-wide activities related to the strategic framework.

Strategic Framework

The TTEP strategic framework defines four goals and outlines 10 objectives, key activities, and an outlook through FY 2025 under each goal. Three cross-cutting approaches support achieving each goal and address important emerging and evolving topics influencing DOE’s technology transfer and commercialization landscape (Figure ES-1).

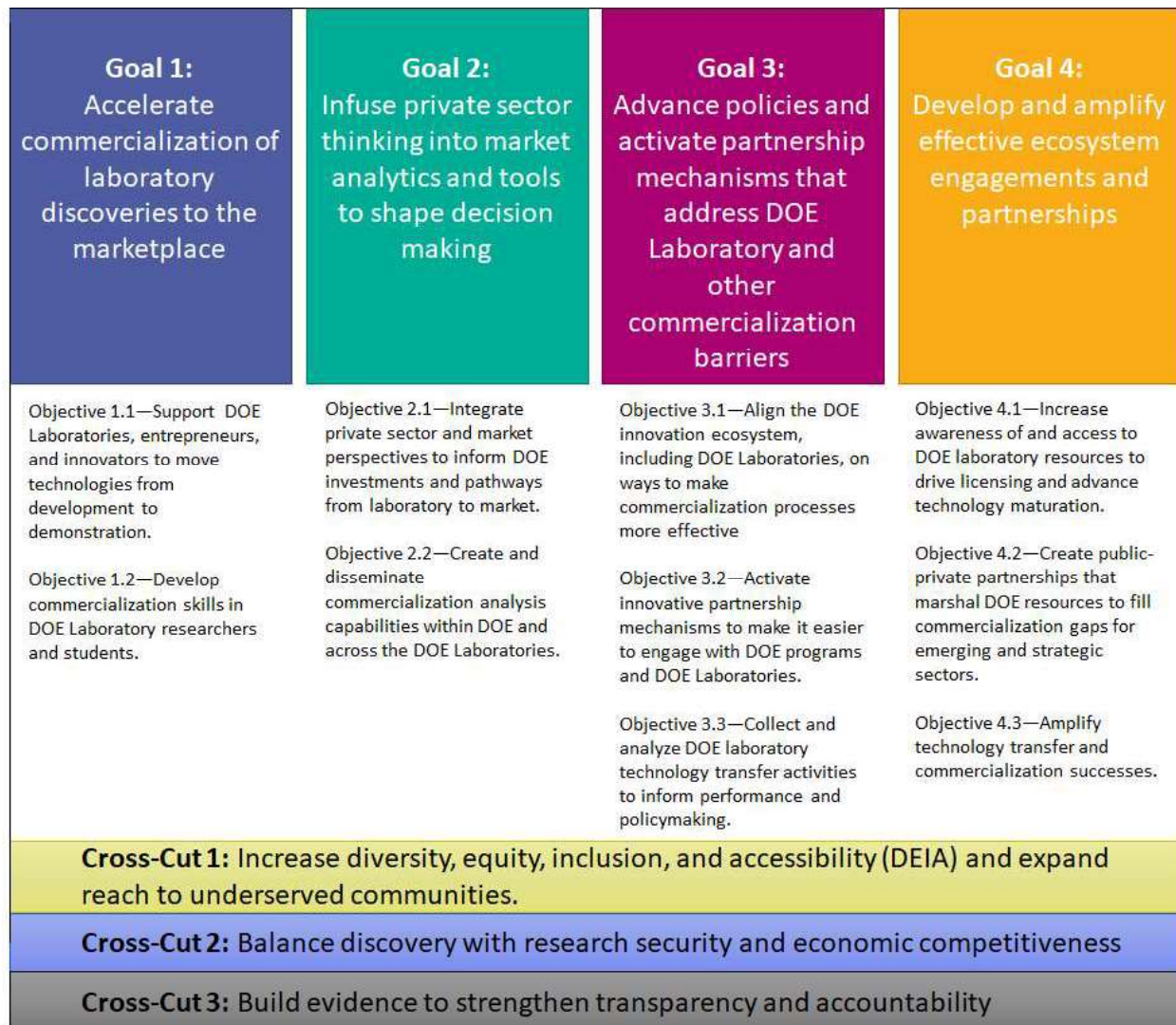


Figure ES-1. DOE’s Technology Transfer and Commercialization Strategic Framework

Goals, Objectives, and Key Activities

Goal 1: Accelerate Commercialization of Laboratory Discoveries to the Marketplace

The first goal enumerated in the TTEP is for DOE to accelerate the commercialization of laboratory discoveries to the marketplace.

Objective 1.1—Support DOE Laboratories, Entrepreneurs, and Innovators to Move Technologies from Development to Demonstration

DOE strives to support the transition of technologies across the RDD&D continuum, and the transition from development of a prototype to technology demonstration is one of the most challenging valleys of death. OTT support bridges this gap, for example, through current and past programs like the Technology Commercialization Fund, Energy Program for Innovation Clusters, COVID-19 Technical Assistance Program (CTAP), and Practices to Accelerate the Commercialization of Technologies (PACT).

TCF is comprised of the largest group of funded programs managed under OTT, mandated by Congress to “provide matching funds with private partners to promote promising energy technologies for commercial purposes” and funded by a 0.9 percent contribution from DOE applied energy funding. Designed to promote technology maturation, TCF consists of two sub-programs, each with different requirements and goals.

- The first TCF sub-program is the Base annual appropriations TCF (Base TCF), funding specific commercialization projects at DOE Laboratories. OTT manages this funding in close coordination with DOE program offices. Incorporating stakeholder feedback, Base TCF also supports projects targeted at enhancing the infrastructure of commercialization at the DOE Laboratories by investing in developing and sharing tools, practices, and approaches that enable high-impact technology transfer.
- The second TCF sub-program, Bipartisan Infrastructure Law (BIL) TCF, represents a portfolio of programs launched in FY 2022 to manage the TCF funding flowing from the BIL. OTT administers BIL TCF collaboratively with DOE program offices to further support energy technology maturation in alignment with the BIL appropriations. Though not limited to funding DOE Laboratory programs, BIL TCF provides an effective conduit for BIL funding to activate the DOE Laboratories in support of DOE infrastructure mission objectives. OTT launched new initiatives under this program in FY 2023, including for example, the *Carbon Dioxide Removal Measurement, Report, and Verification Lab Call*, which offers an opportunity for private industry to partner with DOE’s Laboratories to drive commercialization of carbon management technologies.

In addition to TCF, OTT’s other funding programs have supported and continue to support the transition of technologies from development to demonstration and beyond through a variety of innovative mechanisms—

- EPIC provides direct funding to place-based innovation ecosystems, supporting incubators and accelerators to directly foster technology development by energy-focused startup companies. EPIC has awarded funding to recipients supporting startups across 40 states and supports DOE’s commitments under the Justice 40 (J40) Initiative, which aims to ensure more than 40 percent of the benefits from DOE covered programs flow to historically disadvantaged communities.
- Over the course of the COVID-19 pandemic, CTAP originally provided funding for DOE Laboratories to assist non-DOE entities working to combat the coronavirus pandemic and was later expanded to offer short-term engagements with innovators challenged with technical burdens to take advantage of the cutting-edge researchers and facilities across the DOE Laboratory complex.
- PACT supported numerous projects that worked to enhance commercialization at DOE Laboratories, such as raising awareness of partnership opportunities and strengthening entrepreneurial culture.

Beyond OTT’s portfolio, DOE also administers milestone-based demonstration projects for technologies that have reached the demonstration phase of the continuum. These vehicles provide alternative ways and additional flexibilities to support the transition of technologies across the RDD&D continuum.

Objective 1.2—Develop Commercialization Skills in DOE Laboratory Researchers and Students

DOE fills the gap in entrepreneurial and commercialization skills training for both DOE Laboratory researchers and university students. OTT administers three programs in support of this objective—Energy I-Corps (EIC), EnergyTech University Prize (EnergyTech UP) and the Technology Commercialization Internship Program (TCIP).

- Energy I-Corps, which puts teams of DOE Laboratory researchers through intensive entrepreneurial training, teaching them to develop market pathways for DOE Laboratory technologies. EIC is currently in its 18th cohort. Since 2018, OTT has expanded EIC to include a pipeline program, which offers a miniature version of the EIC curriculum, in which research teams from all 17 National Laboratories have participated.
- EnergyTech UP offers an experiential competition program to college students across the Nation, providing prizes based on teams’ proposals to accelerate energy technology commercialization for specific technologies.
- TCIP offers students a more direct opportunity to work for OTT and the DOE Laboratories, enabling joint summer internships in technology commercialization, with a focus on students from Minority Serving Institutions (MSIs) that can serve as pipelines into full-time employment at the DOE Laboratories.

Goal 1 Outlook

Across OTT’s diverse programs, a common denominator for future success will be our continued collaboration with both DOE program offices and DOE Laboratories. Across our

programs, in FY 2023, OTT has collaborated with eight Program Offices², including nine Energy Efficiency and Renewable Energy (EERE) sub-offices,³ and 16 DOE Laboratories. OTT's programs are recurring and serve as a force multiplier for the commercialization goals of DOE writ large and of specific program offices in support of their missions. OTT, in collaboration with these program offices, will develop additional mission-appropriate programming, continue improve outcome tracking, enhance existing programming through performance measurement and evaluations, and strive to serve a greater number of collaborators.

Goal 2: Infuse Private Sector Thinking into Market Analytics and Tools to Shape Decision Making

DOE seeks to ground commercialization approaches in market realities. As DOE expands its demonstration and deployment activities through the implementation of BIL and IRA funding, driving private sector uptake of clean energy technologies is crucial to maximize returns and benefits to Americans from these investments. Commercialization relies on the \$23 trillion in the private sector to be activated from the BIL and IRA funding. To do so, DOE needs a deep understanding of markets and needs to integrate this understanding into its programs and its interactions with the private sector. As such, the second goal is to infuse private sector thinking into market analytics and tools used to shape decision making.

Objective 2.1—Integrate Private Sector and Market Perspectives to Inform DOE Investments and Pathways from Laboratory to Market

OTT supported the integration of market-based perspectives into DOE strategy and activities by working jointly with the Office of Clean Energy Demonstrations, Office of Policy, and Loan Programs Office to publish the *Pathways to Commercial Liftoff* reports⁴, which provide market analytics and a common fact base in support of BIL and IRA investments and portfolio management activities. The Liftoff reports provide tools and information to support DOE decision-making for funding programs and have activated private sector actors to support the commercialization of DOE technologies. The Liftoff reports have received abundant private sector and media attention, including praise that the reports are “the most detailed look yet at

² Program Offices include the Office of Energy Efficiency and Renewable Energy (EERE), Office of Science (SC), Office of Manufacturing and Energy Supply Chains (MESCC), Office of Fossil Energy (FECM), Office of Nuclear Energy (NE), Office of Electricity (OE), Office of Clean Energy Demonstrations (OCED), Grid Deployment Office (GDO), and National Nuclear Security Administration. OTT also collaborated with the Office of Energy Justice and Equity, a DOE staff office.

³ Sub-offices include the Building Technologies Office (BTO), Vehicle Technologies Office (VTO), Solar Energy Technologies Office (SETO), Geothermal Technologies Office (GTO), Hydrogen Fuel Cell Technologies Office (HFTO), Wind Energy Technologies Office (WETO), Water Power Technologies Office (WPTO), Bioenergy Technologies Office (BETO), and Advanced Materials and Manufacturing Office (AMMTO).

⁴ DOE. “Liftoff Reports,” available at <https://liftoff.energy.gov/>.

how now-experimental energy technologies can be rapidly scaled to meet the needs of the American economy.”⁵

Objective 2.2—Create and Disseminate Commercialization Analysis Capabilities within DOE and Across the DOE Laboratories

To align DOE RDD&D activities with private sector realities, OTT has developed (Commercial) Adoption Readiness Levels (ARLs), a system for combining technology and market risks when assessing technology maturity, the thinking of which was the basis for the *Pathways to Commercial Liftoff* reports. The ARLs help DOE program offices and DOE Laboratories understand both barriers to and opportunities for moving a technology along the RDD&D continuum and to aid in decision-making for investments. For instance, ARLs can be mapped alongside technology readiness levels and investment size to better understand progress of investments (Figure ES-2).

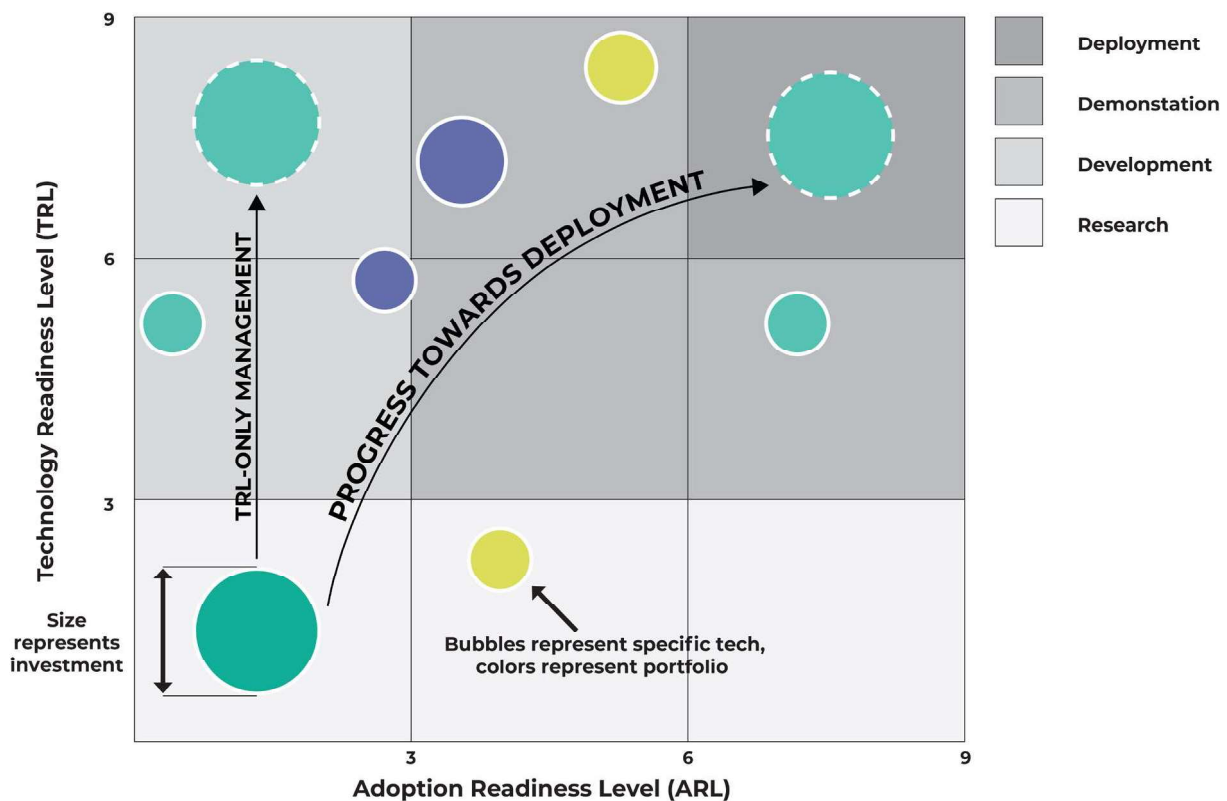


Figure ES-2. OTT's Adoption Readiness Levels Mapped Alongside Technology Readiness Levels (Notional)

Since its inception, ARLs have been embraced across DOE. It has been incorporated in the beginning of the EIC curriculum and has been a critical tool for entrepreneurs to understand barriers beyond technology that need to be understood to drive commercialization. The Office of Clean Energy Demonstrations (OCED) has also used it as the backbone for their Multiyear

⁵ Meyer, Robinson. "Biden's Grand Energy Plan Is Finally Getting Real," March 21, 2023, available at <https://heatmap.news/economy/bidens-grand-energy-plan-is-finally-getting-real>.

Portfolio Planning Report to manage the risk of their portfolio investments. There also has been traction outside of the DOE with the Geneva Association (insurance consortia) adapting it for the insurance industry, ASTM creating a subcommittee to explore its development as an industry standard, and the National Science Foundation (NSF) incorporating it into their I-Corps curriculum.

Goal 2 Outlook

OTT will continue to inform DOE's direction through market analytics, including through new *Pathways to Commercial Liftoff* reports planned for FY 2024 and the further dissemination of ARLs to other parts of DOE, including DOE Laboratories. Additionally, OTT is gathering information about market analysis capabilities across the National Laboratory complex to identify opportunities to expand use of these capabilities to meet DOE's needs. Since a consistent knowledge base supporting DOE's funding decisions requires the capability to conduct commercialization analyses, OTT will develop a framework for building capacity across the DOE Laboratories to support this market analysis work.

Goal 3: Advance Policies and Activate Partnership Mechanisms that Address DOE Laboratory and Other Commercialization Barriers

In addition to evaluating and embracing private sector perspectives and needs, OTT also recognizes that DOE operates as a public institution and that public policies govern the mechanisms that support and that can hinder achieving technology transfer and commercialization goals. To center enabling commercialization of federally funded technologies at the heart of OTT's mission, the third goal is to advance policies and activate partnership mechanisms that address DOE Laboratory and other commercialization barriers.

Objective 3.1—Align the DOE Innovation Ecosystem, Including DOE Laboratories, on Ways to Make Commercialization Processes More Effective

OTT pursues this objective through coordination with three stakeholder communities: DOE Laboratories, primarily through the Technology Transfer Working Group (TTWG) and the National Laboratory Technology Transfer (NLTT) Council; DOE headquarters elements, primarily through the Technology Transfer Policy Board (TTPB); and the Federal interagency community, primarily through the National Science and Technology Council's Lab-to-Market Subcommittee, the Federal Interagency Working Group on Technology Transfer (IAWGTT), and the Federal Laboratory Consortium for Technology Transfer (FLC). The TTPB consists of DOE offices with equities in technology transfer and commercialization outcomes. TTWG includes staff from DOE Laboratories and site and field offices. The FLC helps support training, partnerships, and promotion of DOE Laboratory successes. Engagements with these communities help identify areas of concern and opportunities for improvement to inform development and implementation of policies and processes.

Objective 3.2—Activate Innovative Partnership Mechanisms to Make It Easier to Engage with DOE Programs and DOE Laboratories

In support of this objective, OTT supports the development of DOE’s first ever agency-related foundation to support the DOE mission, the Foundation for Energy Security and Innovation (FESI). The new Foundation, authorized through the CHIPS and Science Act, will be an independent non-profit entity that supports DOE in its critical mission to ensure America’s continued security and prosperity through transformative science and technology solutions. Once established, the FESI will be able to raise and invest funds through engagements with the private sector and philanthropic communities and will be able to complement DOE investments in cutting-edge research helping to bridge commercialization gaps.

To expand the use of other innovative partnership mechanisms, OTT has long served as an informal educator and guide on use of Prize Authority to other DOE Programs. More recently, OTT supported analyses of ways to enhance DOE’s use of Partnership Intermediary Agreements and the Other Transactions (OT) authority, both tools for easing unnecessary burdens to enable projects that cannot easily achieve the intended impact through traditional means. These tools can enhance the ease and impact of DOE program management and avoid unnecessary burdens on potential partners. Building on these efforts, DOE launched a PIA Pilot in FY 2023, which OTT manages. The PIA Pilot is expected to enhance DOE’s mission, including technology transfer and commercialization activities, for example, by increasing flexibility and engagement with non-traditional partners, such as startups and small businesses. After the PIA Pilot was formally established, numerous Sponsoring Offices (including MESC, OCED, EERE, OTT, OE, SETO, FECM, WETO, GDO, Office of State and Community Programs, and Office of Cybersecurity, Energy Security and Emergency Response) began to leverage the new mechanism. From June 18 to November 30, 2023, DOE approved 12 partnership intermediary project orders with a potential aggregate funding level of \$130M. Additionally, there are 15 projects defined and in development, expected to turn into additional project orders for FY 2024.

Objective 3.3—Collect and Analyze DOE Laboratory Technology Transfer Activities to Inform Performance and Policymaking

Policymaking to enhance technology transfer requires the collection and analysis of information and data on commercialization impacts to understand performance and lessons learned. OTT manages an annual technology transitions data call to gather this data as well as supports assessment of DOE laboratory performance on technology transfer and commercialization in coordination with program offices that oversee the DOE Laboratories. OTT contributes input to the Performance Evaluation Management Plan (PEMP) process for the National Laboratories and makes recommendations regarding the integration of technology transfer and commercialization measures through the PEMP.

Goal 3 Outlook

OTT will continue to strengthen coordination in support of policymaking efforts, working with internal and external working groups to enable the commercialization mission while ensuring that sensitive and strategic technologies are positioned to support development of robust, domestic technology sectors. OTT is also advancing planning efforts to establish the FESI in conjunction with relevant DOE program offices and launched an Innovative Partnership Mechanisms (IPM) Team that aims to offer expertise on flexible partnering mechanisms to stakeholders across DOE. This Team will serve as a conduit to the DOE-wide Partnership Intermediary, engage with the prize community of practice across DOE, and coordinate efforts to launch the FESI. The IPM Team will coordinate across OTT and DOE program offices to develop informational materials, analyses and sharing of lessons learned, as well as program execution support, in coordination with OTT's commercialization programs team (refer to Goal 1).

Goal 4: Develop and Amplify Effective Ecosystem Engagements and Partnerships

Beyond strengthening coordination within DOE and the DOE Laboratory complex regarding technology transitions and commercialization, OTT also enables access to and directly engages industry partners and other external stakeholders to build partnerships that can help move technologies to market. The fourth and final goal is to **develop and amplify effective ecosystem engagements and partnerships**.

Objective 4.1—Increase Awareness of and Access to DOE Laboratory Technologies to Drive Licensing and Advance Technology Maturation

OTT has created and deployed tools to increase awareness of DOE Laboratory technologies and capabilities. OTT continues to offer the Laboratory Partnering Service (LPS), a streamlined website that showcases available technologies and patents at DOE Laboratories and user facilities. Since FY 2021, LPS has developed tailored content aimed to drive users to information focused on specific technologies and efforts pursued across DOE and DOE Laboratories, for example in climate⁶ and energy storage.⁷ In addition, a visual patent search tool was created to also help external entities more easily navigate the assets available across our DOE laboratories. OTT has also attended and convened events, both in person and virtually, to engage a broad range of stakeholders. OTT's commercialization and partnering experts spoke at numerous public events over FY 2021 to FY 2023, and OTT hosted conferences and webinars through the InnovationXLab series, including an in-person summit with over 300 attendees.

⁶ LabPartnering.org, "Climate," available at <https://climate.labpartnering.org/?typ%5B%5D=expert&facets=fkgjih,fkgbg,fkgag,fkgcj>.

⁷ LabPartnering.org, "Energy Storage Grand Challenge," available at <https://esgc.labpartnering.org/?typ%5B%5D=expert&facets=fkihi>.

Objective 4.2—Create Public-Private Partnerships that Marshal DOE Resources to Fill Commercialization Gaps for Emerging and Strategic Sectors

OTT also facilitates partnerships directly with industry, assisting consortia of public and private stakeholders seeking to develop emerging technologies in the United States. OTT has also brought together a diverse set of stakeholders into DOE-led Memoranda of Understanding (MOUs), facilitating multiple MOUs since FY 2021 on emerging topics including bidirectional vehicle charging⁸, the quantum economy, and long duration energy storage.⁹ A particular focus of this partnering function is to leverage DOE Laboratory facilities and expertise in service to the development of vibrant, domestic markets that will compete globally in the strategic technology sectors of the future.

Objective 4.3—Amplify Technology Transfer and Commercialization Successes

OTT is dedicated to increasing public awareness and attracting new partnerships by showcasing the successes of OTT programs. This is achieved through the collection and dissemination of success stories, gathered from interviews with participants who have effectively leveraged OTT's resources in bringing research projects to market. These narratives, presented through articles, videos, and various media, not only highlight the pivotal role of OTT in technological advancements but also serve to inspire and engage more industry partners and stakeholders in OTT's initiatives. This approach aims to strengthen and expand OTT's ecosystem of collaboration, thereby enhancing the journey from innovation to commercialization.

Goal 4 Outlook

Going forward, partnership development will continue to remain a priority for OTT, as will increasing awareness of DOE-funded technologies. OTT will develop a strategic communications plan to amplify DOE's commercialization successes and drive future engagements by focusing on partnerships across diverse communities, technologies, and stages of the RDD&D continuum. OTT will also leverage its collected data on DOE Laboratory partnering (Objective 3.3) to quantify the narrative of DOE's commercialization impact.

Cross-Cutting Approaches

Each of the four goals outlined in the strategic framework is supported by three underlying, cross-cutting approaches. These three approaches shape DOE's commercialization landscape, and they are anticipated to continue to do so into the near future.

⁸ DOE. "Department of Energy Announces First of Its Kind Collaboration to Accelerate "Vehicle-to-Everything" Technologies," April 20, 2022, available at <https://www.energy.gov/technologytransitions/articles/departments-energy-announces-first-its-kind-collaboration-accelerate>.

⁹ DOE. "Department of Energy and Partners Sign Landmark Agreement to Accelerate Long Duration Energy Storage," June 27, 2023, available at <https://www.energy.gov/technologytransitions/articles/departments-energy-and-partners-sign-landmark-agreement-accelerate>.

The first cross-cutting approach is to increase diversity, equity, inclusion, and accessibility (DEIA) and expand reach to underserved communities. DOE is committed to integrating DEIA throughout all programmatic work, policy development, and external partnering efforts. All of DOE is involved in implementing the Justice 40 (J40) initiative, which directs all covered programs to be managed toward a goal that 40 percent of their benefits flow toward disadvantaged communities. OTT's EPIC, EnergyTech UP, and TCIP are all covered programs under J40. OTT will continue its focus on catalyzing underserved communities throughout its activities, including outreach and engagement, and has established an internal DEIA council to guide this approach.

The second cross-cutting approach is to balance discovery with research security and economic competitiveness. Reports from internal DOE working groups identified that DOE Laboratory internal controls to track licensing and monitor compliance throughout the licensing lifecycle vary across the DOE complex largely due to broad contractor IP rights set by law. OTT has actively participated in the process of reviewing existing policies and best practices regarding research security and licensing and in seeking to find a balance between openness and addressing these concerns. Through OTT's various teams, OTT is exploring options to support the DOE Laboratories in conducting analysis to inform patent filing decisions and using tools to vet potential licensees and conduct license lifecycle management. OTT's work on these issues is complementary to the broader research security efforts across DOE.

Finally, the third cross-cutting approach is to build evidence to strengthen transparency and accountability. Aligned with Congress' focus and the Office of Management and Budget requirements for evidence-based decision making in all Federal agencies, OTT plans to develop an evidence-based framework aimed at continuous improvement of its policies and programs. OTT is exploring funding and conducting program evaluations, including the development of short-term and long-term performance measures and metrics; developing a formal Learning Agenda, which will prioritize OTT's evidence-building needs; and building a data management infrastructure to support these efforts. Refer to Table ES-1 for OTT's key performance metrics through FY 2025.

Conclusions

The TTEP for FY 2021 to FY 2025 is intended to frame Department-wide coordination and execution of technology transfer and commercialization activities, in particular those activities led by OTT. OTT's missions of commercializing technologies and expanding the impacts of commercialization from DOE's investments have been central to DOE's strategic direction. In developing future updates to the annual TTEP, OTT will continue to collaborate across the DOE enterprise, including the DOE Laboratories, to broaden the picture of DOE-wide technology transfer and commercialization activities supporting the goals and objectives outlined in the strategic framework. OTT also plans to continue its engagement externally across innovation ecosystems nationwide to develop and refine commercialization programs, shape technology

transfer policy, and drive execution and shepherding of technology from the lab to market throughout our economy.

Table ES-1. OTT Performance Metrics Through FY 2025.

Goal 1: Accelerate commercialization of laboratory discoveries to the marketplace	
Objective 1.1—Support DOE Laboratories, entrepreneurs, and innovators to move technologies from development to demonstration	Metric 1: Launch new BIL TCF programs totaling \$210M or more in cumulative funding.
	Metric 2: Launch TCF Base Annual Appropriations solicitations and obligate all TCF funding.
	Metric 3: Implement the first DOE-wide PIA pilot.
	Metric 4: Launch the OTT-funded program focused on supporting incubators and their ecosystems, EPIC.
Objective 1.2—Develop commercialization skills in DOE Laboratory researchers and students	Metric 5: Launch three OTT-funded programs, including Energy I-Corps, EnergyTech UP, and TCIP.
Goal 2: Infuse private sector thinking into market analytics and tools to shape decision making	
Objective 2.1: Integrate private sector and market perspectives to inform DOE investments and pathways from laboratory to market	Metric 1: Publish and promote at least nine <i>Pathways to Commercial Liftoff</i> reports.
Objective 2.2—Bridge DOE activities with private sector needs by creating market analysis capabilities within DOE and leveraging DOE laboratory capabilities	Metric 2: Integrate ARLs into multiple offices' strategic planning and standard operating processes in 2023 and publish the framework externally.
Goal 3: Advance policies and activate partnership mechanisms that address commercialization barriers	
Objective 3.1—Align the DOE innovation ecosystem, including DOE Laboratories, on ways to make commercialization processes more effective	Metric 1: Strengthen engagement with the TTWG stakeholders including DOE Laboratories and site and field offices by hosting at least 4 joint meetings between TTWG and TTPB and facilitating organization of 2 TTWG meetings annually.
	Metric 2: Strengthen engagement with the TTPB stakeholders including DOE program and functional offices by establishing a charter and identifying at least 2 annual priorities and deliverables.
	Metric 3: Foster engagement among stakeholders across the DOE complex, including headquarters, site and field offices, and DOE Laboratories, and the interagency through OTT's representation on at least 2 interagency and 3 internal coordination groups.
Objective 3.2—Activate innovative partnership mechanisms to make it easier to engage with DOE programs and DOE Laboratories	Metric 4: Launch the FESI and announce its Board of Directors to support the DOE mission and to advance collaboration to accelerate the commercialization of energy technologies.
Objective 3.3—Collect and analyze DOE Laboratory technology transfer activities to inform performance and policymaking	Metric 5: Provide timely dissemination of evidence-based analysis to stakeholders, such as through publication of at least 4 congressional reports.
	Metric 6: Develop and implement an OTT learning agenda and establish an analytical and evaluation capability to support evidence-based decisions.
Goal 4: Develop and amplify effective ecosystem engagements and partnerships	
Objective 4.1—Increase Awareness of and Access to DOE Laboratory Technologies to Drive Licensing and Advance Technology Maturation	Metric 1: Grow awareness of DOE technology opportunities and expand the network of potential partners.

Objective 4.2—Create public-private partnerships that marshal DOE resources to fill commercialization gaps for emerging and strategic sectors	Metric 2: Facilitate and develop partnerships that bring together stakeholders to close gaps in the pathway to market for key technology areas.
Objective 4.3—Amplify technology transfer and commercialization successes	Metric 3: Track and increase engagement through success story dissemination.



Technology Transfer Execution Plan Fiscal Years 2021 to 2025

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I. Legislative Language

The Department of Energy (DOE) intends that this report meets the statutory requirements to describe the progress and implementation of select technology transfer and commercialization activities at DOE from fiscal years (FY) 2019 and FY 2023 as provided under the Energy Policy Act of 2005 (EPAct of 2005) and the Energy Act of 2020 (EA2020). Section 1001(g) of EPAct 2005 (42 U.S. Code § 16391 (h)) states:

(2) Updates: Each year after the submission of the plan under paragraph (1), the Secretary shall submit to Congress an updated execution plan and reports that describe progress toward meeting goals set forth in the execution plan and the funds expended under subsection (e).

EA2020 Section 9007 states that “the Secretary of Energy shall submit a “report on the progress and implementation of programs established under sections 9001, 9002, 9003, 9004, and 9005 of this Act.” These provisions describe the following select activities, several of which are managed under the Office of Technology Transitions (OTT)—

- Coordination and technology transfer programs supported by OTT (Section 9001);
- Lab Partnering Service (LPS) pilot program (Section 9002);
- Technology Commercialization Fund (TCF) (Section 9003);
- Streamlining prize competitions (Section 9004); and
- Milestone-Based Demonstration Projects (Section 9005).¹⁰

DOE’s *Technology Transfer Execution Plan 2016-2018* met statutory requirements for annual implementation updates from FY 2016 to FY 2018.¹¹ This updated report primarily focuses on describing implementation updates from FY 2021 through FY 2023, while providing a summary of major milestones and implementation of relevant programs and activities in FY 2019 to FY 2020, among other years since OTT’s establishment in FY 2015, in Appendix C. In addition, this report is prepared in accordance with the requirements in the explanatory statement to the Consolidated Appropriations Act of 2023 (Public Law 117-328), which states that OTT provide “a report outlining the office’s five-year roadmap to achieving its goal of commercializing the Department’s technology.”¹² As such, the focus of this *Technology Transfer Execution Plan* (TTEP) emphasizes OTT’s strategic mission and goals to support technology transfer and commercialization across DOE. This TTEP is not intended to be comprehensive of the vital contributions from technology transfer and commercialization activities managed under other

¹⁰ Sections 9001 through 9003 enumerate specific activities managed under OTT.

¹¹ DOE. 2016. *Technology Transfer Execution Plan 2016-2018*, available at:

<https://www.energy.gov/sites/prod/files/2016/10/f33/TTEP%20Final.pdf>.

¹² Explanatory Statement for Division D--Energy and Water Development And Related Agencies Appropriations Act, 2023, available at <https://www.appropriations.senate.gov/imo/media/doc/Division%20D%20-%20Energy%20&%20Water%20Statement%20FY23.pdf?ref=the-wavelength>.

DOE program offices and DOE Laboratories. Future annual updates to the TTEP will continue our collaborative process that engages stakeholders supporting technology transfer and commercialization goals across DOE and the DOE Laboratories to describe progress and implementation of broader DOE-wide activities related to the strategic framework.

The strategic framework will be revisited and reviewed every four years after FY 2025. The remainder of this report describes—

- In Chapter II, definitions for select terms used throughout this report;
- In Chapter III, an overview of OTT;
- In Chapter IV, DOE’s strategic framework, including strategic goals, objectives, and key activities, focusing on FY 2021 and FY 2023 activities, as well as an outlook through FY 2025;
- In Chapter V, concluding words on the importance of technology transfer and commercialization at DOE and OTT’s mission; and
- In appendices, the full text of legislative provisions covered by this report (Appendix A); projects funded under the TCF program since FY 2016, as required by EA2020 Section 9003 (Appendix B); and major milestones related to OTT’s organizational and programmatic evolution and implementation from FY 2015 to FY 2020 (Appendix C).

II. Definitions

Several terms used throughout this report are worthwhile to define for the purposes of this report at the outset.

Commercialization—refers to the process by which new technologies reach full commercial scale and are available in the marketplace by navigating the research, development, demonstration, and deployment (RDD&D) continuum. Reaching full-scale deployment requires technology and adoption risks to be driven down as technologies navigate across the RDD&D continuum.

Demonstration—refers to a stage in the research, development, demonstration, and deployment (RDD&D) continuum in which an objective is to determine the technical and commercial feasibility of new technologies.¹³

DOE Laboratories—refers collectively to DOE’s 17 National Laboratories and the five plants and sites under the National Nuclear Security Administration (NNSA).

Research, development, demonstration, and deployment (RDD&D) continuum—defines the path to commercialization where a technology starts as an innovative idea in research,

¹³ As defined in EPLA of 1992 and codified in 42 USC §13541 (a).

moves to development where the first prototype is created, then to demonstration where the solution is tested in the real world and ending with commercial scale deployment. Although RDD&D is a continuum, the pathways across stages are not always linear and technologies may need to go back to earlier stages to be refined.

Technology transfer—refers to the process by which existing knowledge, facilities, or capabilities are used to fulfill public and private sector needs.¹⁴ For the purposes of this report, technology transfer spans across the RDD&D continuum and represents activities supporting commercialization across the DOE Laboratories and DOE-funded research communities.

Technology transition—refers to multiple, interlinked connections occurring across different stages of the RDD&D continuum that are needed to achieve commercial impacts.¹⁵

III. Overview of OTT

To meet the Nation’s climate, national security, and economic development goals, DOE’s investments in early-stage discoveries must be guided across the research, development, demonstration, and deployment (RDD&D) continuum to deliver market solutions. To support this goal, the Secretary of Energy established the Office of Technology Transitions (OTT) in 2015 to develop and oversee delivery of DOE’s strategic vision and goals for technology transfer and commercialization and engagement with business and industrial sectors across the Nation. Congress further codified OTT’s mission in 2020 “to expand the commercial impact of the research investments of the Department and to focus on commercializing technologies that support the missions of the Department.”¹⁶ OTT works to fill gaps in the RDD&D continuum to accelerate both DOE and private sector investments toward the commercialization of clean energy technologies. OTT guides the stewardship of technology transfer and commercialization activities across the DOE enterprise, including the DOE Laboratories across the Nation. To accomplish its mission, OTT creates specialized tools, training, analyses, and programs as well as supports policy development, coordination, and partnership development to enable successful technology transfer, transition, and commercialization of new technologies.

The Chief Commercialization Officer is responsible for driving private sector uptake of clean energy technologies as the steward of commercialization activities across DOE. In addition, in 2022, OTT’s reporting structure moved from directly reporting to the Office of the Under Secretary for Science and Energy to the Offices of the Secretary and Deputy Secretary of

¹⁴ Federal Laboratory Consortium for Technology Transfer (FLC). 2023. FLC Technology Transfer Desk Reference: A Comprehensive Introduction to Technology Transfer. Cherry Hill: Federal Laboratory Consortium for Technology Transfer.

¹⁵ Modified as referenced in DOE. 2016. Technology Transfer Execution Plan 2016-2018, available at <https://www.energy.gov/sites/prod/files/2016/10/f33/TTEP%20Final.pdf>.

¹⁶ Energy Act of 2020, Section 9001.

Energy. Through these roles, OTT ensures that the Secretary of Energy’s vision for realizing commercialization impacts is reinforced and guided across the DOE enterprise.

OTT has evolved since its establishment in 2015, adapting to changes in organizational and reporting structure and expansion of its mission. OTT expanded its programs to include innovative partnership mechanisms—such as prizes and internships, supporting 55 prize winners and 51 interns from FY 2021 through FY 2023. OTT continues to create a robust portfolio of first-of-kind innovative partnership mechanisms—such as coordinating across DOE program offices to establish a partnership intermediary agreement (PIA)¹⁷ and advancing the establishment of the Foundation for Energy Security and Innovation (FESI), DOE’s first agency-related foundation¹⁸. Recently, from FY 2021 through FY 2023, OTT managed an increase in total annual budget of more than 25 percent from \$17.6 million (M) to \$22.1M. In addition, OTT managed an increase of more than \$60M annually under management through the TCF, DOE’s core commercialization program, from clean energy demonstration and other investments under the Bipartisan Infrastructure Law (BIL).

IV. Strategic Framework

This TTEP, for FY 2021 to FY 2025, outlines DOE’s strategic framework to support department-wide coordination and execution of technology transfer and commercialization. It includes goals, objectives, and key activities, in particular those managed under OTT. In addition, the strategic framework covers a five-year timeframe with an outlook for executing activities through FY 2025. DOE’s strategic framework aims to explain and guide realignment of DOE’s technology transfer and commercialization investments, programs, and activities with the priorities and needs across the DOE research enterprise, including DOE Laboratories; extramural research community, such as entrepreneurs, industry, academia, and incubator and accelerator communities; non-profits; and State and local governments; among others. Dialogue with and input from these stakeholders through hundreds of outreach and engagement efforts informed the development of this strategic framework.

DOE’s strategic framework is summarized in **Error! Reference source not found.** (and is also Figure ES-1). The strategic framework outlines four goals and 10 objectives that reflect the vision for how DOE will bolster the Nation’s climate, national security, and economic development goals by driving commercialization. In addition, three cross-cutting approaches support achieving each goal and address important emerging and evolving topics influencing DOE’s technology transfer and commercialization landscape.

¹⁷ Refer to Strategic Framework: Goal 1.

¹⁸ Refer to Strategic Framework: Goal 3.

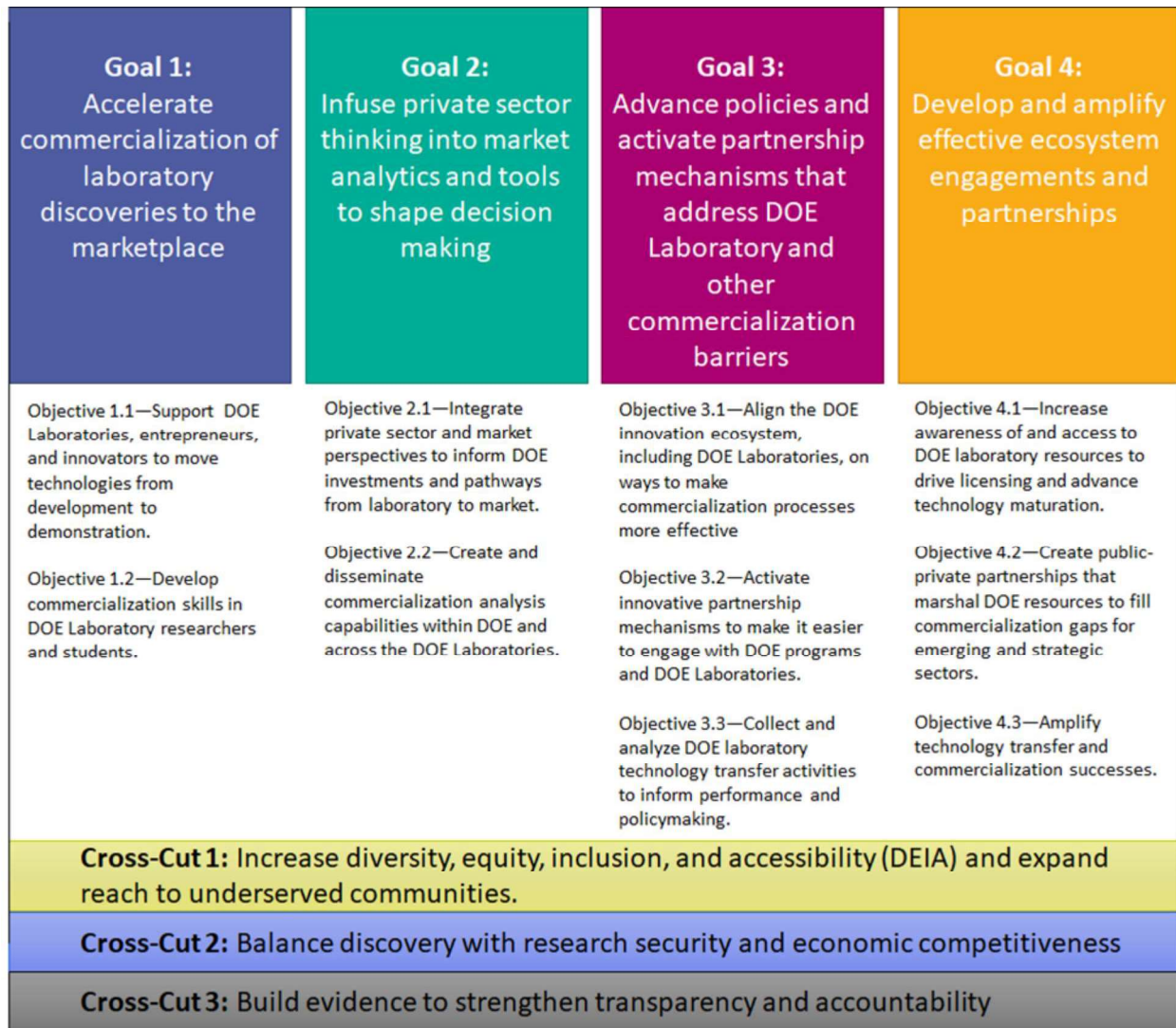


Figure 1. Strategic Framework with Goals and Cross-Cutting Approaches

A. Goals, Objectives, Key Activities, and Outlook

This section describes four goals, and, for each, its objectives, key activities, and an overall outlook for planned activities through FY 2025. The key activities specifically focus on progress and implementation of activities from FY 2021 to FY 2023 and provide illustrative examples of outcomes from these activities.

Goal 1: Accelerate commercialization of laboratory discoveries to the marketplace.

DOE must work to maximize the transfer and transition of technologies toward commercialization to meet the Nation's needs in a rapidly shifting technology marketplace. DOE's technology transfer and commercialization programs, in particular those managed under OTT, engage internal and external partners to enhance the Nation's economic competitiveness

and strengthen its leadership in critical energy technologies. These programs aim to move innovations developed by DOE Laboratories as well as external entities, such as entrepreneurs and startups, from laboratory benches across the Nation to widespread market deployment.

Objectives under Goal 1

DOE has adopted two objectives under Goal 1—

- Objective 1.1—Support DOE Laboratories, entrepreneurs, and innovators to move technologies from development to demonstration.
- Objective 1.2—Develop commercialization skills in DOE Laboratory researchers and students.

Objective 1.1—Support DOE Laboratories, entrepreneurs, and innovators to move technologies from development to demonstration.

One of the most challenging transitions to make across the RDD&D continuum is the transition from development of a laboratory-based prototype to demonstration, in which a first-of-a-kind solution is used in a commercial setting. At this stage, technologies tend to be less mature than desired to attract private sector investments as the linkage to a specific market need is still being explored and tested. DOE must continuously identify ways to enable its DOE Laboratories to transfer their technologies to the private sector and drive commercial application of their technologies at scale. Since FY 2021, OTT has improved upon existing, and created several new, programs to help entrepreneurs and researchers more efficiently navigate through this stage. In collaboration with DOE program offices, OTT often develops joint programs to maximize commercialization impacts.

This objective includes five key program activities—(1) TCF; (2) Energy Program for Innovation Clusters (EPIC) program; (3) the COVID-19 Technical Assistance program (CTAP); (4) Practices to Accelerate the Commercialization of Technologies (PACT); and (5) milestone-based demonstration projects.

Technology Commercialization Fund (TCF)—A core responsibility of OTT is to implement the TCF, which is funded by statute as a 0.9 percent contribution from DOE’s applied energy research, development, demonstration, and commercial application funding. Congress established the TCF through EAct of 2005 and reauthorized it through EA2020 to “promote promising energy technologies for commercial purposes.”¹⁹ TCF is a competitive funding opportunity designed support the commercialization of energy technologies and specifically to help commercialize technologies developed at DOE Laboratories and provide pathways to reach a viable market. TCF aims to advance technology maturation and commercialization such that

¹⁹Consolidated 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>.

technologies reach a point to attract private sector partners and investments. OTT administers the TCF, in coordination with fifteen DOE program offices.²⁰

OTT implements TCF as two programs—the Base Annual Appropriations TCF and the BIL TCF, the latter established to effectively manage the investments from the BIL.

Base Annual Appropriations TCF—The Base Annual Appropriations TCF (Base TCF) provided about \$33M in FY 2021, about \$28M in FY 2022, and over \$40M in FY 2023. Historically, Base TCF has funded technology specific commercialization programs, in which DOE program offices develop their own proposed use of TCF funding that meets the statutory requirements. In FY 2022, OTT, in coordination with stakeholders, designed a new approach to complement this program and announced the TCF Core Laboratory Infrastructure for Commercialization Lab Call, which focuses on enhancing the infrastructure of commercialization at the DOE Laboratories by investing in developing and sharing tools, practices, and approaches that enable high-impact technology transfer. In FY 2022, DOE awarded approximately \$18M to seven first-of-their-kind projects led by teams at Sandia National Laboratory (SNL), National Renewable Energy Laboratory (NREL), Pacific Northwest National Laboratory (PNNL), and Lawrence Berkeley National Laboratory (LBNL).

In FY 2023, DOE programs were given the opportunity to work with OTT on a joint lab call that combines available appropriated TCF funding from multiple DOE program offices, called the Core Laboratory Infrastructure for Market Readiness (CLIMR) lab call. The CLIMR lab call seeks to enable and improve commercialization processes at the labs, similar to the FY 2022 lab call, with an additional topic area seeking technology-specific proposals. Eight program offices participated in the FY 2023 CLIMR lab call, selecting thirty projects for funding. Refer to Appendix B for a list of TCF projects from FY 2016 to FY 2023. In November 2023, the Base TCF team at OTT, in collaboration with 14 program offices, released the FY 2024 CLIMR lab call. The FY 2024 CLIMR lab call is structured similarly to the FY 2023 CLIMR lab call but incorporates some topic area language improvements and an expansion of solicitation scope. The FY 2024 CLIMR lab call is the largest Base TCF lab call in the program's history in both funding available, approximately \$40 million, and in program office participation. Refer to Box: Streamlining Permitting with SolarAPP+ for an example of a TCF-funded project's impacts.

²⁰ Office of Cybersecurity, Energy Security, and Emergency Response (CESER); the Office of Clean Energy Demonstrations (OCED); 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), and the Office of Manufacturing and Energy Supply Chains (MESC).

Streamlining Permitting with SolarAPP+

The permitting process is one of the biggest bottlenecks for residential solar installation, but the Solar Automated Permit Processing Plus (SolarAPP+) platform is tackling this challenge one permit at a time. Launched in 2021, SolarAPP+ now serves more than 62 communities across the Nation, with more than 22,000 permits issued, 127,000 kilowatts approved, and 22,000 estimated hours saved in review time.

Created by a team of researchers out of the National Renewable Energy Laboratory (NREL), SolarAPP+ is an online platform that instantly issues permits for code-compliant residential photovoltaic systems, making it easier for local governments to approve standardized projects quickly and safely. As a result, SolarAPP+ projects are permitted, installed, and inspected 13 days sooner than traditional projects and staff are saving between 15-60 minutes of review time per permit.



The team initially received funding from the DOE Solar Energy Technologies Office (SETO) through TCF in 2019. A SolarAPP+ Foundation has been established to transition SolarAPP+ from the NREL team into a sustainable long-term operation.

Source: DOE, “Streamlining Permitting with SolarAPP+,” available at <https://www.energy.gov/technologytransitions/articles/streamlining-permitting-solarapp>.

BIL TCF—The BIL provided \$62 billion in new funding to support an array of clean energy activities, of which \$274M will be managed under BIL TCF from FY 2022 through FY 2026. In FY 2023, OTT provided over \$110M for programs and projects that broadly support the commercialization of promising energy technologies while simultaneously enhancing and improving the Nation’s infrastructure, competitiveness, opportunity, and equity as well as addressing the climate crisis. OTT worked closely with OCED, EERE, and FECM to develop and launch the first four in a series of new programs, including—

- **Carbon Dioxide Removal (CDR) Measurement, Report, and Verification Lab (MRV) Call²¹**—OTT, in partnership with FECM and OCED, awarded four DOE Laboratory-led teams \$15M to develop CDR MRV best practices and capabilities that are necessary to enable CDR commercialization at scale. The four projects will work collaboratively with over 40 industrial partners to build an overarching framework for CDR MRV as well as advance MRV for direct air capture, mineralization, cement and concrete, and biomass CDR pathways.

²¹ DOE, “Department of Energy Releases 2023 Technology Commercialization Fund Solicitation on Carbon Dioxide Removal Measurement, Reporting, and Verification,” available at <https://www.energy.gov/technologytransitions/articles/department-energy-releases-2023-technology-commercialization-fund>.

- Collaborative Alignment for Critical Technology Industries Lab Call²²—This lab call was developed through a partnership with OTT and OCED and provides \$15.5M to focus on industry alignment for clean hydrogen and long duration energy storage (LDES) technologies. These projects will establish DOE laboratory-led industry and stakeholder working groups that will collaboratively identify industry-wide adoption challenges as well as develop and implement recommendations and best practices.
- Manufacture of Advanced Key Energy Infrastructure Technologies (MAKE IT) Prize²³—This prize was developed by OTT in partnership with OCED and EERE and is aimed at stimulating the resurgence of American manufacturing in the domain of clean energy. The prize makes available approximately \$30M in total funding to catalyze domestic manufacturing of critical clean energy technology components, moving manufacturing facilities from planning to shovel-ready, and enabling strategies for vibrant manufacturing activity in communities.
- Voucher Program²⁴—OTT in collaboration with OCED and EERE developed the voucher program to provide \$27.5M in in-kind commercialization support to organizations that have a role in bringing innovative energy technologies to market nation-wide. The program leverages DOE’s recent partnership intermediary agreement with ENERGYWERX (refer to Goal 3). ENERGYWERX works directly with program participants and facilitates third-party support needed to accelerate commercialization of clean energy technology. The Voucher Program currently offers four categories of in-kind support, with the potential for more to be added in the future, including pre-demonstration commercialization support; performance validation, modeling, and certification support; clean energy demonstration project siting/permitting support; and EERE commercialization support.

In addition, BIL TCF supported development of the *Pathways to Commercial Liftoff* reports (refer to Goal 2)²⁵ in partnership with the Office of Policy, OCED, and the Loan Programs Office. BIL TCF also supported several smaller-scale projects and initiatives, including an OCED-funded and co-developed project with Argonne National Laboratory (ANL) to develop a more user-friendly version of the GREET® (Greenhouse gases, Regulated Emissions, and Energy use in Technologies) Model²⁶ and another ANL project with MESC to develop a holistic strategy around manufacturing and energy supply chain technology commercialization.

²² OCED Funding Opportunity Exchange, “Bipartisan Infrastructure Law Technology Commercialization Fund: Collaborative Alignment for Critical Technology Industries Lab Call,” available at <https://oced-exchange.energy.gov/Default.aspx#Foalddb814b86-222a-41de-ba48-b0b3f58fa4e5>.

²³ DOE, “Bipartisan Infrastructure Law Technology Commercialization Fund,” available at <https://www.energy.gov/technologytransitions/bipartisan-infrastructure-law-technology-commercialization-fund>.

²⁴ DOE, “DOE Announces New \$27.5M Voucher Program to Bring Innovative Energy Technologies to Market,” available at <https://www.energy.gov/technologytransitions/articles/doe-announces-new-275m-voucher-program-bring-innovative-energy>.

²⁵ Refer to Goal 2 for further on the *Pathways to Commercial Liftoff* reports and see DOE. “About the Liftoff Reports,” available at <https://liftoff.energy.gov/about-the-liftoff-reports/>.

²⁶ ANL, “GREET® Model,” available at <https://greet.anl.gov/>.

EPIC—First established as a single-phase prize in FY 2020, EPIC is a vital DOE program that delivers funds to place-based regional innovation ecosystems to help catalyze local collaboration and enable start-ups to commercialize impactful technologies. EPIC aims to directly support startups, harness regional ingenuity and resources, develop pipelines for energy technologies to reach the market, as well as form and grow new businesses. In FY 2021, EPIC’s funding opportunity announcement (FOA) awarded \$9.5M to 10 incubators as three-year awards to develop and implement new programs to support regional startups. These incubators aim to support 180 startups, 17 of which will leverage DOE-funded technologies, and 64 of which will achieve commercial-scale outcomes and integrate diversity, equity, and inclusion (DEI)-relevant leadership teams.²⁷ For further on one awardee’s impacts, refer to Box: EPIC Awardee Bolstering Incubation and Entrepreneurship Community.

EPIC Awardee Bolstering the Incubation and Entrepreneurship Community



Figure 2. Select Incubator Companies

The EPIC program awarded \$900,000 in FY 2021 to Evergreen Climate Innovations, which developed Heartland Climate Tech Partnership. The University of Tennessee’s Spark Innovation Center is part of Heartland Climate Tech Partnership, which plans to support more than 360 startups and small businesses commercialize clean technology. EPIC funding made it possible for Spark Innovation Center to launch a new cleantech accelerator. Companies supported through Spark have acquired \$18M in non-dilutive grants, \$15.6M in equity investments, and \$1.2M in recurring revenue. In addition, these companies have created 46 full time, contract, and internship positions. Refer to Figure 2 for select incubator companies.

Source: University of Tennessee, “Spark Innovation Center,” available at

<https://www.tnresearchpark.org/spark/>.

In FY 2022, EPIC implemented a new program design launching its first multiphase, year-long national prize and startup pitch competition.²⁸ In phase 1, EPIC awarded \$1M to 24 incubators, which were eligible to compete in phase 2. Phase 2 awarded \$1M to 10 incubators, which were

²⁷ Awardees will collect data to track their activities and accomplishments and report this information to OTT to support future reporting to Congress on progress and implementation of the program. Through this data, OTT aims to identify how support of the incubator community and innovation ecosystems through EPIC have a direct impact on the commercial success of technology-focused start-ups and small businesses.

²⁸ In FY 2020, EPIC was structured as a single-phase prize competition. For further on the two-phase FOA, see EERE-Exchange.energy.gov, “DE-FOA-0002425: Energy Program for Innovation Clusters (EPIC),” available at: <https://eere-exchange.energy.gov/Default.aspx?foald=715036e7-e111-442c-bf38-1e33a4633fa5>.

eligible to compete in the final phase 3. OTT, in collaboration with DOE program offices, hosted two startup pitch competitions funding a total of \$358,500 directly to startups (and the incubators that nominated the first-place winners). In October 2023, EPIC awarded \$2M to 4 grand prize-winning incubators, concluding EPIC Round 2. In FY 2023, with input from stakeholder feedback, OTT iterated the program structure to launch a first of its kind hybrid funding program combining prize authority and financial assistance—EPIC Round 3. OTT launched phase 1 of this hybrid program in September 2023 awarded \$3M to 23 incubators in early spring 2024. Phase 2 plans to award winners with invitations to negotiate 3-year cooperative agreements to scale their programs.

The incubator cluster model enables a regional approach that has resulted in geographically diverse OTT EPIC awardees that support entrepreneurs of historically underrepresented groups (Figure 3). EPIC awardees support startups and entrepreneurs in 40 states across the Nation. The EPIC program supports DOE’s commitments under the Justice40 (J40) Initiative, which aims that 40 percent of their overall benefits from DOE funding flow toward disadvantaged communities (refer to Cross-Cut 1: Increase diversity, equity, inclusion, and accessibility (DEIA) and expand reach to underserved communities. for further on the J40 Initiative).²⁹

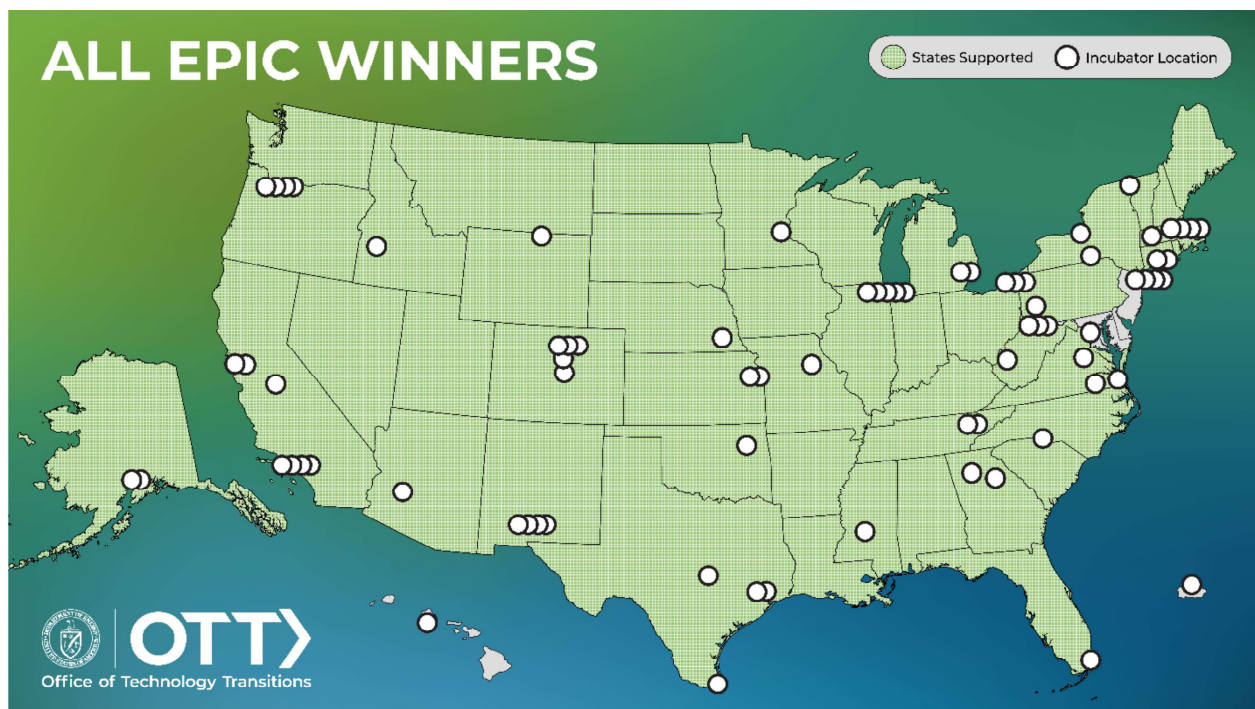


Figure 3. Geographic Distribution of EPIC Prize Winners and FOA Awardees

²⁹ DOE. 2022. Energy Program for Innovation Clusters (EPIC), Report to Congress, available at: <https://www.energy.gov/sites/default/files/2022-06/ott-epic-report-0622.pdf>.

CTAP—In FY 2020, OTT launched CTAP to support new technologies that address the global pandemic reaching the marketplace. From FY 2020 through FY 2022, CTAP provided \$350,000 in funding to the National Laboratories to engage with U.S.-based external entities on coronavirus-related projects. CTAP leveraged OTT’s Lab Partnering Service (LPS) online platform, which facilitates connections with scientific and technical experts across the National Laboratories (refer to Goal 4 for further on LPS). Laboratories received funding to support short-term engagements with U.S.-based state, Tribal, and local governments, not-for-profit organizations, regional and local businesses, and other private sector entities. Examples of partnerships supported by CTAP include—Sandia National Laboratories partnered with a private engineering firm to test COVID-19 protective face shields, and Lawrence Berkeley National Laboratory provided evaluation and optimization services to a medical equipment sterilization startup. Originally focused on health-related projects, OTT expanded the scope of the CTAP in FY 2021 and its final program year in FY 2022 to support economic recovery projects.³⁰

PACT—PACT was launched in FY 2019 as a one-time OTT program that aimed to enhance technology commercialization by reducing barriers to accessing DOE laboratory capabilities, lowering transaction costs, and improving public-private partnerships. PACT provided \$2.1M for projects to DOE Laboratories, with \$640,000 in partner cost-sharing. PACT projects engaged 17 National Laboratories, one NNSA site, and six external partners for a total of 24 participating entities. OTT is continuing to execute funding on select projects through FY 2023. PACT supported a variety of National Laboratory-led projects, including the Bay Area Lab Innovation Networking Center, which creates a central access point to facilitate partnerships with DOE’s laboratories in Northern California.³¹ Another project executed as part of PACT was the Entrepreneurial Thinking: Historical and Observational Study (ETHOS). Led by Idaho National Laboratory (INL), the study assessed and informed DOE and National Laboratory leadership on the state of entrepreneurial culture at six participating National Laboratories.³² The ETHOS results are helping drive efforts to foster entrepreneurial mindsets and encourage technology transfer across the DOE complex.

*Milestone-Based Demonstration Projects*³³—In EA2020, Congress provided DOE with authority to establish milestone-based demonstration projects. Under these projects, DOE will only provide funding to an awardee if they have met specified technical or financial milestones. Milestone-based projects have been used extensively across the Federal Government, including at the National Aeronautics and Space Administration and the Department of Defense for rapid

³⁰ DOE, “COVID-19 Technical Assistance Program,” available at <https://www.energy.gov/technologytransitions/covid-19-technical-assistance-program>.

³¹ Lab Innovation Networking Center, “About,” available at <https://www.bayarealabs.org/aboutlinc>.

³² INL, “A New Ethos: INL Leads Study of Innovation Culture at Six National Labs,” available at: <https://inl.gov/article/a-new-ethos-inl-leads-study-of-innovation-culture-at-six-national-labs/>.

³³ As part of EA2020, Congress specified the TTEP include information about milestone-based demonstration projects across DOE. This section is intended to summarize and complement any planned reporting of milestone-based payments by respective program offices implementing these projects.

development and demonstration of new and uncertain technologies by allowing for quick shifts to redefine milestones. In September of 2022, the DOE Office of Science announced up to \$50 million to deliver fusion pilot plant (FPP) pre-conceptual designs and technology roadmaps by 18 months after award. Funding for meeting subsequent milestones toward full conceptual FPP designs, up to a total period of performance of five years, will be contingent upon meeting early milestones and future annual appropriations.

Objective 1.2—Develop commercialization skills in DOE Laboratory researchers and students.

Commercialization is not often integrated as part of the curricula for undergraduate and graduate students studying scientific and technical fields. Training on the various pathways for technologies to reach the marketplace includes a deep understanding of societal, industry, and market needs, regulations (e.g., siting and permitting for large demonstration and research infrastructure), as well as costs for manufacture and achieving economies of scale. To fill this gap, OTT has created a suite of programs to teach researchers across DOE Laboratories and universities to apply a commercialization lens to their technologies and identify ways to advance across critical commercialization phases (e.g., from basic and applied research to development). These programs aim to raise awareness of how to connect technologies to market needs and accelerate the pace of technology developments to the market.

This objective includes three key program activities—(1) the Energy I-Corps (EIC) program, (2) EnergyTech University Prize (EnergyTech UP), and (3) the Technology Commercialization Internship Program (TCIP).³⁴

EIC Program—To better arm researchers to collaborate with industry and turn research and development into demonstration and deployment, OTT employs a suite of efforts (Figure 4) under the Energy I-Corps portfolio to help researchers gain industry insight to guide innovation and advance energy-related technologies toward commercialization.

³⁴ In addition to the programs under Objective 1.2, OTT also supports commercialization skills through TCF and EPIC (refer to Objective 1.1).

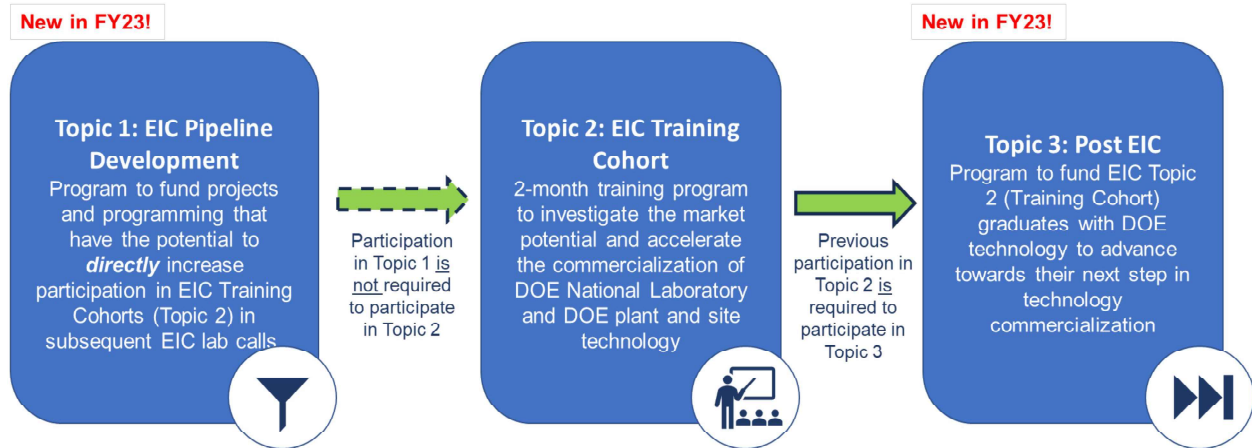


Figure 4. Overview of EIC Program for FY 2023

The founding program under the Energy I-Corps umbrella is the Topic 2 Training Cohorts offering. Established in 2015, and integrated into the OTT portfolio in 2018, the EIC program's training cohorts supports teams of DOE Laboratory researchers and industry mentors through an intensive 10–12 week training program in which the researchers define technology value propositions, conduct 75 stakeholder discovery interviews, and develop viable market pathways for their technologies.³⁵ Researchers return to their labs with a framework for industry engagement to guide future research and inform a culture of market engagement within the lab environment. In FY 2021, EIC hosted its 12th and 13th cohorts; in FY 2022, virtually hosted its 14th and 15th cohorts; and in FY 2023 hosted its 16th and 17th cohorts (Table 1).

Table 1. EIC Program Team, Participants, Select Activities, and Program Offices Supporting Funding from FY 2021 to FY 2023.

FY Cohorts	Funding** (\$)	Number of Teams	Participants	Select Activities	Number of DOE Program Offices Supporting Funding
2021 12 th and 13 th cohorts	2,550,000	33	106	2,400+ customer discovery interviews	14 program offices: AMO, BETO, BTO, FE, HFTO, NE, NNSA, OE, OS, OTT, SETO, VTO, WETO, WPTO
2022 14 th and 15 th cohorts	2,000,000	25	84	1,800+ customer discovery interviews	11 program offices*: AMO, BETO, FECM, NE, NNSA, NREL, OE, OS, SETO, VTO, WETO, WPTO
2023 16 th and 17 th cohorts	1,920,000	24	75	1,700+ customer discovery interviews	13 program offices: AMMTO, BETO, BTO, CESER, FECM, GTO, HFTO, NE, NNSA, OE, SETO, VTO, WETO, WPTO

* In addition to the 11 DOE program offices and semi-autonomous agencies, NREL, a DOE Laboratory, funded a team. Note: Program Office abbreviations—Advanced Manufacturing Office (AMO), Bioenergy Technologies Office (BETO), Building Technologies Office (BTO), Office of Fossil Energy and Carbon Management (FECM), Hydrogen and Fuel Cell Technologies Office (HFTO), Office of Nuclear Energy (NE), National Nuclear Security Administration (NNSA), National Renewable Energy Laboratory (NREL), Office of Electricity (OE), Office of Science (SC), Office of Technology Transitions (OTT), Solar Energy Technologies Office (SETO), Vehicle Technologies Office (VTO), Wind Energy Technologies (WETO), Water Power Technologies Office (WPTO)

**Does not include program management costs.

³⁵ DOE. "About Energy I-Corps," <https://www.energy.gov/technologytransitions/about-energy-i-corps>.

In both FY 2021 and FY 2022, OTT funded an opportunity for DOE Laboratories to provide an EIC program that introduces scientists to the commercialization concepts on a relatively less intensive timeline than the training cohorts. This program addressed feedback from scientists and engineers that were interested in participating but could not commit the time for the full program. All 17 National Laboratories participated. For FY 2023, OTT further iterated on this opportunity. Renamed Topic 1: Pipeline Development, funding is awarded for selected DOE Laboratories to implement projects and programming that have the potential to directly increase participation in subsequent Energy I-Corps training cohorts. OTT provides each DOE Laboratory the flexibility to develop a program to best serve their unique research community while seeding the idea of participation in Topic 2 Training Cohort. In FY 2023, nine projects supporting 11 labs were selected. The cumulative goals of the FY 2023-selected projects aim to provide lab-specific entrepreneurial training to over 80 researchers and increase the number of submissions to the 2024 Energy I-Corps training cohorts by more than 15 new submissions.

In FY 2023, OTT also introduced Topic 3: Post-EIC, which provides follow-on funding the most promising Topic 2: training cohort graduates with a high likelihood of commercializing their technology (**Error! Reference source not found.**). Teams receive funding to cover costs of the next actionable step in their technology's commercialization and facilitate the teams in reaching their next source of more substantive support to continue their commercialization journey. The cumulative goals of the FY 2023 projects aim to engage over 25 new external partners, produce five new DOE Laboratory Cooperative Research and Development Agreements or patent license agreements, create five new prototypes, and implement eight new technology tests or deployments. Each project also has specific DEIA goals, including outreach to underrepresented customer segments and engagement with students from underrepresented groups. Refer to Box: EIC Program Impacts Reach Across the Nation and Box: EIC Funding Seeds the Idea and TCF Funding Enables the Creation of a Company.

EIC Program Impacts Reach Across the Nation

Since the launch of the EIC program in 2015, 212 teams across 12 National Laboratories have participated in the full program (Figure 5). Numerous teams have applied the training and skills received through the program to further develop their technologies and create start-up companies in the clean energy sector. Since completing the program, participants have received over \$170M in follow-on funding to mature their technologies, executed over 75 licenses, and launched more than 20 new businesses.

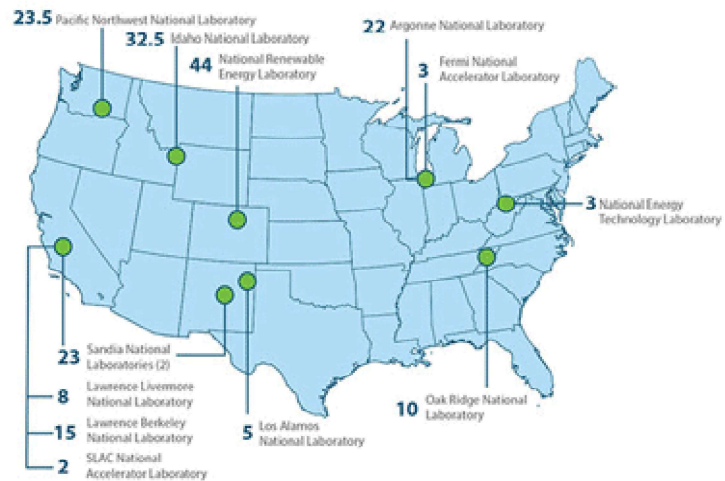


Figure 5. EIC program teams across National Laboratories since 2015.



Figure 6. Energy I-Corp participant and now Gamma Reality Inc. Co-founder Erika Suzuki, with the Localization and Mapping Platform (LAMP) technology.

One notable EIC alumni team, from Lawrence Berkeley National Laboratory and funded by DOE's Office of Environmental Management, founded a startup, Gamma Reality Inc. (GRI), which employs 11 people. Based in the San Francisco Bay Area, GRI's mission is to make radiation detection safer and more efficient through real-time, 3D radiation mapping technologies. The team went through Energy I-Corps in Fall 2017 and spun out a new company after graduating. GRI's commercially available technology, the Localization and Mapping Platform, LAMP, (Figure 6) is applied to support nuclear power operations and facility decommissioning; emergency response; and chemical, biological, radiological, nuclear, and energetic materials response. GRI's products have been successfully deployed in real world radiation environments, including Fukushima, Japan, and the Chernobyl Exclusion Zone in Ukraine, to map radioactive contamination.

Read the full Gamma Reality, Inc success story here: <https://www.energy.gov/technologytransitions/articles/gamma-reality-inc-game-changer-radiation-detection>.

EIC Funding Seeds the Idea and TCF Funding Enables the Creation of a Company

Jake Gentle and the team at Idaho National Laboratory (INL) developed a software technology called General Line Ampacity State Solver (GLASS), which enables greater utilization across power transmission infrastructure. GLASS takes in live weather data to calculate more accurate transmission line limits, so utilities can enable additional capacity while also reducing operating costs, creating a more efficient grid.

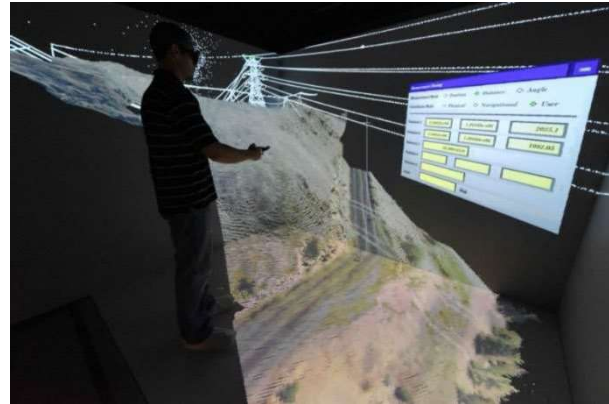


Figure 7. Figure Jake Gentle conducts critical infrastructure analysis using General Line Ampacity State Solver (GLASS) software.

In 2016, Jake Gentle and Donna Rennemo went through Energy I-Corps, funded by WETO, and realized the power of combining GLASS with existing technology from Donna's then-employer, WindSim Americas Inc. The team leveraged their 2017 TCF award from WETO to integrate the two solutions. A new company called WindSim Power Inc. was formed and WindSim Power has since demonstrated their solution with a series of partners including Idaho Power, NY Power Authority, Altalink, and Avangrid.

They recently assisted INL in incorporating WindSim Power's technology into the North American Energy Resilience Model, a tool for the Federal Government to evaluate the energy infrastructure and respond to catastrophic events like natural disasters or cyber-attacks. WindSim Power is wrapping up a 3-year engagement with New York Power Authority, positioning them to take on bigger contracts.

Source: DOE, "WindSim Power Commercializes GLASS Dynamic Line Rating Technology," available at <https://www.energy.gov/technologytransitions/articles/windsim-power-commercializes-glass-dynamic-line-rating-technology>.

EnergyTech UP—Established in FY 2021, this entrepreneurial, experiential learning program for university students has trained more than 500 participating university students in technology commercialization skills, awarded \$275,000 to progress impactful energy solutions, and empowered students from historically underrepresented demographic groups in scientific and technical fields. The prize competition awards national and regional prizes funded by OTT and awards bonus prizes funded by specific DOE program offices. DOE program offices participating include the Office of Energy Efficiency and Renewable Energy, the Office of Fossil Energy and Carbon Management, and the Office of Nuclear Energy. The EnergyTech UP program also supports DOE's commitments under the J40 Initiative.

In FY 2022, EnergyTech UP enabled more than 600 students from 180 teams across 113 universities to develop solutions and present to judges, identified 17 teams as winners with the highest potential to accelerate energy technology commercialization. In FY 2023, EnergyTech UP expanded the number of applicant teams, accepting 186 teams from 124 universities. Twenty-three teams were identified as winners and select teams presented to judges in-person at the Energy Thought Summit in Austin, Texas, held in April 2023 (Figure 8). Over FY 2022 and

FY 2023, teams from 48 states, the District of Columbia, and 3 territories have participated in the prize competition. Refer to Box: EnergyTech UP Participants Gain and Apply Commercialization Knowledge and Skills.

EnergyTech UP Participants Gain and Apply Commercialization Knowledge and Skills

Over 1,100 students have completed the EnergyTech UP program since launching in 2021, including FY 2023 participants. Program-end surveys revealed the positive impact of the program—

- Of 141 competitors who responded to a feedback questionnaire, 110 (78 percent) reported an increased interest in an energy career, and
- 120 (85 percent) reported an increased knowledge of the skills required for technology commercialization.

Further demonstrating EnergyTech UP's impacts are EnergyTech UP alumni Jacob Kumpon and Jack Lamuraglia. They founded Klaw Industries in 2019 and developed a raw material called Pantheon™, which is a carbon-negative replacement for cement made from waste glass diverted from landfills. They have raised \$1.36 million in non-dilutive funding, including a \$25,000 Prize awarded by FECM as part of EnergyTech UP 2022 competition and a \$400K SBIR award from the EPA. In July 2023, Klaw won first place at OTT's EPIC Prize pitch competition, taking home \$100,000 to purchase a new truck for operations. Today, they have completed over 60 pilot projects and sold close to 50 tons of their Pantheon™ material.

Read the full Klaw Industries success story here:

<https://www.energy.gov/technologytransitions/articles/klaw-industries-developing-pantheonm-carbon-negative-replacement>.



Figure 8. Celebrating Klaw Industries' first place EPIC Prize pitch competition with OTT Director & Chief Commercialization Officer Dr. Vanessa Chan, Klaw Industries Co-Founder Jacob Kumpon, Secretary of Energy Jennifer Granholm, and Director of Office of Small And Disadvantaged Business Utilization Ron Pierce.

TCIP—Few graduates enter the workforce equipped with formal training, education, or experience in technology transfer and commercialization. To help fill this workforce gap, OTT sponsors and manages TCIP. Formerly named the OTT Entrepreneurship Program, TCIP is a unique paid opportunity for undergraduate science, technology, engineering, and mathematics (STEM) and business students to experience DOE world-class laboratory system, boost their entrepreneurial thinking, and explore energy technology markets. Interns engage with National Laboratory mentors and learn about technologies developed by laboratory researchers. This internship focuses on the business side of technology commercialization in which interns learn and apply skills, such as customer discovery, value proposition development, and market size analysis. TCIP also supports DOE's commitments under the J40 Initiative. In addition, the National Laboratories also used TCIP as a talent pipeline for recruitment. The TCIP kicked off in FY 2021 with 17 students from diverse backgrounds. In FY 2022, 19 students were selected, and, within one month of completing the internship, four students received internship extensions and three students received full-time offers from their assigned National Laboratory.

FY 2023 TCIP Program Received Record High Number of Applicants



Figure 9. FY 2023 TCIP Interns

In FY 2023, 305 diverse applicants submitted to the TCIP program for 15 internship positions. Of the 15 interns, 11 (73 percent) come from a disadvantaged community as defined by J40 (Figure 9). Interns include students who attend a minority-serving institution (MSI) and students who come from underserved communities covered under the J40 initiative. (Refer to Cross-Cutting Approaches, Cross-Cut 1: Increase diversity, equity, inclusion, and accessibility (DEIA) for further on the J40

Initiative).

Outlook for Goal 1

OTT plans to strengthen its collaborations with DOE program offices to create relevant and mission-appropriate programs in support of the diverse needs across DOE. Under its commercialization funding programs, OTT will launch FY 2024 base annual appropriations solicitations and obligate all funding. OTT also expects to launch six new BIL TCF programs totaling \$90 million or more in funding by the end of FY 2025. OTT will continue to work with partners across DOE in the coming years to launch additional programming as well as iterate and adapt to continuously improve programs, for example, through systematic evidence collection and robust evaluations.

In FY 2024, OTT will continue to publish and amplify stories that highlight the achievements and impact of past OTT Program participants. As of early December 2023, OTT has published 11 success stories. Existing publications include spotlighting an Energy I-Corps team that spun out and grew to be an 11-person company developing real time 3-D radiation mapping technologies³⁶ and an EPIC awardee that started a new cleantech accelerator for the Tennessee region, raising over \$34M in follow-on funding and creating over 46 jobs.³⁷

³⁶ DOE. "Gamma Reality, Inc. – A Game Changer for Radiation Detection," <https://www.energy.gov/technologytransitions/articles/gamma-reality-inc-game-changer-radiation-detection>.

³⁷ DOE. "SPARK Cleantech Accelerator Bolsters Innovation for Tennessee Region," available at <https://www.energy.gov/technologytransitions/articles/spark-cleantech-accelerator-bolsters-innovation-tennessee-region>.

In addition, OTT plans to collect lessons learned from EPIC awardees to refine and expand the program. Thus far, OTT has improved EPIC by implementing a novel prize to cooperative agreement structure, including startup pitch competitions, and better outreach to rural and disadvantaged communities to raise awareness of the funding opportunity. Moreover, OTT continues to work with other DOE program offices, such as the Office of Small and Disadvantaged Business Utilization (OSDBU), and external stakeholders to collaborate on leveraging EPIC's incubator community and prize platform.

OTT will continue to support and identify target regions and activities to encourage place-based innovation. In the spring of 2023, OTT and DOE's Office of Science released a Request for Information (RFI) seeking input on opportunities to strengthen place-based innovation activities leveraging DOE Laboratories. OTT plans to incorporate feedback from this RFI into future policy initiatives and program design.

Under its talent development programs, OTT plans to improve EIC by engaging with more DOE program offices and DOE Laboratories. In addition, OTT plans to better promote alumni participation in other OTT programs to ensure the full value of the skills and commercialization potential from EIC are realized. In FY 2024, OTT will announce its first Faculty prize winners for the inaugural EnergyTech UP Faculty Track which expands EnergyTech UP's inclusivity and increases outreach to and participation from educators. In addition, in FY 2023, TCIP interns will have the opportunity to visit their assigned National Laboratory during their internship. In FY 2024, OTT plans to support funding for students to conduct their entire internships in-person at their respective National Laboratory.

Refer to Table 2 for a summary of key performance metrics and milestones through FY 2025 related to Goal 1.

Goal 2: Infuse private sector thinking into market analytics and tools to shape decision making.

DOE recognizes the critical need to ground commercialization approaches in market realities. This approach seeks to start with what the market needs and then subsequently support the development of technology-based solutions that meet those needs. As such, OTT invests in market analysis capabilities to drive market-based and private sector thinking. Specifically, OTT supports the development and application of market analysis skills and professional services to DOE program offices and DOE Laboratories. DOE continues to expand its market and commercialization analytical capabilities and leverage those capabilities across DOE Laboratories to illuminate technology market trends and drivers, enable transitions of technology across the RDD&D continuum, and maximize the impact of taxpayer dollars on public outcomes. In particular, OTT conducts market analyses that explore market structures and commercial-adoption risks as well as help identify commercialization opportunities for new technologies. OTT facilitates the development and application of market analysis content, methodologies, and data services across DOE program offices. In addition, OTT convenes a community of practice, in coordination with DOE Laboratories, to promote market awareness

and share information, resources, and methodologies to expand commercialization opportunities for DOE technologies.

Objectives under Goal 2

There are two objectives under Goal 2—

- Objective 2.1—Integrate private sector and market perspectives to inform DOE investments and pathways from laboratory to market.
- Objective 2.2—Create and disseminate commercialization analysis capabilities within DOE and across the DOE Laboratories.

Objective 2.1—Integrate private sector and market perspectives to inform DOE investments and pathways from laboratory to market.

DOE has been historically challenged in identifying a cohesive approach for making investment decisions that complement and further private sector uptake of decarbonization technologies. Meanwhile, DOE has substantially expanded its demonstration and deployment activities through the passage of the BIL and IRA. There is a need to integrate private sector thinking into DOE’s investment approach more broadly. To achieve full commercial deployment of DOE technologies, the clean energy investments made through BIL and IRA must drive the activation of \$23 trillion—the expected size of the global clean energy market by 2030.³⁸ This situation creates a need for deeper understanding of energy and related technology markets to identify data-informed commercialization opportunities through economic, market, and other analytical approaches. To orient DOE toward a market-based approach to inform investment decisions, OTT has worked with several DOE program offices, including OCED and the Loan Programs Office (LPO), to incorporate market-based analytical metrics into the selection process for FOAs.

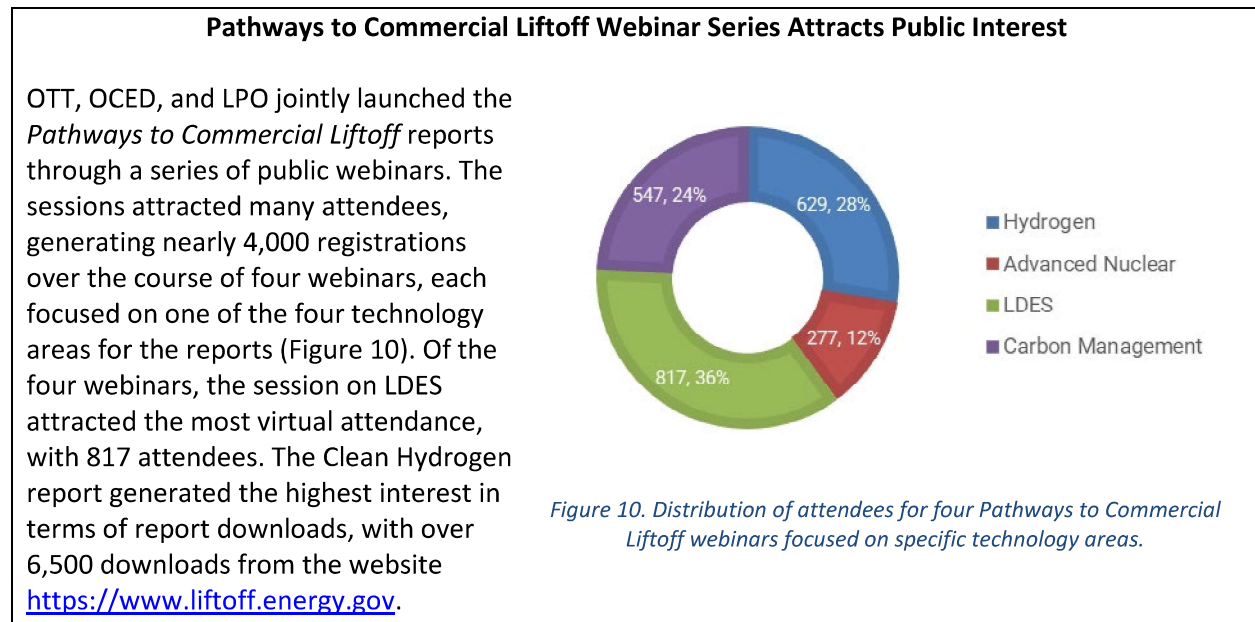
This objective includes one key activity—continuing to build out the *Pathways to Commercial Liftoff* reports.

Pathways to Commercial Liftoff Reports—Since initiating this effort in FY 2022, OTT played an integral role in the development of four *Pathways to Commercial Liftoff* reports, which provide risk analytics in support of OCED’s portfolio planning activities.³⁹ For example, the *Liftoff* reports have helped inform investment decisions that activated public-private sector investments for the seven clean hydrogen hubs announced in October 2023. The efforts to develop the *Liftoff* reports illustrate collaborative relationships among several DOE program offices—OTT co-led these efforts with OCED and LPO, and worked closely with EERE, FECM, NE,

³⁸ DOE. “DOE Fact Sheet: The Bipartisan Infrastructure Deal Will Deliver For American Workers, Families and Usher in the Clean Energy Future,” available at <https://www.energy.gov/articles/doe-fact-sheet-bipartisan-infrastructure-deal-will-deliver-american-workers-families-and-0>.

³⁹ DOE. “About the Liftoff Reports,” available at <https://liftoff.energy.gov/about-the-liftoff-reports/>.

GDO, and OE, among others. This effort supplements ongoing DOE initiatives to accelerate technology commercialization activities in high-priority cross-cutting efforts, such as the Energy Storage Grand Challenge.⁴⁰ DOE intends that these analyses will support DOE decision-making for key funding programs, as well as activate private sector actors, including capital allocators, technology companies, and project developers to accelerate commercialization of clean energy technologies. Refer to Box: Pathways to Commercial Liftoff Webinar Series Attracts Public Interest.



Objective 2.2—Create and disseminate commercialization analysis capabilities within DOE and across the DOE Laboratories.

To reach technology deployment, technologies must be de-risked and ecosystem economics established so that stakeholders in the value chain have a viable economic model. OTT supports the development of tools that describe project and adoption risks according to these criteria to guide investment decisions and drive private sector uptake of DOE clean energy technologies.

This objective includes one key activity—developing a new framework for market adoption.

Development of Tools and Frameworks—OTT has developed (Commercial) Adoption Readiness Levels (ARLs), a new OTT-developed framework. The ARLs are designed to help DOE program offices understand both barriers to and opportunities for moving a technology along the RDD&D continuum and to aid in decision-making for investments. Technology Readiness Levels (TRLs) serve as a basis for assessing technology risk, while market risk is determined by

⁴⁰ DOE. “Energy Storage Grand Challenge,” available at <https://www.energy.gov/energy-storage-grand-challenge/energy-storage-grand-challenge>.

performing a high-level assessment across numerous dimensions of market adoption. OTT published the framework and plans to collaborate with multiple DOE program offices to integrate ARLs into strategic planning and standard operating procedures in FY 2023.

Since its inception, ARLs have been embraced across DOE. OTT's EIC program has incorporated ARLs into its curriculum and it has been a critical tool for entrepreneurs to understand barriers beyond technology that need to be understood to drive commercialization. The Office of Clean Energy Demonstrations has also used it as the backbone for their Multiyear Portfolio Planning Report to manage the risk of their portfolio investments. There also has been traction external to DOE with the Geneva Association (insurance consortia) adapting ARLs for the insurance industry, ASTM creating a subcommittee to explore its development as an industry standard, and the National Science Foundation incorporating it into their I-Corps curriculum.

Outlook for Goal 2

OTT will continue collaborating with partner offices to accelerate DOE efforts to commercialize and achieve liftoff of innovative technologies needed to address national climate, economic, and security goals. In this vein, OTT plans to work on additional *Pathways to Commercial Liftoff* reports in collaboration with program offices across DOE and publish at least eleven of these reports by the end of 2024. OTT will also continue working to integrate ARLs into DOE offices' strategic planning and standard operating procedures in FY 2024, while also publishing the ARL framework for public consumption.

Ensuring a rigorous and consistent knowledge base that supports DOE's funding decisions requires a coordinated, in-house capacity for conducting commercialization analyses targeting key market sectors. Developing and maintaining that capability requires leveraging and harmonizing existing analytical expertise across the lab complex and supporting new capacity building across the labs. OTT is collaborating with DOE program offices and the DOE Laboratories to better understand the market analysis capabilities that exist at each of the laboratories, including how those capabilities have been utilized historically and how they might be used in the future to meet DOE's broader needs for market analysis. A capability such as this will support and enable successful outcomes for current DOE priorities, such as the Energy Earthshots Initiative⁴¹ and Joint Strategy teams portfolios. It will also, ideally, evolve into a nationally recognized source of analysis for hardtech deployment scenarios including the facets of infrastructure development and secure supply chains.

Going forward, OTT will develop a framework for building DOE Laboratory capacity to perform the market analysis necessary to support commercialization and deployment outcomes. OTT will continue to engage those in the technology transfer community who perform market analysis work through the Market Analysis Community of Practice (MACOP), which is a Subcommittee under the Technology Transfer Working Group (TTWG) (refer to Goal 2). OTT

⁴¹ DOE. "Energy Earthshots Initiative," available at <https://www.energy.gov/energy-earthshots-initiative>.

also aims to serve as an internal resource for program offices to help them connect with subject matter experts that can meet their market analysis needs.

Refer to Table 2 for a summary of key performance metrics and milestones through FY 2025 related to Goal 2.

Goal 3: Advance policies and activate partnership mechanisms that address DOE Laboratory and other commercialization barriers.

Legislation, regulations, and agency policies govern the availability of mechanisms to support technology transfer, transition, and commercialization. It is important for these policies to facilitate rather than hinder partnerships that boost America's competitiveness and provide an enabling environment to accelerate the secure movement of technologies from the laboratory to the private sector. DOE aims to use robust analytical approaches to continuously refine existent policies meanwhile developing new ones to address the rapidly evolving technology and business needs in today's fast-moving marketplace.

Objectives under Goal 3

There are three objectives under Goal 3—

- Objective 3.1—Align the DOE innovation ecosystem, including DOE Laboratories, on ways to make commercialization processes more effective.
- Objective 3.2—Activate innovative partnership mechanisms to make it easier to engage with DOE programs and DOE Laboratories.
- Objective 3.3—Collect and analyze DOE laboratory technology transfer activities to inform performance and policymaking.

Objective 3.1—Align the DOE innovation ecosystem, including DOE Laboratories, on ways to make commercialization processes more effective.

The DOE enterprise is vast and organized to tackle diverse research and technology areas in support of its mission. As such, achieving a consistent and harmonized strategic approach to commercialization, and, in particular, aligning common interests and solutions across many DOE stakeholders involves deep understanding and coordination to develop policies that address their needs. Effective policymaking is achieved through an inclusive, collaborative, and participatory approach with DOE ecosystem stakeholders that implement and are impacted by these policies. Key stakeholders include DOE program offices, in particular the stewards of DOE Laboratories; site and field offices; DOE Laboratories; other Federal stakeholders; external energy innovation communities, such as industry and small businesses; and end users of energy technologies. This communication, coordination, input, and feedback is vital to ensure that policies are sound, effective, and efficient.

This objective includes three key activities focused on coordination with vital stakeholders—coordination with DOE Laboratories, DOE Headquarters elements, and across the interagency.

Coordination with DOE Laboratories—OTT supports coordination and facilitates sharing of best practices among the DOE Laboratories, for example, through the TTWG and the NLTT Council. The TTWG is a coordinating body consisting primarily of technology transfer professionals from DOE Laboratories, with participation from DOE field and site offices. The NLTT is a council comprising the technology transfer leads for DOE’s 17 National Laboratories appointed by the individual laboratory directors and housed under the National Laboratory Directors Council. OTT engages with the NLTT and TTWG’s executive board, subcommittees, communities of practice (COPs), and ad hoc working groups, which are short-term groups that focus on specific areas of interest throughout the year. Over FY 2021 through FY 2023, OTT has strengthened its coordination and oversight of the TTWG by representing on and co-leading various efforts alongside TTWG members, for instance on two COPs on market analysis and communications. In March 2023, TTWG established an ad hoc working group, co-led by OTT and Lawrence Livermore National Laboratory, to develop recommendations for the FESI, DOE’s first agency-associated foundation (refer to Objective 3.2) and outlining opportunities for collaboration with DOE Laboratories and the four extant laboratory-associated foundations. This input is a valued and necessary perspective in helping to shape the path forward.

Coordination with DOE Headquarters Elements—OTT chairs and convenes the Technology Transfer Policy Board (TTPB), an internal DOE body established by the Secretary of Energy in 2007 and made up of representatives from 21 DOE headquarters elements with interests in technology transfer. The TTPB offers a forum for dialogue, sharing, and coordination of solutions for improving DOE’s technology transfer and commercialization outcomes. Refer to Box: Tech Transfer Data Committee Supports Execution of Annual Data Call. In addition, OTT serves as a member and provides input on several internal coordination and working groups focused on research security; IP and license protections; manufacturing policy; export control for patents, and open science; among other topics impacting technology transfer and commercialization of DOE-funded technologies.

Tech Transfer Data Committee Supports Execution of Annual Data Call

DOE Policy 482.2 requires OTT to collect unclassified technology transfer-related data from the DOE Laboratories in coordination with their stewarding DOE program offices. The policy also established the Technology Transfer Data Committee (TTDC), which serves under the TTPB.

The Policy further states: “The committee will be consulted by OTT prior to making changes to the structure of the TT Data or any elements within it, including changes based on Technology Transfer Working Group (TTWG) recommendations, interagency metrics requirements (as required by statute or regulation), or other material changes and clarifications. After consultation with the committee, decisions on collection and management of all TT Data will be made by the Director of OTT.”

OTT has developed internal data dashboards to support sharing of certain data across the DOE Laboratories. This dashboard provides an opportunity for benchmarking and trends analysis to better understand outputs and outcomes associated with technology transfer and commercialization activities.

Coordination across the Interagency—DOE’s interagency coordination across the Federal Government on technology transfer and commercialization ensures that the impacts from taxpayer’s investments can be fully maximized. For example, the White House Office of Science and Technology Policy (OSTP) through the National Science and Technology Council Lab-to-Market (L2M) Subcommittee is co-chaired by OSTP, OTT, and the Department of Commerce’s National Institute for Standards and Technology (NIST). This forum allows the interagency to implement whole-of-government solutions to address administrative and regulatory burdens, needs for tools and services, communication strategies, and understanding of the funding landscape and communities supported through each Department and agency across the Federal Government to advance technologies across the RDD&D continuum. Other interagency policy coordination is conducted through the Interagency Working Group on Technology Transfer, which is also led by NIST. The Federal Laboratory Consortium for Technology Transfer (FLC) is another avenue by which coordination and sharing across the Federal technology transfer community, as well as across the Federal laboratory enterprise occur.⁴² The FLC is a cross-agency organization with a network of over 300 Federal laboratories to foster commercialization from Federal Laboratories into the marketplace.⁴³

Objective 3.2—Activate innovative partnership mechanisms to make it easier to engage with DOE programs and DOE Laboratories.

A persistent challenge in DOE’s support for technology transfer and commercialization is the perception among innovation ecosystem stakeholders, including industry and small businesses, that engagement with DOE and funding opportunities is overly burdensome and complex. In

⁴² FLC was formally chartered by the Federal Technology Transfer Act of 1986 (15 U.S.C. § 3710).

⁴³ FLC, “Who We Are,” available at <https://federallabs.org/about/who-we-are/mission-vision>.

addition, there is a perception that collaborations with DOE Laboratories are difficult due to differing policies and their interpretation and practice. DOE supports the development of policy initiatives that streamline the ways of engaging and partnering with DOE programs and DOE Laboratories, respectively.

This objective includes two key activities—innovative funding mechanisms and DOE’s first agency-related foundation, the Foundation for Energy Security and Innovation (FESI).⁴⁴

Innovative Funding Mechanisms—Developing and utilizing innovative funding mechanisms are critical for simplifying engagement with DOE programs.⁴⁵ From FY 2021 to FY 2022, OTT supported analyses on ways to enhance the use of DOE’s OT authority and partnership intermediary agreements (PIAs). OTT engaged across DOE Laboratories and DOE program offices to identify barriers, solutions, and potential use cases for these mechanisms. OTT conducted a DOE-wide webinar in FY 2022 to describe findings and seek input on policy recommendations and further raised awareness of these mechanisms and potential use cases through presentations at invited internal workshops.^{46, 47} These efforts spurred DOE leadership to establish an Innovative Funding Mechanisms Working Group in August 2022, with representation from DOE program offices, OTT, the Office of the General Counsel, Office of Management, and contracting officers across site and field offices. The charge for this working group, among others, was to launch a DOE-wide PIA pilot. In addition, the Working Group developed guidance to raise awareness and facilitate the establishment of OT agreements to make full use of DOE’s authority.

The federal-wide authority to use partnership intermediaries was provided by Congress to Federal laboratories in 1991. A partnership intermediary is defined as an “agency of State or local government, or nonprofit entity owned, chartered by, funded, or operated on behalf of the State or local government.”⁴⁸ A partnership intermediary can engage in activities with academic institutions and industry, including small businesses, to increase the likelihood of successful cooperative or joint activities with Federal laboratories. In FY 2021, OTT piloted one instance of the PIA through its PACT program to support technology transfer capabilities at four

⁴⁴ Goal 3, Objective 3.2 is strongly linked to Goal 1, Objective 1.1, which focuses on the development of commercialization programs to facilitate movement of technologies from lab to market. Feedback from advancements in policy to address technology transfer and commercialization barriers informs new program design and implementation. Policy activities are also informed through commercialization programs, such as TCF’s suite of programs and the PIA’s programmatic execution, which can identify needs and potential solutions to achieve improved commercialization outcomes.

⁴⁵ Innovative funding mechanisms span efforts across OTT’s teams supporting both policy and commercialization programs in execution of certain innovative agreements (refer to Goal 1), such as the PIA.

⁴⁶ OTT, “Briefing on the Other Transactions (OT) Authority,” April 7, 2022, virtual presentation.

⁴⁷ Gonzales-Harsha, Marcos, Passarelli, Derek, Carabajal, Stephanie, and Peña, Vanessa, “Background and Options to Enhance Use of DOE’s Other Transactions (OT) Authority,” available at <https://science.osti.gov/-/media/fes/pdf/fes-presentations/2022/Harsha-OT-Authority-Briefing-Fusion-Workshop.pdf>.

⁴⁸ 15 U.S. Code § 3715.

of DOE's single-purpose laboratories.⁴⁹ The partnership intermediary enhanced technology transfer capabilities at these National Laboratories by hosting technology showcases, conducting market analysis, and identifying promising technologies that could be of interest to potential collaborators or private partners.

Stemming from DOE's coordination efforts, DOE launched a first-of-a-kind DOE-wide PIA pilot in April 2023. Potential activities under the PIA pilot include 15 defined priorities in furtherance of DOE's mission, including facilitating and managing innovation hubs and public-private partnerships; performing technology and market research and scouting; acting as an independent facilitator among DOE program offices, DOE Laboratories, and external solution providers; and facilitating rapid prototyping, demonstration, deployment, and manufacturing.⁵⁰

OTT is managing the execution of the DOE-wide PIA pilot, and, as of November 30, 2023, the PIA Pilot has approved 12 PI project orders with a potential aggregate funding level of \$130M in partnership with 11 DOE program offices. These projects include, but are not limited to:

- A \$32M Voucher Program to provide commercialization support to organizations involved in bringing energy technology to market (refer to Goal 1);⁵¹
- A \$80M Industrial Assessment Center Implementation Grant Program funded by the Bipartisan Infrastructure Law providing grants to small and medium manufacturers;⁵²
- A \$3.5M Capacity Building for Repurposing Energy Assets initiative to help communities across the country create a roadmap toward repurposing the energy assets;⁵³
- A \$10.6M Renewable Energy Siting through Technical Engagement and Planning (R-STEP) program to support the creation of new, or the expansion of existing, state-based programs or initiatives that improve renewable energy siting processes at the state and local levels; and
- A \$750,000 Supply Chain Analysis project to assess clean energy supply chains, synthesize existing supply chain expertise from across DOE, and build a single, concise resource that summarizes supply chain issues in a standardized framework.⁵⁴

⁴⁹ Princeton Plasma Physics Laboratory (PPPL), SLAC National Accelerator Laboratory, Fermi National Accelerator Laboratory (Fermilab), and Thomas Jefferson National Accelerator Facility (Jefferson Lab).

⁵⁰ Grants.gov, "DE-FOA-0002930 DOE Partnership Intermediary Pilot, Department of Energy, Golden Field Office," available at <https://www.grants.gov/web/grants/view-opportunity.html?oppld=344712>.

⁵¹ Energy.gov, "DOE Announces New \$27.5M Voucher Program to Bring Innovative Energy Technologies to Market," <https://www.energy.gov/technologytransitions/articles/doe-announces-new-275m-voucher-program-bring-innovative-energy>.

⁵² Energy.gov, "Industrial Research and Assessment Center Implementation Grants," available at <https://www.energy.gov/mesc/industrial-research-and-assessment-center-implementation-grants>.

⁵³ Energy.gov, "DOE Announces \$3.5 Million to Provide Workforce Development Opportunities in Energy Communities," available at <https://www.energy.gov/fecm/articles/doe-announces-35-million-provide-workforce-development-opportunities-energy>.

⁵⁴ Energywerx.org, "DOE OTT Supply Chain Analysis Assessment Event (AE)," available at <https://www.energywerx.org/opportunities/doe-ott-assessment-event>.

Through these and anticipated future PIA projects, OTT expects the PIA to enhance DOE's mission impacts. The PIA is a key initiative to address general concerns regarding the burden and complexity of DOE's traditional funding pathways and the needs to strengthen engagement with non-traditional partners, including startups, communities, and under-represented institutions and organizations.

FESI—In May 2024, DOE appointed the Board of Directors for FESI, which is mandated by Congress to support the DOE mission and accelerate the commercialization of energy technologies. Together with the Office of the Secretary of Energy, OTT co-chairs an internal working group planning for the establishment of the FESI. OTT also hosted a workshop with participants from across sectors, including DOE, venture and private funders, and nonprofits and philanthropy. In addition, OTT released a Request for Information (RFI) to gain further input from the public regarding how DOE could engage with the FESI, among other topics.⁵⁵ These and other engagement activities will inform DOE on the potential opportunities and gaps that the FESI could help fill.

Objective 3.3—Collect and analyze DOE laboratory technology transfer activities to inform performance and policymaking.

Traditional measures and metrics of technology transfer activities, such as those based on counts of number of patents and licenses, provide a limited picture of the broader impacts of these activities. Effective decision and policymaking are informed by the collection and analysis of data and broad technology transfer and commercialization impacts, including economic, national security, and climate goals. Evidence-based policymaking ensures that policies aimed at addressing barriers to DOE technology transfer and commercialization are informed by systematic collection and analysis of evidence. OTT supports policies that track outcomes as well as share best practices and success stories from DOE's commercialization and partnering activities.

This objective includes two key activities regarding technology transfer performance measurement—OTT's management of DOE's annual technology transitions data call and OTT's contributions to the annual laboratory appraisal process.

DOE Annual Technology Transitions Data Call—DOE-wide technology transfer data and metrics collection, management, analysis, reporting, and evaluation are a core function of understanding performance and outcomes. In accordance with DOE Policy 482.2, OTT manages an annual data call, which provides information on three non-classified technology transfer partnership agreement mechanisms—strategic partnership projects (SPPs), collaborative research and development agreements (CRADAs), and agreements for commercializing technology (ACTs). Analysis of the data on agreements enables leadership within DOE and

⁵⁵ DOE. Request for Information-Foundation for Energy Security and Innovation (FESI). 88 Federal Register 9876 (February 15, 2023).

across DOE Laboratories to explore the nature and extent of the work and the types of partners that engage in technology transfer and commercialization activities. In addition, this effort is part of statutory intramural reporting requirements to include metrics associated with DOE's technology transfer activities, such as the number of patents, licenses, and earned royalty income, among others.⁵⁶ OTT has maintained, assessed, and stored information from the annual data call since FY 2015, providing a rich source of information for analyzing historical trends.

Laboratory Appraisal—DOE program offices that steward the DOE Laboratories annually assess laboratory performance through the Performance Evaluation and Management Plans (PEMP). The PEMP evaluations provide the basis for determining annual performance fees and the possibility of renewing management and operating contracts. To provide feedback and recommendations regarding the importance of technology transfer and commercialization in the annual PEMPs, OTT stood up the Laboratory Appraisal Working Group (LAWG), an internal DOE forum focused on identifying and implementing options for raising the visibility of technology transfer in the PEMP evaluations. As a result of these efforts, starting in FY 2022 the Office of Science doubled the weighting of the technology transfer and commercialization goal in the PEMPs for their single-purpose laboratories. Information sharing through the LAWG and efforts by OTT further expanded the role of tech transfer and commercialization in FY 2023 through the addition of an enhanced goal for Savannah River National Laboratory and the establishment of formal metrics tracking for INL's commercialization goal.

Outlook for Goal 3

Through FY 2025, OTT aims to continue to strengthen coordination and collaboration efforts through the TTPB, TTWG, and the NLTT, among other working groups, including interagency committees and involving multi-stakeholder participation. OTT will also seek ways to engage with new innovation-focused bodies being established at the National Science Foundation, the Department of Commerce, and other Federal agencies.

OTT plans to assess ways to revitalize the TTPB so it can effectively meet its charge and assess current-day relevance to support technology transfer and commercialization activities across DOE. As part of this process, OTT will consider and recommend updates to the TTPB's scope given the evolution of technology transfer and commercialization efforts within OTT and across DOE since its establishment. In this effort, OTT will coordinate across the member program offices and integrate input from DOE Laboratories and site and field offices.

OTT will also prioritize engagement with Congress, responding to congressional requests and reporting requirements in a timely fashion.

⁵⁶ 15 USC 3710 (f)(2)(B).

Also, in conjunction with relevant program offices, OTT will further bring to bear subject matter expertise in innovative, non-traditional partnership and funding mechanisms, such as prizes, PIAs, and the FESI, across DOE. In fall 2023, OTT launched an Innovative Partnership Mechanisms (IPM) Team that aims to offer expertise on flexible partnering mechanisms to stakeholders across DOE. The IPM Team will serve as a conduit to the DOE-wide Partnership Intermediary, engage with the prize community of practice across DOE, and coordinate efforts to launch the FESI. Through FY 2025, the IPM Team aims to coordinate across OTT and program offices to develop informational materials, analyses and sharing of lessons learned, as well as program execution support related to non-traditional partnership and funding mechanisms, which is provided through OTT's commercialization programs team (refer to Goal 1).

OTT supports efforts within DOE to protect American research advancements and IP while driving innovation and commercialization. In this vein, OTT will continue to provide support and expertise as a representative in internal coordinating groups developing policies on vetting and monitoring practices as well as manufacturing requirements for potential licensees of DOE technology. Refer to Cross-Cut 2: Balance discovery with research security and economic competitiveness. for further on these approaches.

OTT will also be continuing to collect and refine technology transfer metrics and partnerships agreements in alignment with DOE Policy 482.2 and in coordination with DOE stakeholders, including DOE Laboratories, for example, via the TTWG. OTT will continue to identify value-added analyses and ways that this data can inform decisions and policymaking. Further, OTT plans to continue and prioritize its engagement across DOE stewarding offices to improve assessment of technology transfer and commercialization performance and outcomes for the FY 2024 cycle and beyond. More broadly, OTT intends to further develop its capacity to collect evidence, develop short- and long-term performance metrics related to its mission and goals outlined in this TTEP (refer to Cross-Cut 3: Build evidence to strengthen transparency and accountability.).

Refer to Table 2 for a summary of key performance metrics and milestones through FY 2025 related to Goal 3.

Goal 4: Develop and amplify effective ecosystem engagements and partnerships.

DOE engages the market ecosystem to drive awareness of the DOE's technology portfolio and catalyze partnerships that move technologies to market. In particular, OTT's activities involve presentations and speaking engagements at conferences and events; management of incoming requests for information on DOE technology opportunities; and making connections between external stakeholders, including industry, and DOE Laboratories, including technology transfer teams and technology experts. Through these engagements, OTT develops a critical network of industry and external go-to-market partners to advance technology transfer and commercialization. In addition, DOE supports the dissemination of information resources and tools aimed at increasing awareness of DOE's available technologies, facilities, and capabilities

among stakeholders to improve identifying technology transfer and commercialization opportunities.

Objectives under Goal 4

There are three objectives under Goal 4—

- Objective 4.1—Increase awareness of and access to DOE laboratory resources to drive licensing and advance technology maturation.
- Objective 4.2—Create public-private partnerships that marshal DOE resources to fill commercialization gaps for emerging and strategic sectors.
- Objective 4.3—Amplify technology transfer and commercialization successes.

Objective 4.1—Increase awareness of and access to DOE Laboratory resources to drive licensing and advance technology maturation.

Innovators across sectors may be hindered from engaging with and accessing DOE’s vast laboratory technology portfolio due to a general lack of knowledge or understanding of how to navigate through information resources. Technology companies need accurate and timely information about advances in DOE technologies to identify the potential for collaborations and understand how to apply new discoveries to mature their own technologies. Tools, such as a centralized online platform with relevant technology information resources and targeted engagements aim to increase awareness of, interest in, and access to DOE’s technologies in support of commercialization.

This objective includes two key activities related to efforts to increase awareness of DOE laboratory technologies—through the Lab Partnering Service (LPS), as well as participating in events and organizing convenings.

LPS—OTT manages and promotes the LPS to provide a one-stop virtual stop for potential partners to engage with DOE Laboratories. The LPS website launched in FY 2018 and provides streamlined information on (1) thousands of available technologies from DOE Laboratories; (2) partnering mechanisms for working with DOE Laboratories; (3) DOE Laboratory experts and their research areas; and (4) DOE Laboratory facilities and user facilities. LPS has supported partnerships between DOE Laboratories and public and private sector entities; communication of research, development, and commercialization projects; and technology transfer collaborations. Since FY 2021, LPS has developed information targeted to users from different technology sectors. This tailored content aimed to drive users to information focused on specific technologies and efforts pursued across DOE and DOE Laboratories. In FY 2021, LPS

launched two popular topic pages for climate⁵⁷ and energy storage.⁵⁸ In FY 2022, LPS launched three topic pages for carbon dioxide removal,⁵⁹ hydrogen,⁶⁰ and EnergyTech UP.⁶¹

LPS and Visual Patent Search Tool Showcase DOE Technologies Available for Licensing

The Visual Patent Search, a tool within LPS, provides a quick way for users to find patents issued and patent applications funded by DOE dating back nearly 20 years to 2004 (Figure 11). In FY 2021, OTT deployed a new user interface within the Visual Patent Search tool and enhanced algorithms for pulling and attributing patent data from the U.S. Patent and Trademark Office to DOE Laboratories, thereby improving the universe and accuracy of the technologies available for licensing. In 2022, LPS had 164,000 pageviews, 46,000 users, 54,000 visits, and 420 lab connection requests sent, including a lab connection request to NREL that resulted in a patent license. The FY 2022 EnergyTech UP national winning team and one of the regional winning teams based their projects on technologies featured on LPS.

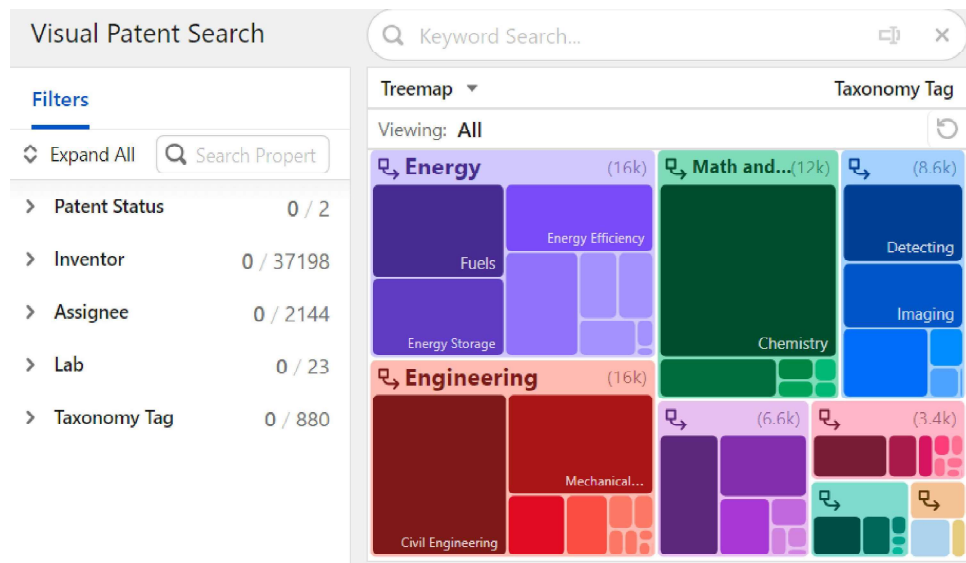


Figure 11. Snapshot of the LPS Visual Patent Search tool, showcasing the Taxonomy Treemap of all DOE-funded issued patents and patent applications since 2004

Source: LPS, "Visual Patent Search," available at <https://vps.labworks.org/v2/explorer>.

⁵⁷ LabPartnering.org, "Climate," available at <https://climate.labpartnering.org/?typ%5B%5D=expert&facets=fkgjih,fkgbg,fkgag,fkgcj>.

⁵⁸ LabPartnering.org, "Energy Storage Grand Challenge," available at <https://esgc.labpartnering.org/?typ%5B%5D=expert&facets=fkihj>.

⁵⁹ LabPartnering.org, "Carbon Dioxide Removal," available at <https://cdr.labpartnering.org/?typ%5B%5D=expert&facets=fkifj,fkifg,fkifc,fkiga,fkiig>.

⁶⁰ LabPartnering.org, "Hydrogen," available at <https://hydrogen.labpartnering.org/?typ%5B%5D=expert&facets=fkihb>.

⁶¹ LabPartnering.org, "EnergyTech University Prize," available at <https://energytechup.labpartnering.org/?facets=fkhid&from=0&typ%5B%5D=lab-technologies>.

Participating in Events and Organizing Convenings—Efforts to attend and organize events and other convenings have been vital to ensuring diverse stakeholders are engaged and aware of collaboration opportunities with DOE, in particular entrepreneurs, small businesses, and the incubator and accelerator communities. From FY 2021 to FY 2022, OTT led engagement with more than 200 industry partners and representation at over 150 public events. Specifically, over the course of FY 2021 and FY 2022, OTT organized and hosted several events under the InnovationXLab conference series, which began in FY 2018. This series aimed to facilitate dialogue and exchange of ideas among industry, universities, manufacturers, investors, end-use customers, and innovators across the DOE Laboratories and broader DOE enterprise.⁶² These efforts included—

- OTT and Brookhaven National Laboratory co-hosted the virtual Quantum Information Science and Technology Summit in October 2020.
- The virtual CarbonX Summit, which OTT co-hosted with the National Energy Technology Laboratory, was held in September 2020.
- OTT partnered with DOE’s Arctic Energy Office to host the ArcticX series of webinars over the course of FY 2022. This series included three webinars that attracted more than 1,000 attendees⁶³ and concluded with an in-person summit in May 2022 in Anchorage, Alaska. Refer to Box: ArcticX Summit Explored Challenges and Opportunities to Unleash Arctic Energy Innovation.
- OTT was prominently featured during September 2022’s Global Clean Energy Action Forum (GCEAF, the Clean Energy Ministerial and Mission Innovation Summit). OTT’s senior advisor serves on the Mission Innovation Technical Advisory Group (TAG) as the representative for the U.S. Government.
- OTT sponsored the Department of Energy booth at the Consumer Electronics Show in January 2023. Three National Laboratories joined the effort, displaying technologies available for licensing to thousands of conference attendees.

⁶² DOE, “InnovationXLab,” available at <https://www.energy.gov/technologytransitions/innovationxlab>.

⁶³ DOE, “ArcticX,” available at <https://www.energy.gov/technologytransitions/arcticx>.

ArcticX Summit Explored Challenges and Opportunities to Unleash Arctic Energy Innovation

The ArcticX webinar series, co-hosted by OTT and the Arctic Energy Office, culminated in the ArcticX Summit, an in-person conference at the Dena'ina Center in Anchorage, Alaska. Over 300 attendees from DOE, Alaska Native communities, National Laboratories, and Alaska-based businesses gathered to leverage the strength and knowledge of local entrepreneurs and discuss how to drive energy affordability, reliability, and innovation (Figure 12). Panelists discussed existing energy projects and new development ideas, promoted funding opportunities, and highlighted cutting-edge clean energy technologies. Keynote speakers included U.S. Senator Lisa Murkowski, Alaska Governor Mike Dunleavy, and DOE Under Secretary for Science and Innovation Geraldine Richmond. DOE also announced a new memorandum of understanding with OTT, DOE's Office of Electricity, Sandia National Laboratories, and the Port of Alaska at the event.



Figure 12. Speakers and Attendees of the ArcticX Summit in Anchorage, Alaska.

Sources: DOE, "ArcticX Summit: Committing to a Sustainable Arctic," available at <https://www.energy.gov/technologytransitions/arcticx-summit-committing-sustainable-arctic>; SNL, "Sandia and Port of Alaska sign agreement on renewable-energy, resilience research," available at <https://www.sandia.gov/labnews/2022/06/02/sandia-and-port-of-alaska-sign-agreement-on-renewable-energy-resilience-research/>.

Objective 4.2—Create public-private partnerships that marshal DOE resources to fill commercialization gaps for emerging and strategic sectors.

DOE's program offices engage in a variety of technology transfer and commercialization activities; however, these activities can be fragmented, leading to inconsistent and disjointed approaches of support across the RDD&D continuum. OTT aims to help connect pathways across this continuum by identifying whitespaces and commercialization gaps across DOE and filling those gaps through unified public-private partnership efforts. Specifically, OTT identifies, incubates, and develops partnerships, nationally and internationally, with key industry and other external partners to address gaps or constraints required to commercialize technologies, advocates and aligns resources and activities with potential partners, and, in some cases, develops formal partnerships, for example, through MOUs or similar agreements.

This objective includes two key activities—developing partnerships and collaborations with industry and fostering partnerships through MOUs.

Partnerships and Collaborations with Industry—OTT participates as DOE's representative on the board of the Quantum Economic Development Consortium (QEDC). Congress mandated the

establishment of QEDC as a consortium of public and private stakeholders seeking to enable and grow the quantum industry.

OTT collaborated with the QEDC on the QuEnergy Workshops in February 2022 and June 2023. These workshops focused on bringing together the quantum industry and the energy sector to evaluate high value near term quantum technologies to optimize and protect the energy grid. Over 200 experts participated the workshops and collectively produced over 500 ideas. The workshops inspired updates to the Quantum Initiative Act to include commercialization activities for quantum and activities in applying QIS for energy. They also encouraged DOE's Grid Modernization Initiative (GMI) 2023 lab call to include a topic area focused on demonstrating how quantum information science (QIS) can provide security, resilience, and optimization for the energy grid. OTT also chairs the Quantum Sensing Use Cases Technical Advisory Committee and is represented on the Use Cases Technical Advisory Committee on quantum computing and quantum networking.

Partnerships Through MOUs—Since FY 2021, OTT has facilitated and signed multiple MOUs with external partners:

- OTT announced the Vehicle-to-Everything (V2X) MOU in April 2021.⁶⁴ The V2X MOU brings together resources from DOE, the DOE Laboratories, state and local governments, utilities, unions, and private entities to evaluate the technical and economic feasibility of integrating bidirectional charging into energy infrastructure. Additional partners, including Shell and Honda, joined the V2X MOU in December 2022. More recently, in July 2023, DOE added nine more signatories to include virtual power plant providers eager to harness the bidirectional capacity of electric vehicles.
- In May 2022, OTT facilitated an MOU between Sandia National Laboratories and the Port of Alaska. The MOU memorialized the parties' intent to collaborate in conducting preliminary studies to evaluate energy resilience and economic development options for the Port and the Upper Cook Inlet region. This MOU stemmed from an existing project funded by the DOE Office of Electricity, under which Sandia and the Port of Alaska are addressing the technical, financial, and regulatory challenges to deploy energy infrastructure at the Port to support their resilience and infrastructure modernization efforts. These collaborative efforts involve startup incubator Launch Alaska.
- In June 2023, OTT announced finalizing a MOU focused on LDES and aimed at accelerating the commercialization of multiple LDES technologies to market.⁶⁵ Parties to the MOU include OTT, the Edison Electric Institutes' Institute for the Energy Transition, the Electric Power Research Institute, and the Long Duration Energy Storage Council.

⁶⁴ DOE, "Department of Energy Announces First of Its Kind Collaboration to Accelerate "Vehicle-to-Everything" Technologies," April 20, 2022, available at <https://www.energy.gov/technologytransitions/articles/departments-energy-announces-first-its-kind-collaboration-accelerate>.

⁶⁵ DOE, "Department of Energy and Partners Sign Landmark Agreement to Accelerate Long Duration Energy Storage," June 27, 2023, available at <https://www.energy.gov/technologytransitions/articles/departments-energy-and-partners-sign-landmark-agreement-accelerate>.

Goals under the five-year MOU include improving understanding of LDES technology's economic and resilience benefits, leveraging DOE and DOE Laboratory core competencies in energy storage and energy infrastructure integration for RDD&D, and receiving information from individual regulators, electric companies, technology vendors, and the financial community to help identify and address barriers to LDES deployment.

- OTT is leading a formal collaboration to facilitate applied demonstrations of QIS in space by identifying and addressing use cases serving national security, climate, and innovation needs in the energy sector, as well as defense and space exploration. The collaboration includes Federal and industry partners and aims to further commercialization of QIS in support of a space economy that benefits the goals and mission of the stakeholders. DOE will leverage DOE Laboratory QIS technologies to the extent possible. The first demonstration involves QIS technology from Los Alamos National Laboratory.

Objective 4.3—Amplify technology transfer and commercialization successes.

The challenge this objective aims to address is the under-recognition and under-utilization of successful technology transfers and commercialization efforts stemming from DOE activities. Despite numerous successful outcomes, these accomplishments may not be widely known or appreciated, which can impact future technology transfer initiatives and partnerships. Amplifying these successes will help in showcasing the value and impact of DOE's work, encouraging further innovation and collaboration.

This objective includes two key activities—highlighting success stories and building a network of communicators.

Highlighting Success Stories—In 2023, OTT successfully published 12 success stories related to OTT's commercialization programs. Continuing this momentum, OTT will systematically compile and publicize stories of successful technology transfer and commercialization. This involves creating comprehensive case studies that highlight the practical applications and societal benefits of DOE technologies. These success stories will be disseminated across various platforms, including the DOE website, social media, press releases, and industry publications, emphasizing tangible outcomes such as innovative products, job creation, and advancements in energy efficiency and sustainability.

Building a Network of Communicators—OTT is actively engaging with a network of communicators, encompassing internal DOE program offices, DOE Laboratories, TTWG, and external organizations like the Federal Lab Consortium. This network is dedicated to promoting DOE Laboratories' commercialization successes. Through this collaboration, we aim to expand our reach, share best practices, and explore innovative ways to promote DOE's technological advancements and their benefits to society. This network will play a pivotal role in amplifying our success stories, ensuring they gain the recognition and visibility they deserve.

Outlook for Goal 4

Through FY 2025, OTT will continue to promote LPS through events as well as the development and implementation of a dedicated stakeholder engagement plan. Over the next few years, OTT intends to use LPS to streamline access to content and improve the customer experience of audiences interested in partnering with DOE. In FY 2024, OTT plans to initiate a review of and develop an evaluation report on the LPS effort.

Partnership development will remain a priority. OTT will continue to facilitate and develop MOUs with external partners, seeking to increase participation in new or existing cross-cutting agreements that close gaps in the pathway to market for key technologies. OTT will also continue to grow awareness of DOE technologies and collaboration opportunities and expand the network of potential partners through attendance and speaking engagements at prominent workshops, conferences, and trade shows. To further support this goal, OTT will develop a strategic communications plan to amplify DOE's commercialization successes and to drive future engagements by focusing on partnerships across diverse communities, technologies, and stages of the RDD&D continuum. OTT will also leverage its collected data on DOE Laboratory partnering (Objective 3.3) to quantify the narrative of DOE's commercialization impact.

Refer to Table 2 for a summary of key performance metrics and milestones through FY 2025 related to Goal 4.

B. Cross-Cutting Approaches

This section describes three cross-cutting approaches that support achieving each of the four goals. These crosscuts represent emerging and evolving topics that have and foreseeably will continue to influence DOE's technology transfer and commercialization landscape. DOE must remain flexible to adapt and effectively respond to changing needs across these topic areas. In particular, OTT expects that the implementation of new policies, programs, and lessons learned regarding these topics will continue to influence how OTT's role and activities in stewarding commercialization across the DOE enterprise will evolve through FY 2025 and beyond.

Cross-Cut 1: Increase diversity, equity, inclusion, and accessibility (DEIA) and expand reach to underserved communities.

DOE is committed to integrating DEIA throughout its mission to promote a more equitable America through its clean energy investments. For example, DOE's Office of Energy Justice and Equity is implementing the J40 Initiative, established by *Executive Order 14008 Tackling the Climate Crisis at Home and Abroad*. The Executive Order directs that covered programs be managed toward a goal that 40 percent of their overall benefits flow toward disadvantaged

communities. Inclusion in the J40 Initiative centers environmental justice at the heart of covered programs. DOE has over 140 programs covered under the J40 initiative.⁶⁶

Specifically, OTT has three commercialization funding and talent development programs covered under Justice40—EPIC, EnergyTech UP, and TCIP (refer to Goal 1). In the recent FY 2023 EPIC Round 2, the majority of prize winners incorporated programming support for communities from traditionally underserved and disadvantaged backgrounds and regions.⁶⁷ In addition, in FY 2023, half of the EPIC \$500,000 grand prize winners were located in disadvantaged communities.⁶⁸ Further, a focus on underserved communities plays an important role in OTT’s outreach to university and college communities, including from Tribal communities, that apply to TCIP and ETUP.

More broadly, OTT will continue to collaborate with the Office of Energy Justice and Equity (EJE) and its Office of Diversity, Equity, Inclusion, and Accessibility to broaden its reach to underserved communities throughout its activities, not just those covered under the J40 Initiative. As an example, OTT’s Bipartisan Infrastructure Law Technology Commercialization Fund pursues activities that support the commercialization of promising energy technologies while simultaneously enhancing and improving American infrastructure, competitiveness, opportunity, and equity and addressing the climate crisis, including activities with an explicit focus on underserved communities, such as the MAKE IT Prize (refer to Goal 1). Beginning in February 2023, OTT and EJE began a monthly update meeting where OTT Program Managers discuss program activities with EJE staff to determine where EJE staff can assist with program development, execution, and outreach activities. In April 2023, OTT established an internal DEIA Council to support this approach, in which OTT staff share and apply lessons learned under the J40 Initiative and other efforts to support underserved communities. OTT will continue to increase and integrate DEIA more holistically in technology transfer and commercialization activities throughout the DOE enterprise, including the DOE Laboratories.

Cross-Cut 2: Balance discovery with research security and economic competitiveness.

The importance of research security and IP protections has become increasingly important and recognized by external stakeholders. DOE is ensuring that it is effectively addressing these issues, in particular for technologies that have national security and economic competitiveness implications.

⁶⁶ DOE. “DOE Justice40 Covered Programs,” available at <https://www.energy.gov/diversity/doe-justice40-covered-programs>.

⁶⁷ DOE. 2023. EPIC Prize Round 2, Official Rules Document Modification 2, available at https://americanmadechallenges.org/challenges/epic/docs/Energy_Program_for_Innovation_Clusters_Prize_Official_Rules.pdf.

⁶⁸ DOE. “U.S. Department of Energy Awards \$2 Million to Incubators and Accelerators Shaping Regional Energy Innovation Pipeline,” available at <https://www.energy.gov/technologytransitions/articles/us-department-energy-awards-2-million-incubators-and-accelerators>.

Most of DOE's Laboratories are government-owned, contractor-operated (GOCO) entities, and, therefore, have the rights to ownership of IP generated through DOE-funded research. DOE relies on its stewardship role and the contractor assurance model in oversight of its GOCO labs and their appropriate stewardship of DOE-funded IP, including the establishment, tracking, monitoring, and enforcement of IP and licensing terms. Recent reports from the Laboratory Licensing Review Team (LLRT), an internal working group established by the Office of the Secretary of Energy in FY 2022 to recommend ways to address concerns regarding licensing practices, identified that DOE Laboratory internal controls to actively track licensing and monitor compliance, for instance of domestic manufacturing provisions, throughout the lifecycle of a license vary across the DOE complex with limited oversight largely due to broad contractor IP rights set by law.^{69,70} In addition, the LLRT found that primarily due to cost concerns, DOE Laboratories typically file for patent protection only in the U.S., which limits the ability to protect the IP outside the U.S. and can more easily allow DOE-funded technologies to be produced abroad. These issues may be exacerbated for smaller DOE Laboratories that have limited resources, including staff and access to tools, to support risk-informed decisions for foreign patent filings and monitoring throughout the licensing lifecycle.

It is important to strike a balance between continued encouragement of openness and cross-boundary research discovery as DOE considers new and more restrictive policies to address these concerns. DOE must also ensure that it is supporting the DOE enterprise in strengthening its capabilities to protect IP and their licensing. Resource decisions for IP protection should be informed by analysis of the trade-offs, risks, and global market value, manufacturing feasibility, and commercialization potential of the technologies so that prospective licensees and commercialization goals are not adversely or unintentionally affected. In addition, the effective lifecycle management of a license requires the use of effective monitoring tools and management systems for information collection. OTT aims to support DOE Laboratories by establishing and providing access to data, tools, services, and other resources that can be leveraged to achieve research security and economic competitiveness goals. OTT plans to explore options to support DOE Laboratories in—

- Conducting or accessing market and other data analysis to support IP valuation and inform foreign patent filing decisions; and
- Accessing, analyzing, and scaling tools and platforms that improve the ability to vet potential licensees and sublicensees, as well as track and monitor information to support lifecycle management a license.

For example, OTT is co-chairing a working group to implement part of the LLRT's report recommendations, in collaboration with DOE Laboratories. The working group's efforts can inform ways OTT can address needs, including resources and services, identified by DOE

⁶⁹ DOE. 2022. Licensing of Pacific Northwest National Laboratory's (PNNL) Vanadium Redox Flow Battery Technology (VRFBT)-30-Day Review Report.

⁷⁰ DOE. 2023. Licensing of Intellectual Property by Department of Energy and National Nuclear Security Administration Laboratories-180-Day Review Report.

Laboratories. OTT aims to align and coordinate with other DOE-wide research security efforts, including those involving manufacturing policy—such as implementation of the Science and Energy Determination of Exceptional Circumstances⁷¹, and the Research, Technology, and Economic Security Vetting Center⁷² established in March 2023—which aims to ensure requirements related to research security are upheld throughout the design of funding announcements and before selecting awardees.

Cross-Cut 3: Build evidence to strengthen transparency and accountability.

The Foundations for Evidence-Based Policymaking Act of 2018 (P.L. 115-435) and subsequent guidance from the Office of Management and Budget (OMB) bolstered requirements for evidence-based decisions in the Federal Government by outlining processes, such as the development of agency-wide evidence plans and the designation of a Chief Evaluation Officer, among others. Aligned with these efforts, OTT plans to develop an evidence-building framework aimed at transparency, accountability, and continuously improving the office's activities to maximize technology transfer and commercialization impacts. OTT is committed to developing robust evidence planning processes and performance measures, as well as applying evidence-building principles and fostering a culture of evidence across the office.

Specifically, OTT plans to explore as part of the evidence-building framework —

- Developing an OTT Learning Agenda that sets priorities and plans for collecting and analyzing evidence;
- Funding, planning, and conducting evaluations;
- Identifying evaluation needs (statutorily required evaluations⁷³ and others);
- Establishing priorities and criteria for when and what to evaluate;
- Establishing short- and long-term performance metrics and milestones for meeting objectives;
- Building a data management infrastructure;
- Providing evidence and evaluation training for OTT staff; and

⁷¹ DOE. “Memorandum for Heads of Departmental Elements: Department of Energy Research, Technology and Economic Security Vetting Center,” March 1, 2023.

⁷² DOE. “Department of Energy Determination of Exceptional Circumstances Under the Bayh-Dole Act to Further Promote Domestic Manufacture of DOE Science and Energy Technologies,” June 7, 2021.

⁷³ For instance, OTT's statutory requirements for the conduct of evaluations and similar reviews in EA2020 (e.g., Section 9007, which requires DOE to “Not later than 3 years after the enactment of this Act and every 3 years thereafter the Secretary shall submit to the Committee on Science, Space, and Technology of the House of Representatives and the Committee on Energy and Natural Resources of the Senate an evaluation on the extent to which programs established under sections 9001, 9002, 9003, 9004, and 9005 of this Act are achieving success based on relevant short term and long-term metrics” in addition to a report on technology transfer gaps to be conducted by the National Academies of Science, Engineering, and Medicine) and the CHIPS and Science Act of 2022, which requires evaluations for the national clean energy incubator program (Section 10713), clean energy technology university prize competition (Section 10714), and the lab embedded entrepreneurship program (Section 10717), and evaluation of other OTT programs (Section 10727).

- Leveraging DOE and other Federal and non-Federal evidence-building resources.⁷⁴

These efforts aim to identify evaluative research questions, outline priorities for maturing OTT's evidence-building capability, and develop short- and long-term performance measures for OTT's strategic goals. OTT has already been working towards some of these activities, such as development of an OTT logic model and outlining short-term performance measures as part of a DOE-wide goalsetting initiative led by the Office of the Secretary of Energy. These short-term metrics and milestones through FY 2025 related to each of the four goals in the TTEP are summarized in **Table 2**.

OTT will continue development of additional short- and long-term performance metrics and milestones as its evidence-building framework is developed and refined. Through these efforts, OTT intends to improve the ability to generate and analyze evidence efficiently to inform decisions and manage OTT funding, document technology transfer and commercialization impacts, and better support the commercialization of DOE technologies across the Nation. OTT recognizes that building a mature evidence and evaluation capability may take several years and requires a dedicated commitment for developing its existing workforce and potentially hiring additional subject matter experts. Future personnel requirements beyond FY 2025 will be informed by needs identified in the evidence-building framework.

DOE's Annual Evaluation Plan and Learning Agenda⁷⁵ guide DOE's Departmental elements to conduct their evidence-building and evaluations through a decentralized approach and to improve the efficiency and effectiveness of its programs and operations in pursuit of the Department's mission. In addition, OTT hopes these evidence-building efforts will address challenges raised and conform with prior recommendations by the Government Accountability Office to develop objective, quantifiable, and measurable performance goals and metrics to assess progress towards OTT mission and DOE's commercialization efforts.⁷⁶

⁷⁴ For instance, DOE's Evaluation Community of Practice, which is led by the Office of Energy Efficiency and Renewable Energy (EERE); the Interagency Council on Evaluation Policy, which is organized by OMB, see OMB. "The Council," available at <https://www.evaluation.gov/interagency-council-on-evaluation-policy/>; and non-Federal subject matter expertise, such as through the American Evaluation Association, among professional and academic associations.

⁷⁵ DOE. 2022. DOE Program and Functional Offices Evaluation/Evidence Building Activities, FY 2024 Evaluation Plan, Learning Agenda, and Capacity Assessment, available at [DOE Program and Functional Offices Evaluation/Evidence-Building Activities, FY 2024 Evaluation Plan, Learning Agenda and Capacity Assessment \(energy.gov\)](https://www.energy.gov/evaluation/evidence-building-activities-fy-2024-evaluation-plan-learning-agenda-and-capacity-assessment).

⁷⁶ GAO recommended that the "Director of OTT should develop objective, quantifiable, and measurable performance goals as appropriate, and a limited number of related performance measures or milestones, to assess progress toward the objectives in its technology transfer execution plan and signal priorities," see GAO. 2021. *Department of Energy: Improved Performance Planning Could Strengthen Technology Transfer*, available at <https://www.gao.gov/products/gao-21-202>.

Table 2. OTT Performance Metrics and Milestones through FY 2025

Goal 1: Accelerate commercialization of laboratory discoveries to the marketplace	
Objective 1.1: Support DOE Laboratories, entrepreneurs, and innovators to move technologies from development to demonstration	Metric 1: Launch new BIL TCF programs totaling \$210M or more in cumulative funding. - Launch 10 unique programs by the end of September 2025. - Obligate \$210M of total BIL TCF funding by the end of September 2025. 20+ projects or other initiatives completed or under active management by the end of September 2025.
	Metric 2: Launch TCF Base Annual Appropriations solicitations and obligate all TCF funding. - Release all solicitations by April 2023. - Released a cross office lab call before December 2023 for FY2024. - Obligate all FY2024 TCF Base Annual Appropriations funding by end of September 2024. - Release all solicitations before December 2024 for FY2025. - Obligate all FY2025 TCF Base Annual Appropriations funding by end of September 2025 - Actively manage the resulting 125 to 150 awards.
	Metric 3: Implement the first DOE-wide PIA pilot. - Coordinate across program offices on needs and direct technology transfer efforts and funds from at least twenty program offices through the PIA by December 2024. - Assess interim outcomes and lessons from the pilot by September 2024. - Establish unique projects that span all fifteen lines of work identified as foundational tasks eligible for inclusion in the pilot by September 2024. - Assess the effectiveness of the PIA pilot and provide a recommendation for termination, continuation, and/or expansion of the Department's use of the PIA by September 2025.
	Metric 4: Launch the OTT-funded program focused on supporting incubators and their ecosystems, EPIC. - Publish EPIC Report to Congress on OTT website by Fall 2024. - Host four EPIC Pitch competitions by Fall 2024. - Announce EPIC Round 3, grand prize winners by November 2024. - EPIC cooperative agreements to start in Winter 2025. - Launch EPIC Round 4 in FY2025.
Objective 1.2: Develop commercialization skills in DOE Laboratory researchers and students	Metric 5: Launch three OTT-funded programs including EPIC, Energy I-Corps, EnergyTech UP, and TCIP. - Release two 2023 Energy I-Corps Annual Reports by end of January 2025. - Launch six Energy I-Corps Cohorts (Cohorts 16 –21) from March 2023 to through October 2025. - Publish five semi-annual lab calls for the Energy I-Corps Program from April 2023 through October 2025. - Announce two EnergyTech UP Faculty and Student Track Explore Phase winner and National Winner cohorts through April 2025. - Host two EnergyTech UP National Competitions through April 2025. - Publish EnergyTech UP Energy Technology Commercialization Playbook by June 2025. - Host three cohorts of Technology Commercialization Interns from May 2023 through August 2025, in which the first week is held in-person at DOE HQ.

Table 3. OTT Performance Metrics and Milestones through FY 2025 (cont.)

Goal 2: Infuse private sector thinking into market analytics and tools to shape decision making		
Objective 2.1: Integrate private sector and market perspectives to inform DOE investments and pathways from laboratory to market	Metric 1: Publish and promote at least nine <i>Pathways to Commercial Liftoff</i> reports.	• Publish and promote Wave 1 reports by March 2023.¹ • Publish and promote Wave 2 reports by December 2023.² • Publish and promote Wave 3 reports by May 2024. • Support follow-on activities informed by reports and build ongoing private sector engagement through industry events and one-on-one engagement.
Objective 2.2—Create and disseminate commercialization analysis capabilities within DOE and across the DOE Laboratories	Metric 2: Integrate ARLs into multiple offices' strategic planning and standard operating processes in 2023 and publish the framework externally.	• Use ARLs in 2023 and 2024 Office of Clean Energy Demonstrations (OCED) program design and embed the ARL framework in OCED Multi-Year Program Plan (MYPP) and standard operating procedures (SOPs), as well as solicitation language in key BIL funding opportunity announcements (FOAs). • Use ARLs in R&D investment planning and monitoring for Energy Earthshots. • Expand ARL framework used across DOE HQ offices and DOE laboratories through FY 2025.
Goal 3: Advance policies and activate partnership mechanisms that address commercialization barriers		
Objective 3.1: Align the DOE innovation ecosystem, including DOE Laboratories, on ways to make commercialization processes more effective	Metric 1: Strengthen engagement with the TTWG stakeholders including DOE Laboratories and site and field offices by hosting at least 4 joint meetings between TTWG and TTPB and facilitating organization of 2 TTWG meetings annually.	• Support at least 2 new coordinating TTWG subcommittees through FY 2025. • Launch at least two major policy initiative to de-risk technology transfer activities across the DOE Laboratories and support the TTWG stakeholders through FY 2025. • Conduct 10+ DOE Laboratory visits through FY 2025. • Host at least 4 joint meetings between TTWG and TTPB through FY 2025. • Facilitate at least 2 TTWG meetings annually in the Spring and Fall, and support coordination of DOE Headquarters representation.
	Metric 2: Strengthen engagement with the TTPB stakeholders including DOE program and functional offices by establishing a charter and identifying at least 2 annual priorities and deliverables.	• Engage with all member offices of the TTPB to solicit feedback on coordination needs and commercialization priorities. • Present findings to TTPB members and to OTT leadership. • Facilitate at least 4 planning sessions to develop a charter and an action plan on priority topics and deliverables through FY 2025.

Metric 3: Foster engagement among stakeholders across the DOE complex, including headquarters, site and field offices, and DOE Laboratories through OTT's representation on at least 2 interagency and 3 internal coordination groups.	•	Conduct 10+ site or field office visits through September 2025.
	•	Identify pathways and implement new processes, through TTPB and other forums, for site and field offices to engage across the DOE complex and contribute to policy dialogue, for example by representing on at least 3 DOE-wide internal coordination groups.
	•	Engage across the interagency to ensure equities and input across the DOE complex are integrated in at least 2 interagency coordination groups and their policymaking efforts.

Error! Bookmark not defined. Round 1 focuses on four technology areas: clean hydrogen, long duration energy storage, advanced nuclear, and carbon management. Round 2 will focus on rural and remote communities, industrial decarbonization (including steel, cement, and chemicals), and virtual power plants, among others.

² Round 2 will focus on rural and remote communities, industrial decarbonization (including steel, cement, and chemicals), and virtual power plants, among others.

Table 4. OTT Performance Metrics and Milestones through FY 2025 (cont.)

Goal 3: Advance policies and activate partnership mechanisms that address commercialization barriers (cont.)		
Objective 3.2: Activate innovative partnership mechanisms to make it easier to engage with DOE programs and DOE Laboratories	Metric 4: Launch the FESI and announce its Board of Directors to support the DOE mission and to advance collaboration to accelerate the commercialization of energy technologies.	• Appointed and announced the FESI Board of Directors in May 2024. • Engage the FESI Board of Directors to enable formal establishment and incorporation of the foundation. • Develop a formalized agreement to govern the DOE and FESI relationship in FY 25. • Announce the first DOE and FESI collaboration in FY 25.
	Objective 3.3: Collect and analyze DOE Laboratory technology transfer activities to inform performance and policymaking	• Publish new analyses and 2 additional congressional reporting requirements through the CHIPS and Science Act, including annual updates to the TTEP, through FY 2025.
	Metric 6: Develop and implement an OTT learning agenda and establish an analytical and evaluation capability to support evidence-based decisions.	• Engage OTT staff to solicit input on high-level priority questions and evidence-building activities, including evaluations, to address priority questions through FY 2025. • Publish OTT's first Learning Agenda focused on identifying activities, resources, and methods for building evidence and an evidence-based decision-making culture.
	Goal 4: Develop and amplify effective ecosystem engagements and partnerships	

Objective 4.1: Increase awareness of and access to DOE Laboratory resources to drive licensing and advance technology maturation	Metric 1: Grow awareness of DOE technology opportunities and expand the network of potential partners.	•	Presented or spoke at 40 or more relevant workshops, conferences, or trade shows by December 2023, either broadly promoting DOE technology partnerships or targeting specific technology verticals.
		•	Develop a stakeholder engagement plan for the Lab Partnering Service (LPS) to identify key segment information needs by FY 2024 and develop plan to address required updates by December 2024.
		•	Promote LPS engagement at key external events

Table 5. OTT Performance Metrics and Milestones through FY2025 (cont.)

Goal 4: Develop and amplify effective ecosystem engagements and partnerships (cont.)		
Objective 4.2: Create public-private partnerships that marshal DOE resources to fill commercialization gaps for emerging and strategic sectors	Metric 2: Facilitate and develop partnerships that bring together stakeholders to close gaps in the pathway to market for key technology areas.	• Introduce 30 new potential commercialization partners to DOE technology opportunities annually through FY 2025.
		• Bring at least 10 new commercialization partners into new or existing cross-cutting agreements annually through FY 2025.
Objective 4.3: Amplify technology transfer and commercialization successes	Metric 3: Track and increase engagement through success story dissemination	• Identify and document a diverse range of success stories from DOE Laboratories, emphasizing the variety and impact of technologies successfully transferred to the market. Aim to highlight at least 30 distinct cases by December 2025.
		• Target a measurable increase in digital engagement metrics (views, shares, interactions) by at least 25 percent by June 2024, and thereafter through FY 2025.
		• Implement at least two significant strategy adaptations based on feedback and performance metrics by September 2024, and thereafter through FY 2025.

V. Conclusion

DOE plays a key role in moving innovative technologies developed through the DOE Laboratories and by the extramural research community into the commercial marketplace. With the unprecedented investments provided under the BIL and IRA, DOE and OTT are working to accelerate the speed by which Americans receive the return-on investment from DOE's energy research. This requires strategically guiding technologies across the RDD&D continuum. In this way, DOE bolsters scientific discovery as well as strengthens the national security and economic competitiveness of our Nation.

The TTEP for FY 2021 to FY 2025 is intended to guide DOE in supporting department-wide coordination and execution of technology transfer and commercialization activities, in particular those activities under the Office of Technology Transitions. OTT's mission of commercializing technologies and expanding the impacts of commercialization from DOE's investments have been central to DOE's strategic direction. Since its founding in 2015, OTT has grown from a small startup office to a well-organized team with the resources and capacity to drive and guide stewardship of technology transfer and commercialization activities across the DOE enterprise. OTT's accomplishments over the past few years include the effective implementation and continued improvement of TCF leading to new collaborations and innovative program design to attract small businesses, startups, and others; and the publishing of six *Pathways to Commercial Liftoff* reports to guide public and private sector investments in clean energy technologies; among others.

Stewarding the energy technology RDD&D continuum is one of DOE's top priorities. OTT, in implementing the TTEP, will continue to guide the Department's strategy and implementation to achieve this goal. In future updates to the annual TTEP, OTT will continue to collaborate across the DOE enterprise, including the DOE Laboratories, to describe progress and implementation of technology transfer and commercialization activities supporting the goals and objectives outlined in the strategic framework. OTT also plans on continuing its engagement externally across innovation ecosystems nationwide to develop and refine programs and policy driving energy commercialization throughout our economy.

Appendix A: Excerpts of Requirements Related to the Technology Transfer Execution Plan

This appendix provides excerpts from relevant requirements for this report—the Energy Policy Act of 2005, the Energy Act of 2020, and the explanatory statement to the Consolidated Appropriations Act of 2023.

A. Energy Policy Act of 2005

TITLE X—DEPARTMENT OF ENERGY MANAGEMENT

SEC. 1001. IMPROVED TECHNOLOGY TRANSFER OF ENERGY TECHNOLOGIES.

- (a) Technology Transfer Coordinator.—The Secretary shall appoint a Technology Transfer Coordinator to be the principal advisor to the Secretary on all matters relating to technology transfer and commercialization.
- (b) Qualifications.—The Coordinator shall be an individual who, by reason of professional background and experience, is specially qualified to advise the Secretary on matters pertaining to technology transfer at the Department.
- (c) Duties of the Coordinator.—The Coordinator shall oversee—
- (1) the activities of the Technology Transfer Working Group established under subsection (d);
 - (2) the expenditure of funds allocated for technology transfer within the Department;
 - (3) the activities of each technology partnership ombudsman appointed under section 11 of the Technology Transfer Commercialization Act of 2000 (42 U.S.C. 7261c); and
 - (4) efforts to engage private sector entities, including venture capital companies.
- (d) Technology Transfer Working Group.—The Secretary shall establish a Technology Transfer Working Group, which shall consist of representatives of the national laboratories and single-purpose research facilities, to—
- (1) coordinate technology transfer activities occurring at national laboratories and single-purpose research facilities;
 - (2) exchange information about technology transfer practices, including alternative approaches to resolution of disputes involving intellectual property rights and other technology transfer matters; and
 - (3) develop and disseminate to the public and prospective technology partners information about opportunities and procedures for technology transfer with the Department, including opportunities and procedures related to alternative approaches to resolution of disputes involving intellectual property rights and other technology transfer matters.
- (e) Technology Commercialization Fund.—The Secretary shall establish an Energy Technology Commercialization Fund, using 0.9 percent of the amount made available to the Department for applied energy research, development, demonstration, and commercial application for each

fiscal year, to be used to provide matching funds with private partners to promote promising energy technologies for commercial purposes.

(f) Technology Transfer Responsibility.—Nothing in this section affects the technology transfer responsibilities of Federal employees under the Stevenson-Wydler Technology Innovation Act of 1980 (15 U.S.C. 3701 et seq.).

(g) Planning and Reporting.—

(1) In general.—Not later than 180 days after the date of enactment of this Act, the Secretary shall submit to Congress a technology transfer execution plan.

(2) Updates.—Each year after the submission of the plan under paragraph (1), the Secretary shall submit to Congress an updated execution plan and reports that describe progress toward meeting goals set forth in the execution plan and the funds expended under subsection (e).

B. Energy Act of 2020

TITLE IX—DEPARTMENT OF ENERGY INNOVATION

SEC. 9001. OFFICE OF TECHNOLOGY TRANSITIONS.

Section 1001 of the Energy Policy Act of 2005 (42 U.S.C. 16391) is amended—

(1) by striking subsection (a) and all that follows through “The Coordinator” in subsection (b) and inserting the following:

“(a) Office of Technology Transitions.—

“(1) Establishment.—There is established within the Department an Office of Technology Transitions (referred to in this section as the ‘Office’).

“(2) Mission.—The mission of the Office shall be—

“(A) to expand the commercial impact of the research investments of the Department; and

“(B) to focus on commercializing technologies that support the missions of the Department, including reducing greenhouse gas emissions and other pollutants.

“(3) Goals.—

“(A) In general.—In carrying out the mission and activities of the Office, the Chief Commercialization Officer appointed under paragraph (4) shall, with respect to commercialization activities, meet all of the goals described in subparagraph (B).

“(B) Goals described.—The goals referred to in subparagraph (A) are the following:

“(i) Reduction of greenhouse gas emissions and other pollutants.

“(ii) Ensuring economic competitiveness.

“(iii) Enhancement of domestic energy security and national security.

“(iv) Enhancement of domestic jobs.

“(v) Improvement of energy efficiency.

“(vi) Any other goals to support the transfer of technology developed by Department-funded programs to the private sector, as consistent with missions of the Department.

“(4) Chief commercialization officer.—

“(A) In general.—The Office shall be headed by an officer, who shall be known as the ‘Chief Commercialization Officer’, and who shall report directly to, and be appointed by, the Secretary.

“(B) Principal advisor.—The Chief Commercialization Officer shall be the principal advisor to the Secretary on all matters relating to technology transfer and commercialization.

“(C) Qualifications.—The Chief Commercialization Officer”;

(2) in subsection (c)—

(A) in paragraph (1), by striking “subsection (d)” and inserting “subsection (b)”;

(B) by redesignating paragraphs (1) through (4) as clauses (i) through (iv), respectively, and indenting appropriately; and

(C) by striking the subsection designation and heading and all that follows through “The Coordinator” in the matter preceding clause (i) (as so redesignated) and inserting the following:

“(D) Duties.—The Chief Commercialization Officer”;

(3) by adding at the end of subsection (a) (as amended by paragraph (2)(C)) the following:

“(5) Coordination.—In carrying out the mission and activities of the Office, the Chief Commercialization Officer shall coordinate with the senior leadership of the Department, other relevant program offices of the department, national laboratories, the Technology Transfer Working Group established under subsection (b), the Technology Transfer Policy Board, and other stakeholders (including private industry).”;

(4) by redesignating subsections (d) through (h) as subsections (b) through (f), respectively;

(5) in subsection (f) (as so redesignated), by striking “subsection (e)” and inserting “subsection (c)”;

(6) by adding at the end the following:

“(g) Additional Technology Transfer Programs.—The Secretary may develop additional programs to—

“(1) support regional energy innovation systems;

“(2) support clean energy incubators;

“(3) provide small business vouchers;

“(4) provide financial and technical assistance for entrepreneurial fellowships at national laboratories;

“(5) encourage students, energy researchers, and national laboratory employees to develop entrepreneurial skillsets and engage in entrepreneurial opportunities;

“(6) support private companies and individuals in partnering with national laboratories; and

“(7) further support the mission and goals of the Office.”

SEC. 9002. LAB PARTNERING SERVICE PILOT PROGRAM.

(a) Pilot Program.—

(1) In general.—The Secretary of Energy (in this section referred to as the “Secretary”), acting through the Chief Commercialization Officer established in section 1001(a) of the

Energy Policy Act of 2005 (42 U.S.C. 16391(a)), shall establish a Lab Partnering Service Pilot Program (hereinafter in this section referred to as the “pilot program”).

(2) Purposes.—The purposes of the pilot program are to provide services that encourage and support partnerships between the national laboratories and public and private sector entities, and to improve communication of research, development, demonstration, and commercial application projects and opportunities at the national laboratories to potential partners through the development of a website and the provision of services, in collaboration with relevant external entities, and to identify and develop metrics regarding the effectiveness of such partnerships.

(3) Activities.—In carrying out this pilot program, the Secretary shall—

- (A) conduct outreach to and engage with relevant public and private entities;
- (B) identify and disseminate best practices for strengthening connections between the national laboratories and public and private sector entities; and
- (C) develop a website to disseminate information on—
 - (i) different partnering mechanisms for working with the national laboratories;
 - (ii) National laboratory experts and research areas; and
 - (iii) National laboratory facilities and user facilities.

(b) Metrics.—The Secretary shall support the development of metrics, including conversion metrics, to determine the effectiveness of the pilot program in achieving the purposes in subsection (a) and the number and types of partnerships established between public and private sector entities and the national laboratories compared to baseline data.

(c) Coordination.—In carrying out the activities authorized in this section, the Secretary shall coordinate with the Directors of (and dedicated technology transfer staff at) the national laboratories, in particular for matchmaking services for individual projects, which should be led by the national laboratories.

(d) Funding Employee Partnering Activities.—The Secretary shall delegate to the Directors of each national laboratory and single-purpose research facility of the Department the authority to compensate national laboratory employees providing services under this section.

(e) Duration.—Subject to the availability of appropriations, the pilot program established in this section shall operate for not less than 3 years and may be built off an existing program.

(f) Evaluation.—Not later than 6 months after the completion of this pilot program, the Secretary shall support the evaluation of the success of the pilot program in achieving the purposes in subsection (a) and shall submit the evaluation to the Committee on Science, Space, and Technology of the House of Representatives and the Committee on Energy and Natural Resources of the Senate. The assessment shall include analyses of the performance of the pilot program based on the metrics developed under subsection (b).

(g) Definition.—In this section, the term “national laboratory” has the meaning given such term in section 2(3) of the Energy Policy Act of 2005 (42 U.S.C. 15801(3)).

SEC. 9003. TECHNOLOGY COMMERCIALIZATION FUND.

Section 1001(e) of the Energy Policy Act of 2005 (42 U.S.C. 16391(e)) is amended to read as follows:

“(e) Technology Commercialization Fund.—

“(1) Establishment.—The Secretary, acting through the Chief Commercialization Officer established in section 1001(a) of the Energy Policy Act of 2005 (42 U.S.C. 16391(a)), shall establish a Technology Commercialization Fund (hereafter referred to as the ‘Fund’), using nine-tenths of one percent of the amount of appropriations made available to the Department for applied energy research, development, demonstration, and commercial application for each fiscal year, to be used to provide, in accordance with the cost-sharing requirements under section 988, funds to private partners, including national laboratories, to promote promising energy technologies for commercial purposes.

“(2) Applications.—

“(A) Considerations.—The Secretary shall develop criteria for evaluating applications for funding under this section, which may include—

“(i) the potential that a proposed technology will result in a commercially successful product within a reasonable timeframe; and

“(ii) the relative maturity of a proposed technology for commercial application.

“(B) Selections.—In awarding funds under this section, the Secretary may give special consideration to applications that involve at least one applicant that has participated in an entrepreneurial or commercialization training program, such as Energy Innovation Corps.

“(f) Annual Report.—The Secretary shall include in the annual report required under section 9007(a) of the Energy Act of 2020—

“(1) description of the projects carried out with awards from the Fund for that fiscal year;

“(2) each project's cost-share for that fiscal year; and

“(3) each project's partners for that fiscal year.

“(g) Technology Commercialization Fund Report.—

“(1) In general.—Not later than 1 year after the date of enactment of the Energy Act of 2020, the Secretary shall submit to the Committee on Science, Space, and Technology and Committee on Appropriations of the House of Representatives and the Committee on Energy and Natural Resources and Committee on Appropriations of the Senate a report on the current and recommended implementation of the Fund.

“(2) Contents.—The report under subparagraph (A) shall include—

“(A) a summary, with supporting data, of how much Department program offices contribute to and use the Fund each year, including a list of current funding restrictions;

“(B) recommendations on how to improve implementation and administration of the Fund; and

“(C) an analysis on how to spend funds optimally on technology areas that have the greatest need and opportunity for commercial application, rather than spending funds at the programmatic level or under current funding restrictions.”.

SEC. 9004. STREAMLINING PRIZE COMPETITIONS.

Section 1008 of the Energy Policy Act of 2005 (42 U.S.C. 16396) is amended by inserting after subsection (d) the following and redesignating subsections (f) and (g) as subsections (g) and (h), respectively):

“(e) Coordination.—In carrying out subsection (a), and for any prize competitions under section 105 of the America Creating Opportunities to Meaningfully Promote Excellence in Technology, Education, and Science Reauthorization Act of 2010, the Secretary shall—

- “(1) issue Department-wide guidance on the design, development, and implementation of prize competitions;
- “(2) collect and disseminate best practices on the design and administration of prize competitions;
- “(3) streamline contracting mechanisms for the implementation of prize competitions; and
- “(4) provide training and prize competition design support, as necessary, to Department staff to develop prize competitions and challenges.”.

SEC. 9005. MILESTONE-BASED DEMONSTRATION PROJECTS.

(a) In General.—Acting under section 646(g) of the Department of Energy Organization Act (42 U.S.C. 7256(g)), notwithstanding paragraph (10) of such section, the Secretary of Energy (in this section referred to as the “Secretary”) may carry out demonstration projects as a milestone-based demonstration project that requires particular technical and financial milestones to be met before a participant is awarded grants by the Department through a competitive award process.

(b) Requirements.—In carrying out milestone-based demonstration projects under the authority in paragraph (1), the Secretary shall, for each relevant project—

- (1) request proposals from eligible entities, as determined by the Secretary, including—
 - (A) a business plan, that may include a plan for scalable manufacturing and a plan for addressing supply chain gaps;
 - (B) a plan for raising private sector investment; and
 - (C) proposed technical and financial milestones, including estimated project timelines and total costs; and
- (2) award funding of a predetermined amount to projects that successfully meet proposed milestones under paragraph (1)(C) or for expenses deemed reimbursable by the Secretary, in accordance with terms negotiated for an individual award;
- (3) require cost sharing in accordance with section 988 of the Energy Policy Act of 2005; and
- (4) communicate regularly with selected eligible entities and, if the Secretary deems appropriate, exercise small amounts of flexibility for technical and financial milestones as projects mature.

(c) Awards.—For the program established under subsection (a)—

- (1) an award recipient shall be responsible for all costs until milestones are achieved, or reimbursable expenses are reviewed and verified by the Department; and
- (2) should an awardee not meet the milestones described in subsection (a), the Secretary or their designee may end the partnership with an award recipient and use

the remaining funds in the ended agreement for new or existing projects carried out under this section.

(d) Project Management.—In carrying out projects under this program and assessing the completion of their milestones in accordance with subsection (b), the Secretary shall consult with experts that represent diverse perspectives and professional experiences, including those from the private sector, to ensure a complete and thorough review.

(e) Report.—In accordance with section 9007(a), the Secretary shall report annually on any demonstration projects carried out using the authorities under this section.

SEC. 9007. TECHNOLOGY TRANSFER REPORTS AND EVALUATION.

(a) Annual Report.—As part of the updated technology transfer execution plan required each year under section 1001(h)(2) of the Energy Policy Act of 2005 (42 U.S.C. 16391(g)(2)), the Secretary of Energy (in this section referred to as the “Secretary”) shall submit to the Committee on Science, Space, and Technology of the House of Representatives and the Committee on Energy and Natural Resources of the Senate a report on the progress and implementation of programs established under sections 9001, 9002, 9003, 9004, and 9005 of this Act.

(b) Evaluation.—Not later than 3 years after the enactment of this Act and every 3 years thereafter the Secretary shall submit to the Committee on Science, Space, and Technology of the House of Representatives and the Committee on Energy and Natural Resources of the Senate an evaluation on the extent to which programs established under sections 9001, 9002, 9003, 9004, and 9005 of this Act are achieving success based on relevant short-term and long-term metrics.

(c) Report on Technology Transfer Gaps.—Not later than 3 years after the enactment of this Act, the Secretary shall enter into an agreement with the National Academies of Science, Engineering, and Medicine to submit to the Committee on Science, Space, and Technology of the House of Representatives and the Committee on Energy and Natural Resources of the Senate a report on programmatic gaps that exist to advance the commercial application of technologies developed at the national laboratories (as defined in section 2(3) of the Energy Policy Act of 2005 (42 U.S.C. 15801(3))).

C. Explanatory Statement to the Consolidated Appropriations Act of 2023

TECHNOLOGY TRANSITIONS

The agreement provides \$22,098,000 for Technology Transitions.

The agreement provides not less than \$5,000,000 to support the Energy Program for Innovation Clusters Program.

The Department is directed to provide the Committees not later than 180 days after enactment of this Act a report outlining the office's five-year roadmap to achieving its goal of commercializing the Department's technology.

Appendix B: Technology Commercialization Fund Projects

This appendix provides the projects funded under the TCF program since the last publication of the TTEP in 2016 (Table D-1 to Table D-9 provides the projects awarded from FY 2022 to FY 2016). Per the statutory requirements under Section 9003 of EA2020, each project’s cost-share and partners are also included. The projects are alphabetically ordered by lead laboratory and descending by fiscal year (FY) the project was awarded and total budget.

Abbreviations: Argonne National Laboratory=ANL; Ames National Laboratory=Ames; Brookhaven National Laboratory=BNL; Fermi National Accelerator Laboratory=Fermilab; Idaho National Laboratory=INL; Kansas City National Security Campus=KNSC; Lawrence Berkeley National Laboratory=LBL; Lawrence Livermore National Laboratory=LLNL; Los Alamos National Laboratory=LANL; National Energy Technology Laboratory=NETL; National Renewable Energy Laboratory=NREL; Oak Ridge National Laboratory=ORNL; Pacific Northwest National Laboratory=PNNL; Sandia National Laboratories=SNL; SLAC National Accelerator Laboratory=SLAC; Thomas Jefferson National Accelerator Facility=Jefferson Lab

Table D-1. TCF Cost-Share and Total Budget by Fiscal Year

Year	Cost-Share (\$)	Total Budget (\$)
FY2016	\$17,003,599	\$32,994,230
FY2017	\$23,196,089	\$42,831,404
FY2018	\$28,551,088	\$49,162,391
FY2019	\$25,921,307	\$50,231,375
FY2020	\$36,379,355	\$69,957,922
FY2021	\$35,322,446	\$68,223,332
FY2022	\$20,409,046	\$48,061,912
FY2023	\$32,966,242	\$71,792,033

Table D-2. TCF Projects Awarded in FY 2023

Lead Laboratory	Title of Project	Partners	Cost-Share (\$)	Total Budget (\$)
ANL	Towards Commercialization of Used Nuclear Fuel Recycling in the U.S.	SHINE Technologies, Orano Federal Services	\$11,865,920	\$14,315,920
ANL	Advanced System Analysis Code Enhancement for Commercial Deployment of Molten Salt Cooled Reactors	Kairos Power LLC	\$980,000	\$1,960,000
ANL	5 MT/year Supercritical Hydrothermal Continuous One-Step Manufacturing Process	ACTion Battery Technologies	\$900,000	\$1,800,000

ANL	Ultra-Fast Thick Boriding Treatment to Enhance Reliability and Reduce Cost in Geothermal Power Plant Components	Controlled Thermal Resources, BlueWater Thermal Solutions	\$900,000	\$1,607,760
ANL	Automotive Magnesium from Domestic Aluminum-Magnesium Scrap	Galvotec Alloys	\$250,000	\$500,000
ANL	Scaling up Arrested Methanogenesis Technology for Sustainable Aviation Fuel Production	University of Illinois at Chicago, Great Lakes Authority, Sulzer Chemtech Ag	\$154,085	\$308,170
BNL	MSI Connect	LLNL, SNL, PPPL, SLAC, NETL, FedTech	\$60,000	\$1,937,229
INL	Radiation-Tolerant Liquid Level Instrumentation	Industrial Measurement System Inc, BWR Owners Group, MIT	\$836,000	\$2,551,000
INL	Scale-Up of High-Performance Proton Conducting Solid Oxide Electrolysis Cells (p-SOECs) and Development of the Short-Stack for Low-cost Hydrogen Production at Intermediate Temperatures	University of Louisiana at Lafayette	\$101,880	\$751,880
INL	Streamlining Foreign Review Process for National Laboratory Agreements	INL, Ames, SNL, LLNL, LANL, SLAC, ANL, ORNL	\$0	\$600,438
INL	OmniTap Enables Protection for Networks of Industrial Control Systems (OEPNICS)	Cynalytica LLC	\$250,000	\$500,000
INL	Streamlining CRADAs associated with Cooperative Agreements	LANL, ANL, SLAC, ORNL	\$0	\$124,627
LBNL	Advanced MRV protocols for soil and forest carbon sequestration using dynamic modeling and remote sensing	Cultivo; Living Carbon; Berkeley Carbon Trading Project	\$734,000	\$2,441,960
LBNL	Real-time soil core scanner for carbon and other elements	Adelphi Technology Inc	\$360,000	\$1,200,000
LLNL	Commercialization of Hollow-Core Fiber Optic Hydrogen SensorEM		\$150,000	\$300,000
LLNL	High Voltage Zinc-Manganese Dioxide Batteries with 3D Structured Anodes for Grid Storage	Urban Electric Power	\$250,000	\$500,000
LLNL	Development of Cryo-Compressed Hydrogen Storage Systems for the Heavy-Duty Transportation Industry	Verne Inc, The University of New Mexico	\$295,000	\$487,000
LLNL	Self-Assembling Microgrids for Resilient Distribution Systems of the Future: Implementation in a Commercial DERMS Platform	NREL, LANL, Smarter Grid Solutions Inc, University of Wisconsin-Madison	\$150,000	\$450,000
NETL	Deploying a New Tool for Rapid Characterization and Quantification of REE/CM Resources - Using Advanced X-Ray Fluorescence and Custom Machine-Learning Technologies	Ramaco Carbon, Weir International	\$960,000	\$2,759,219
NREL	OTT's coLABoratory Open Voucher Call (OTT's coLABoratory OVC)	SNL, PNNL, ANL, LANL, Ames, LBNL, ORNL	\$440,000	\$4,481,443
NREL	Efficient decarbonization of heating using a cascade heat pump with phase-change thermal storage	Trane Technologies, NETenergy LLC	\$875,000	\$1,750,000

NREL	Energy Metrics in Traffic Signal Performance Measures	Iteris	\$745,000	\$1,391,704
NREL	The Climate and Water Risk Assessment Tool: Improving Power System Planning and Investment Decisions	Electric Power Research Institute, Research Foundation of the City of University of New York	\$120,000	\$870,000
NREL	Engineering enzymes for crystalline PET substrates	Birch Biosciences Inc	\$250,000	\$500,000
NREL	Negative Cracked Film Lithography for PERC CdTe	First Solar, Inc	\$250,000	\$500,000
NREL	Robust phase identification in distribution networks using advanced metering infrastructure data	Duquesne Light Company, Larsen & Toubro	\$245,000	\$490,000
NREL	Commercialization of Reflected Target Non-intrusive Assessment (ReTNA) tool, for indoor optical analysis of Heliostats	Solar Dynamics, Kansas State University	\$60,000	\$300,000
NREL	Commercialization of a Non-Intrusive Optical (NIO) Technology to Measure Heliostat Optical Errors in Utility-Scale Concentrating Solar Power Plants	Tietronix Software Inc	\$36,000	\$180,000
ORNL	Advanced Dessiccant Clothes Dryers with a Heat Recovery System	Samsung Electronics America; University of South Carolina	\$1,200,000	\$2,400,000
ORNL	Non-Isocyanate Biobased Spray Foam Insulation	DuPont	\$1,000,000	\$2,000,000
ORNL	Sustainable Aviation Fuel from Cellulosic Ethanol	Gevo Inc	\$900,000	\$1,800,000
ORNL	Additive manufacturing of polymer composite heat exchangers for heat pumps and electronics cooling operation	Carrier Corporation, Johnson Controls	\$900,000	\$1,800,000
ORNL	Development and demonstration of the heat pump with ultra-high sink temperature	Carrier Corporation	\$900,000	\$1,800,000
ORNL	High-speed, High-volume, and Cost-effective Manufacturing of Intermediate Temperature Electrolyzer Cells	Redox Power Systems, Southern California Gas	\$814,000	\$1,617,000
ORNL	Copper-Carbon Nanotube based Ultrahigh Conductivity Composites for Electric Vehicle Charging Infrastructure	Southwire Company LLC	\$600,000	\$1,200,000
ORNL	Addressing challenges in manufacturing molten salt reactor components using novel high-strength Ni-based alloys	Haynes International, MetalTek International	\$400,000	\$800,000
ORNL	Inconel-718 Printed Circuit Heat Exchanger (PCHE) with Micro-Channels for Optimal Thermal Performance of Supercritical Carbon Dioxide Cycles	EarthEn	\$0	\$649,711
ORNL	Low-carbon, Fire Resistant Exterior Siding	Vitriform 3D	\$0	\$649,711
ORNL	Enabling Commercialization of Thixomolded Components Fabricated Using New Magnesium Alloy	Leggera Technologies, Terves LLC	\$325,000	\$645,000
ORNL	Commercial software development for mitigating oscillations in power grids with high penetration of renewables	Grid Protection Alliance Inc, The University of Tennessee Knoxville	\$44,500	\$444,500
PNNL	Sustainable Tire Production: Catalytic Upgrading of Ethanol into Butadiene	Bridgestone Americas Tire Operations	\$1,200,000	\$2,400,000
PNNL	An Ultra-Stable Reference Electrode as In-Situ System Diagnostics Tool for Redox Flow Batteries	Stryten Energy	\$125,200	\$250,200
PNNL	High-Performance InZn Alloy Anodes for Long Duration Zinc Batteries	GEO Battery	\$125,000	\$250,000

SNL	Rapidly-Deployable Agrivoltaics Tensile Based PV Microgrid & Storage System for Resilient Power Production	Skyrun LLC, Rio Grande Community Farm, Circle Two LLC, Jemez Mountains Electric Cooperative	\$343,750	\$1,530,530
SNL	Wind Interconnection Standard Platform (WISP)	DER Security Corp, Intergrid Consulting, Windurance LLC, Bergey Windpower Company, University of Puerto Rico-Mayaguez	\$225,000	\$1,125,000
SNL	Next-Generation Unified CAD/CAE Kernel for Accelerated Nuclear Reactor Development	INL, Coreform LLC	\$410,073	\$2,050,363
SNL	DARWIN	GE Research	\$300,000	\$600,000
SNL	Critical Usability Improvements to the Hydrogen Plus Other Alternative Fuels Risk Assessment Models (HyRAM+) Software	Hydrogen Fuel Cell Partnership, Electric Power Research Institute	\$50,000	\$450,000
SNL	Ultra-Low GHG Emissions for Off-Road Equipment through Low-Carbon Fuels and Increased CI-Engine Efficiency	Michigan Technological University, Cummins Inc, Stanadyne	\$885,834	\$1,771,668

Table D-3. TCF Projects Awarded in FY 2022

Lead Laboratory	Title of Project	Partners	Cost-Share (\$)	Total Budget (\$)
ANL	Deploying the POLARIS Workflow to Extend Metropolitan Planning Organization SMART Mobility Modeling Capabilities	North Central Texas Council of Governments	\$613,000	\$1,226,000
ANL	Electrochemical production of monoethylene glycol from CO2		\$600,000	\$1,200,000
INL	CyberPact 2.0	Cyber Capital Partners	0	\$315,000
LBNL	Cradle to Commerce Innovation Engine for Energy Efficiency, Clean Generation, and Distribution (C2C)	LBNL, ANL, INL, and ORNL, The Engine by MIT, OneValley, and DecisivePoint	\$4,450,000	\$8,900,000
LLNL	Printable materials for next generation 3D batteries	Millipore	\$450,000	\$900,000
LLNL	Direct Ink Writing of low-cost metal dichalcogenide/graphene composite electrodes for H2 generation/evolution, as well as conversion of CO2 and N2 to value-added chemicals		\$375,000	\$750,000
NREL	Rapid Electrochemical Mineralization to form Dolomite (REMined)	Newmont USA Ltd · Blue Planet Systems Corporation · the Doe Run Company · the Quapaw Nation · University of California Los Angeles (UCLA) · Missouri University of Science and Technology · Colorado Earth	\$2,190,000	\$4,380,000

Lead Laboratory	Title of Project	Partners	Cost-Share (\$)	Total Budget (\$)
NREL	OTT Lab MATCH Prize: Making Advanced Technology Commercialization Harmonized	SNL, ORNL, ADL Venture	\$300,000	\$1,812,164
NREL	Commercializing Bio-Derived 2,3-Butanediol Production from Industrial Waste for Sustainable Chemicals	BioPrincipia	\$849,999	\$1,699,998
ORNL	High Filler, Low Water (HFLW) concrete with ≥35% less cement		\$578,000	\$1,156,000
ORNL	High Power Wireless Charging System Vehicle-Side Enclosure Development Using a Novel Polymer Composite Solution	Volkswagen, Mitsubishi	\$100,000	\$1,100,000
PNNL	Scale-up of hybrid chemical, electro- and thermo-catalytic (Hy-CET) process to enable the electrification of sustainable aviation fuel production from lignocellulosic agricultural waste	CogniTek Management Systems, Inc., and Evoqua Water Technologies	\$1,260,000	\$2,520,000
PNNL	Lab-To-Market Workflows: Streamlining DOE Technology Transfer Lab-to-Market Workflows	JLAB, Fermilab, SNL, INL, ANL,	\$1,086,000	\$2,168,541
PNNL	Semiconductor Sector RDD&D-Expedite and Develop Game-Changing Exemplar (S2EDGE)	LBNL, LLNL, PNNL, SLAC, Intel, GlobalFoundries, Micross, Integra Technologies, Collins Aerospace, Skorpions Technologies	\$1,005,941	\$1,996,941
SNL	C-4 Partnering Model	SLAC, Fermilab, Jefferson Lab, LANL, ORNL, KCNSC, Albuquerque Regional Economic Alliance, Bernalillo County Economic Development, Central New Mexico College, Industrial Inspection & Analysis, New Mexico Manufacturing Extension Program	\$3,500,000	\$7,000,000
SNL	DOE Boost Platform	SNL, BNL, Fermilab, INL, LLNL, LANL, NETL, NREL	\$1,816,667	\$6,648,667
SNL	Streamlined Curation of Opensource Software for Efficient Search and Utilization by Industry	Fermilab, NREL, SLAC, INL, BNL, SNL, and LBNL	\$259,439	\$2,338,601
SNL	Multi-Cylinder Heavy-Duty Engine Demonstration of Ducted Fuel Injection with Low-Net-Carbon Fuel	John Deere	\$975,000	\$1,950,000

Table D-4. TCF Projects Awarded in FY 2021

Lead Laboratory	Title of Project	Partners	Cost-Share (\$)	Total Budget (\$)
Ames	Hot Shot Coanda-Stabilized Free Stream Gas Atomization (Hot CoSA) of Powders of Refractory Multi-Principle Element Alloys (RMPEA) for Extreme Environments	Retech Systems LLC	\$250,000	\$500,000
Ames	High Performance Critical Rare Earth Free Cerium Gap Magnets for Automotive Applications	Bunting-Dubois	\$93,500	\$187,000
ANL	FIVSIM – An accurate and efficient code for the industrial simulation of Flow Induced Vibrations	Framatome Inc.	\$1,520,230	\$3,020,230
ANL	Application of Advanced Materials Processing to Enable Direct Production of Fast Reactor Fuel Alloys	Oklo Inc.	\$1,000,000	\$2,000,000
ANL	Enhancement of PyARC for Westinghouse Electric Company's Lead Fast Reactor design and modeling	Westinghouse Electric Company	\$450,000	\$900,000
ANL	A deep learning enabled fast and robust chemistry solver for reacting flow simulations	Convergent Science Inc	\$400,000	\$650,000
ANL	Highly efficient electrocatalysts for direct conversion of CO2 to chemicals	Northern Illinois University, Beam Suntory, Inc	\$250,000	\$500,000
ANL	Multiscale manufacturing design tool based on machine learning workflow	Sentient Science	\$250,000	\$500,000
ANL	Capability Enhancements for System-level Thermal Hydraulic Modeling of Lead Fast Reactors		\$250,000	\$500,000
ANL	Fast thermal processing of ceramic nanomaterials for energy storage applications	NovaCentrix	\$200,000	\$400,000
INL	Wireless Radio Frequency signal Identification and protocol Reverse Engineering (WiFIRE)		\$750,000	\$1,500,000
INL	New Alloy Anodes for Electrochemical Production of Advanced Materials	Caltrade, Inc.	\$200,000	\$400,000
INL	MASTERRI: Modeling And Simulation for Targeted Electrical Resilience and Reliability Improvements		\$125,000	\$250,000
INL	Highly efficient low-thermal-budget hydrogen and chemical co-production via an electrochemical activation of propane		\$100,000	\$200,000
LANL	Actinide-Molten Fluoride Salt Property Measurement and Low-Level Detection	Kairos Power	\$1,500,000	\$3,000,000
LANL	DME as a Renewable Hydrogen Carrier: Innovative Approach to Renewable Hydrogen Production	Oberon Fuels	\$1,500,000	\$3,000,000
LANL	Additive Manufacturing of Carbon-Carbon Composites with Tailored Thermal Transport Properties	Northrup Grumman Corporation	\$1,356,000	\$2,705,659
LANL	Unsupervised Physics-informed Machine Learning of Complex Natural and Engineered Geoscience Processes	Julia Computing, Inc.	\$250,000	\$500,000
LANL	Terrestrial Energy-Efficient Long-Range Network (TERN) for Remote Monitoring		\$125,000	\$250,000
LBNL	Scale-up and Business Aviation Test Flight of DMCO High-Performance Sustainable Aviation Fuel	Praj Industries Ltd	\$1,530,000	\$3,030,000
LBNL	Porous transport electrodes for proton exchange membrane electrolyzers	De Nora Tech, LLC, NEL Hydrogen	\$450,000	\$900,000
LBNL	Compact, portable, triple-mode detector for identification of fissionable materials	RMD, Inc.	\$79,599	\$159,198

Lead Laboratory	Title of Project	Partners	Cost-Share (\$)	Total Budget (\$)
LLNL	Lightfield Directing Array Commercialization	Bright Silicon Technologies	\$3,498,984	\$4,998,984
LLNL	High Efficiency Power-to-Gas in a Modular Hybrid Electrobioreactor	Electrochaeta GmbH	\$1,030,000	\$2,030,000
LLNL	Enhanced Biomimetic Three-Dimensional Nanoporous Gyroid Membrane for High Efficiency Carbon Dioxide Absorption		\$250,000	\$500,000
LLNL	Novel biogas bioreactors for energy recovery at small-scale wastewater treatment facilities		\$250,000	\$500,000
LLNL	Electron sensing diagnostics for increased reliability of metal additive manufacturing		\$130,000	\$260,000
NETL	Demonstration of Scaled-up Microwave-Assisted Ammonia Production	NuIonic	\$150,000	\$300,000
NREL	Energy Storing Efficient HVAC	Blue Frontier, LLC	\$600,000	\$1,195,558
NREL	Grid-Edge Intelligent Distribution Automation System for Self-Healing Distribution Grids	Survallent Technology Inc.	\$550,000	\$1,100,000
NREL	Inexpensive Superinsulation for Cryogenic and Highly Insulating Applications	IP Group, Inc.	\$500,000	\$1,000,000
NREL	Field Testing and Validation of HOPP	GE Global Research	\$500,000	\$1,000,000
NREL	Reducing Protein Production Costs to Enable Cell Free Biocatalysis	Invizyne Technologies	\$400,002	\$800,002
NREL	Real Time-Optimal Power Flow based Distributed Energy Resources Management System (DERMS)	Utilidata, Inc.	\$300,000	\$599,329
NREL	Electrodialysis-coupled desiccant air conditioning	Palo Alto Research Center	\$325,000	\$575,000
NREL	OpenOA	ENTR Alliance	\$315,000	\$564,950
NREL	Particle Thermal Energy Storage and Efficient Heat Exchanger for Carbon-Free Industry Heat Supply	Alumina Energy, LLC	\$252,000	\$501,500
NREL	Robust Carbonic Anhydrases for Novel Biological, Sustainable and Low Energy CO2 Scrubbing Process from Waste Gases	Novozymes North America	\$250,483	\$500,483
NREL	HYdrogen based Power grid support using ElectrolyzeRs with Value stacking (HYPER-V)	Eaton Corporation	\$250,000	\$500,000
NREL	Fuel Additives for Solid Hydrogen (FLASH) Carriers for Electric Aviation	Honeywell	\$250,000	\$500,000
NREL	Commercialization of Distribution System Load Modeling Tool for Improved DER Interconnection Studies	Microsoft Corporation	\$250,000	\$500,000
NREL	Offshore wind turbine digital twin for the prediction of component failures		\$200,000	\$400,000
NREL	Development of High-Quality, Very Large-Grained Cd (Se, Te) thin films for CdTe solar modules	First Solar Inc.	\$150,000	\$300,000
NREL	Bio-based Insecticides from Thermochemical Conversion of Biomass	Marrone Bio Innovations, Ensyn	\$100,000	\$200,000
ORNL	Development of a low-cost and hardware friendly instantaneous waveform measurement technology for distribution system	DigiCollect LLC	\$1,500,000	\$3,000,000
ORNL	Continuous stirred tank reactors for the scale up of high energy density cobalt-free cathodes for advanced lithium-ion batteries	Sparkz	\$1,204,800	\$2,404,800
ORNL	Used (spent) nuclear fuel management and analysis tool	Electric Power Research Institute	\$920,000	\$1,840,000
ORNL	Leveraging Artificial Intelligence to Enable Reliable Non-Destructive Characterization of Additively Manufactured Parts using X-ray CT	Carl ZEISS Industry Metrology	\$757,000	\$1,513,689
ORNL	High-Power Oak Ridge Converter (ORC) for Extreme Fast Charging (XFC) Applications	HEVO, Inc	\$750,000	\$1,500,000

Lead Laboratory	Title of Project	Partners	Cost-Share (\$)	Total Budget (\$)
PNNL	Self-Healing Cements with Improved Toughness at Casing and Formation Interfaces for Subsurface Applications	Resource Cementing, LLC, Cyrqenergy	\$1,487,600	\$2,975,200
PNNL	Electric Grid OT Cybersecurity Dashboard for Control Room Environments	Traverity	\$600,000	\$1,200,000
PNNL	Scale up, Field testing, and Optimization of Nontoxic, Durable, Economical Coatings for Control of Invasive Mussels at Hydropower Facilities	Lorama Group Inc., Dry Surface Technologies, LLC, BioBlend Renewable Resources, Prometheus Innovations, LLC	\$586,000	\$1,172,000
PNNL	Scale up, Field testing, and Optimization of Nontoxic, Durable, Economical Coatings for Control of Biofouling and Corrosion on MHK Devices Facilities	Lorama Group Inc., Dry Surface Technologies LLC, BioBlend Renewable Resources, Prometheus Innovations, LLC	\$529,000	\$1,058,000
PNNL	Aluminization Coatings and Glass Seals for the H2Gen Reactor	Utility Global	\$400,000	\$800,000
PNNL	Remote Deployment and Setup of VOLTTRON Instances	Intellimation, LLC	\$300,000	\$600,000
PNNL	DER as a service	ecoLong LLC	\$250,000	\$500,000
PNNL	Mesofluidic Inline Separation for Produced Water Treatment	APEX Petroleum Engineering	\$246,979	\$493,958
PNNL	Enhancing Lifetime and Reducing Costs for Fish Diversion Netting Structures	BioBlend Renewable Resources, Dry Surface Technologies, Lorama Group Inc., Prometheus Innovations, Pacific Netting Products	\$252,500	\$472,500
PNNL	Common Information Model for Electromagnetic Transients (CIM for EMT)	PGSTech	\$100,000	\$200,000
PNNL	MEMS-enabled in operando spectroscopy and imaging during heating		\$100,000	\$200,000
SLAC	Transactive Energy Services System		\$115,000	\$230,000
SNL	Assessment Robot for Resilient Optimized Wind Energy ARROW(e)	SkySpecs	\$1,000,000	\$2,000,000
SNL	Power Converters and Components for Resilient MVDC Microgrids	Emera Technologies, LLC	\$300,000	\$599,754
SNL	Optimized PV single-axis tracking algorithm informed by sky imaging	Array Technologies	\$250,000	\$500,000
SNL	Development of Rechargeable Energy Dense Long Cycle-life Zinc/Copper Oxide Batteries	Urban Electric Power	\$250,000	\$500,000
SNL	Terrestrial Heat Repository for Months of Storage (THERMS)	CSolPower, LLC.	\$125,000	\$250,000
SNL	Alkaline water electrolysis	Giner Inc.	\$100,000	\$200,000
SNL	In vivo production of Ethyl Acetate	Johnson-Matthey	\$67,769	\$135,538

Table D-5. TCF Projects Awarded in FY 2020

Lead Laboratory	Title of Project	Partners	Cost-Share (\$)	Total Budget (\$)
Ames	Mechanically robust high magnetic performance Sm-Co sintered magnets	Electron Energy Corporation	\$250,000	\$500,000

Lead Laboratory	Title of Project	Partners	Cost-Share (\$)	Total Budget (\$)
ANL	Advanced Drivetrain lubricants for enhanced reliability in harsh conditions	Exxon Mobil, GE Renewable Energy, NREL, Pixelligent Technologies, University of Pennsylvania	\$1,500,000	\$2,500,000
ANL	Dual-Fuel Technology for Diesel Combustion Engines	Progress Rail	\$667,940	\$1,317,940
ANL	Preparing large area of thermochromic nanocomposite films for smart window application		\$250,000	\$500,000
ANL	Binder Jet Additive Manufacturing of Nickel Alloy Based Low-Cost Heat Exchangers for Harsh Environments	ExOneCompany	\$250,000	\$500,000
ANL	A user-friendly AI manufacturing toolkit for generation of metastable phase diagram	Sentient Science, UTRC	\$250,000	\$500,000
ANL	Demonstration of Ceramicrocrete® as a Robust Geothermal Well Cement		\$250,000	\$500,000
ANL	Extending PDC Capabilities to TerraPower Direct-Cycle Supercritical CO2 ("Pascal") Nuclear Reactor Concepts	TerraPower	\$250,000	\$500,000
ANL	A comprehensive validation methodology for benchmarking wide bandgap power devices for Aerospace application and improving manufacturing process	Boeing, Kyma Tech	\$250,000	\$500,000
BNL	Sustainable well cement for geothermal, thermal recovery and carbon storage wells	HERO, Imerys, Resourcecementing, Trabits Group	\$253,406	\$503,405
BNL	Surface Modification of Graphite Anodes Enabling Fast Charging of Li-ion Batteries	State University of New York, Stony Brook	\$250,000	\$500,000
BNL	Maturation of Technology for Trapping Xenon and Krypton	Forge Nano Inc.	\$160,626	\$321,252
INL	Accelerated Deployment of Economic Benefits for Advanced Technology and High-Efficiency Fuels Employing Predictive Tools for Analyzing DNB and Time-at-Temperature Criteria	Electric Power Research Institute (EPRI)	\$1,500,000	\$3,000,000
INL	Development of a Prototype Control Room for an Advanced Reactor Vendor	Kairos Power, University of Idaho	\$750,000	\$1,500,000
INL	High Accuracy Self-Navigation of Indoor Environment Drones	LPI, Inc.	\$250,000	\$500,000
INL	Automated Logging of Analog Control Rooms		\$250,000	\$500,000
INL	Operational Integration and Scalable Deployment of Microgrid Control Algorithms into Nanogrid Inverter+PV+storage Applications	Inergy Holdings, LLC	\$220,000	\$440,000
INL	EMRALD Technology Advancements for Commercial Grade Dedication Readiness	FPoliSolutions	\$125,000	\$250,000
INL	Fractionation of Lignocellulosic Biomass into High-Value Products	Golden Leaf Energy, ORNL	\$120,000	\$240,000
INL	A Longitudinal Finned Heat Exchanger for Thermal Energy Storage and Recovery	Rapid Cutting, LLC	\$100,000	\$200,000
LBNL	Nanosegregated bimetallic oxide anode catalyst for proton exchange membrane electrolyzer	IRD Fuel Cells, Pajarito Powder, Proton Onsite/NEL	\$300,000	\$600,000
LBNL	Adaptation of CRAGE for Clostridium strains to enable rapid strain engineering for production of biofuels and bioproducts from low-cost gas feedstock	LanzaTech, Inc.	\$252,191	\$502,191
LBNL	Production of a new aviation biofuel precursor from cellulosic biomass using an engineered strain of Novozymes' C5/C6 sugar consuming yeast	Novozymes North America, Inc.	\$250,000	\$500,000

Lead Laboratory	Title of Project	Partners	Cost-Share (\$)	Total Budget (\$)
LBNL	Expanding Access and Scalability of Microgrid and DER Analysis with DER-CAM		\$200,000	\$400,000
LLNL	Zero-order Reaction Kinetics: Enabling the Use of Detailed Chemical Kinetics in Combustion Simulations	Convergent Science, Gamma Technologies, LLC	\$545,000	\$1,090,000
LLNL	Materials Design Simulator: A Practical Tool for Advanced Alloys Development	MolyWorks	\$250,000	\$500,000
LLNL	System Integration of Rationally Designed Dilute Alloy Catalysts for Energy-Efficient Electrochemical CO ₂ -to-Fuel Conversion	Opus-12, TOTAL American Services, Inc.	\$250,000	\$500,000
LLNL	Advanced Magnetic Radiation Shielding for Nuclear Energy Applications	American Ceramic Technology, Ames NL	\$240,000	\$480,000
LLNL	Micro-liter Fuel Ignition Tester for Accelerated Discovery of Advanced Combustion Fuels		\$100,000	\$200,000
NETL	Rare Earth Element Extraction from Powder River Basin Coal Byproducts and Mining Waste	Campbell County Board of Commissioners, City of Gillette, Energy Capital Economic Development Fund, University of Wyoming	\$810,568	\$1,621,136
NETL	Catalyst Development for Automotive Exhaust Treatment	Pyrochem Catalyst Company	\$101,146	\$202,292
NREL	Improving the Accuracy of Building Energy Models used in the Design Process	Autodesk, Cedar Stack	\$1,015,000	\$2,015,000
NREL	High fidelity modeling toolkit for wind farm development	GE Global Research, GE Renewable Energy, SNL	\$850,000	\$1,700,000
NREL	Commercialization of Fully Renewable Non-Isocyanate Polyurethanes	Algix, Honda R&D Americas, Patagonia	\$730,000	\$1,459,918
NREL	Scribe and Interface Modification for Stable Halide Perovskite Modules	Tandem PV, Inc.	\$900,639	\$1,350,639
NREL	Technical and commercial assessment of a newly developed secondary reflector design for linear Fresnel technology	Hyperlight Energy	\$600,000	\$1,200,000
NREL	A Customizable Metric to Quantify the Quality of Mobility	Street Light Data	\$448,000	\$886,149
NREL	3D Printed Desiccant Wheel with Thermo-responsive Desiccants for Energy Efficiency and Thermal Comfort in Buildings	Blue Mountain Energy, Gas Technology Institute, TCPoly, Inc.	\$275,000	\$525,000
NREL	Cracked film lithography for metal grids in CdTe modules	First Solar	\$250,000	\$500,000
NREL	Technology Agnostic Loss and Life Informed Dispatch of battEry Assets (TALLIDEA)	Centrica Business Solutions	\$250,000	\$500,000
NREL	Advanced Power Distribution Sensing and Communications Through the Cable TV Broadband Network	Cable Television Laboratories, Inc., Commscope, Inc, Holy Cross Energy, Northern Lights, Society of Cable Telecommunications Engineers	\$250,000	\$500,000
NREL	Advanced OT Edge-level Data-Driven Threat Detection	Eaton Research Labs	\$250,000	\$499,752
NREL	Wet Waste for High-Performance Sustainable Aviation Fuels	AID Nanosolutions, Earth Energy Renewables	\$249,660	\$499,320

Lead Laboratory	Title of Project	Partners	Cost-Share (\$)	Total Budget (\$)
NREL	Urban Algal Forests to Capture Atmospheric Carbon Dioxide and Wastewater Nutrients: Algal Strain Development to Enhance Efficiencies	Gross-Wen Technologies, MWRD Chicago	\$240,000	\$480,000
NREL	Carbon Free Data Center Control & Assessment	Daimler AG, Hewlett Packard Enterprise, Power Innovations	\$261,999	\$411,999
NREL	Impacts of Hydrogen Blending in Natural Gas Networks	Encoord, LLC, Institute of Gas Innovation and Technology, Southern California Gas Company	\$200,000	\$375,000
NREL	Passivated contacts for Direct Wafers	1366 Technologies	\$152,654	\$302,559
NREL	Full area quality control for advanced membrane R2R fabrication lines by in-line, high resolution, multi-layer thickness mapping	Middleton Spectral Vision	\$125,000	\$249,986
NREL	Surface Modified Electrolyzer Components for Corrosion Resistance and Electrical Conductivity	Treadstone Technologies, Inc.	\$125,000	\$249,900
NREL	Geothermal Resource Portfolio Optimization & Reporting Technique	CanGEA, Hungarian Geological Survey, International Geothermal Association, Jacobs Engineering, Inc., Reykjavik Energy	\$112,500	\$225,000
NREL	Commercializing Biographite for Lithium-Ion Batteries	Ensyn	\$100,063	\$200,125
ORNL	Integrated Process for Direct Air Capture of CO2 and Its Electrochemical Conversion to Ethanol	Reactwell, LLC	\$1,500,000	\$3,000,000
ORNL	Roll-to-Roll Manufacturing of Solid Oxide Fuel Cells	Rdox Power Systems	\$1,200,000	\$2,400,000
ORNL	Simulation Capability for Fuel Assembly Bow Distortion in PWRs	Westinghouse Electric Company	\$750,000	\$1,500,000
ORNL	Misalignment Tolerant Three-Phase Wireless Fast Charging System for Electric Vehicles	FCA US LLC	\$750,000	\$1,500,000
ORNL	Recovery of Lithium from Geothermal Brine with Lithium-Aluminum Layered Double Hydroxide Chloride Sorbents	All American Lithium, INL	\$500,000	\$1,000,000
ORNL	Nanofluids with Enhanced Heat Transfer and Reduced Corrosion Properties for Advanced Molten Salt Reactors	ThorCon US, Inc., University of Tennessee at Knoxville	\$400,000	\$800,000
ORNL	LNG based energy storage concept for behind the meter energy storage	ThermoFisher Scientific	\$250,000	\$500,000
ORNL	sCO2 to molten salt heat exchanger for ultra-high temperature applications	Brayton Energy, Inc., General Atomics	\$250,000	\$500,000
ORNL	Self-healing films for vacuum insulation panels and air/vapor barrier membranes	FLEXcon Industrial Park	\$200,000	\$400,000
ORNL	3D Printing Catalysts for Improved Efficiency and Selectivity: Converting Waste to Jet Fuel	Honeywell UOP	\$150,000	\$300,000
ORNL	Expansion of Atmospheric CO2 Plasma Conversion Coatings on Lightweight Magnesium Alloys		\$120,000	\$240,000
ORNL	3D Reality Energy Modeling Software	Bentley Systems	\$100,000	\$200,000

Lead Laboratory	Title of Project	Partners	Cost-Share (\$)	Total Budget (\$)
ORNL	Primer-Less Self-Healing Sealant for Building Envelopes		\$100,000	\$200,000
PNNL	Production of High-Pressure Hydrogen from the Decomposition of Formic Acid	OCO Chem	\$700,000	\$1,400,000
PNNL	Multi-purpose Advanced Coatings for Protection of High Temperature Alloys in Harsh Industrial Processes	Praxair, Inc.	\$600,000	\$1,200,000
PNNL	Optimize the autonomous sensor fish device for understanding interactions of aquatic animals with marine and hydrokinetic and hydro systems.	Advanced Telemetry Systems, Electric Power Research Institute, Natel Energy, Inc., University of Alaska Fairbanks, University of Washington	\$600,000	\$1,200,000
PNNL	Optimization and commercialization of the juvenile eel/lamprey acoustic transmitter and micro-battery	Advanced Telemetry Systems, Innovasea, MicroBatt Technologies Inc.	\$600,000	\$1,200,000
PNNL	Deep Learning for Fish Identification from Sonar Data	The Eel Passage Research Center, Great Lakes Fishery Commission, SOUND METRICS, The Technical University of Munich, USGS, Great Lakes Science Center	\$489,199	\$978,199
PNNL	Smart Monitoring and Diagnostic System (SMDS) for Packaged Air Conditioners and Heat Pumps for Small/Medium Commercial Buildings: Preparation for Commercialization	JouleSmart Solutions, Inc.	\$250,000	\$500,000
PNNL	Smart Building Start (SBS)	Verdicity	\$250,000	\$500,000
PNNL	HIPPO – An Electricity Market and Power System Research Platform	MISO Energy	\$250,000	\$500,000
PNNL	Electrolyte development for fast-charging high-energy-density lithium batteries	American Lithium Energy Corporation, Navitas Advanced Solutions Group	\$250,000	\$500,000
PNNL	Retro-Commissioning Sensor Suitcase for Energy Efficiency	BC Hydro, GreenPath Energy Solutions, LBNL, Sacramento Municipal Utility District, University of Idaho, Zepher	\$250,000	\$500,000
PNNL	Manufacturing Hybrid Copper- Aluminum Rotors for High Power Induction and Permanent Magnet Electric Motors	General Motors Research and Development	\$200,000	\$400,000
PNNL	Magnetic Nanoparticle Extraction of Lithium from Produced Waters	Canada Natural Resources Limited, Conoco-Phillips Corporation, Hatch Engineering, Moselle Technologies	\$182,990	\$365,980

Lead Laboratory	Title of Project	Partners	Cost-Share (\$)	Total Budget (\$)
SNL	High-Temperature, Self-Healing Advanced Superalloy Components for High-Performance Reactors	Dynetics, University of New Mexico, Westwind Computer Products	\$2,025,402	\$3,525,402
SNL	Robotic Handling of Commercial Spent Nuclear Fuel to Support Implementation of a Consolidated Rod Canister	NAC International Inc.	\$1,607,342	\$3,107,342
SNL	Dry Cooling Technology to Reduce Costs and Water Use at Power Plants	Palo Verde Generating Station/Arizona Public Service	\$1,003,624	\$2,003,624
SNL	Continuous Interoperability for Distributed Energy	SunSpec Alliance	\$1,500,000	\$2,000,000
SNL	Development of Microfabricated Sensor Solutions for Petrochemical Applications	Honeywell PMT UOP HPS	\$469,406	\$938,812
SNL	HelioStat Observation System Commercial Qualification (HOS-C-Q)	Heligen	\$300,000	\$600,000

Table D-6. TCF Projects Awarded in FY 2019

Lead Laboratory	Title of Project	Partners	Cost-Share (\$)	Total Budget (\$)
Ames	Concentric Ring Gas Atomization Die Design for Optimized Particle Production	Praxair	\$150,000	\$300,000
ANL	High-fidelity ignition models to boost engine thermal efficiency	Convergent Science Inc.	\$1,070,000	\$1,790,000
ANL	Advanced ignition system for enhanced ignition stability and combustion efficiency	8 Rivers Capital LLC, Combustion Research & Flow Technology Inc., Purdue University	\$750,000	\$1,500,000
ANL	Qualification of SAS4A/SASSYS-1 for Sodium-Cooled Fast Reactor Authorization and Licensing	Advanced Reactor Concepts LLC, TerraPower LLC	\$674,484	\$1,348,968
ANL	Simulation Tool for Energy-Efficient Connected and Automated Vehicle Control Development	Hyundai America Technical Center	\$600,000	\$1,200,000
ANL	Industry-Informed Physics-Based Monitoring for Asset Management and Maintenance Optimization	Electric Power Research Institute, LPI Inc.	\$500,000	\$1,000,000
ANL	Integrated Power Block Heat Exchanger/Thermal Energy Storage System for CSP Plants	CFOAM LLC, Touchstone Research Laboratory	\$350,000	\$698,000
ANL	Remote Area Modular Monitoring for Critical Facilities	Embedded Planet	\$300,000	\$600,000
ANL	Development of RF cured nanocomposite adhesives for thermal-budget reduction in adhesive bonding processes	Mitsubishi Chemical America Inc.	\$150,000	\$300,000
ANL	Ultra-Fast and - Thick Boriding of Geothermal Casing to Enhance Reliability	Controlled Thermal Resources Inc.	\$150,000	\$300,000
ANL	Aluminum Purification and Magnesium Recovery from Mg-Al Scrap	Phinix LLC	\$150,000	\$300,000
ANL	Low-Cost Roll-to-Roll Manufacturing of Reusable Sorbents for Energy and Water Industries		\$150,000	\$300,000
ANL	Extension of Core Restrain Design Code NUBOW-3D to Lead Cooled Fast Reactor Systems	Westinghouse Electric Company	\$75,000	\$150,000

Lead Laboratory	Title of Project	Partners	Cost-Share (\$)	Total Budget (\$)
INL	Highly Dynamic Electronic Work Instructions for Advanced Reactors	GSE Systems	\$750,000	\$1,500,000
INL	Application of advanced preprocessing technologies for biopower and biobased products	Lignetics Inc.	\$300,000	\$600,000
INL	High Temperature Next Generation Compact Heat Exchanger Development Using Additive Manufacturing Techniques with Embedded Sensor Capability	NuScale Power	\$150,000	\$300,000
INL	Switchable Solvent Water Extraction for Material Processing and Isolation	Trevi Systems Inc.	\$150,000	\$300,000
INL	Wireless radio Frequency signal Identification and protocol Reverse Engineering (WiFIRE)		\$150,000	\$300,000
INL	Computer Programs for Analysis of Thermally Reactive Tracer Tests in Geothermal Reservoirs	Geothermal Scientific Inc., NREL, Ormat Inc	\$150,000	\$300,000
INL	Full-set Transformer Protection Barrier Manufacturing and Technology Commercialization Demonstration		\$125,000	\$250,000
INL	Advanced Flow Meter for Extreme Environments (AFMEE)	MicroNuclear LLC	\$100,000	\$200,000
INL	Advanced Manufacturing of Electrochemical Sensors for Molten Salt Applications	INFlex Labs LLC	\$75,000	\$150,000
INL	Fabrication of Near-net-shape Metallic Components from Oxides		\$75,000	\$150,000
INL	Neutron Spectrum Generator		\$75,000	\$150,000
INL	Rapid Field Chemical Detection and Determination of Actinides		\$42,500	\$85,000
INL	Advanced Inorganic Fluors in the Scintillation Hydro-Gel for Isotopic Neutron Emitters (SHINE) Neutron Detection Material for Nuclear Reactor Monitoring Systems		\$37,500	\$75,000
LANL	FracMan / dfnWorks: Translating Geological Fracture Characterizations for Massively Parallel Subsurface Flow and Transport Simulations	Golder Associates Inc.	\$753,700	\$1,503,700
LANL	Near-Net-Shape Hot Pressing Technologies	CoorsTek	\$750,000	\$1,500,000
LANL	Hydrogen Contaminant Detector	Skyre, Inc.	\$150,000	\$300,000
LBNL	High Throughput Cell-Free Microreactor Platform for Optimization of Biochemical Pathways	LanzaTech	\$535,000	\$1,070,000
LBNL	Localization of hot spots in solids using acoustic waves	Commonwealth Fusion Systems	\$150,000	\$300,000
LLNL	Instrumentation to Provide Realistic Training Exercises for Radiation Protection at Nuclear Facilities	Argon Electronics (UK) LTD	\$1,792,000	\$2,542,000
LLNL	LLNL Composite Sorbents: Enabling Economical Biomethane Production	WWTP, SoCalGas, Xebec	\$500,000	\$1,000,000
LLNL	Cold Spray Manufacturing of High-Performance Magnets and Energy-Harvesting Materials	TTEC LLC	\$305,000	\$605,000
LLNL	Commercializing 3D Printable Feedstocks for the Advanced Manufacturing of Energy Products	MilliporeSigma	\$300,000	\$600,000
LLNL	Hydroscanner: Instrumentation for water ingress imaging in photovoltaic module packaging materials	D2Solar Inc., Quanex Building Products Corporation, SCP SVS LLC, Sunrun, Vitroflex Inc.	\$250,000	\$500,000
LLNL	Reservoir Evaluation Tools Using Seismic Interferometry and Fiber Optic Sensors		\$150,000	\$300,000
NETL	Novel thermal process for conversion of CO2 to CO using metal ferrite oxygen carriers	CanmetENERGY, Glowink Inc.	\$150,000	\$300,000
NETL	Novel chemical looping process for conversion of natural gas to pure hydrogen	CanmetENERGY, Glowink Inc.	\$150,000	\$300,000

Lead Laboratory	Title of Project	Partners	Cost-Share (\$)	Total Budget (\$)
NREL	Flexible perovskite-perovskite PV for mobile power applications	Swift Solar	\$747,000	\$1,492,500
NREL	Solar Automated Permit Software for Distributed PV and Battery Storage	California Solar + Storage Association, Institute for Building Technology and Safety, Solar Energy Industries Association, SunPower, Sunrun, Tesla, The Solar Foundation, Vivint Solar	\$695,000	\$1,390,000
NREL	Catalyst Leaching Resistance for the Oxidative Production of Biobased Chemicals	Forge Nano, Johnson Matthey	\$335,000	\$670,000
NREL	Performance advantaged acrylonitrile	Zoltek (Toray Group)	\$300,000	\$600,000
NREL	Enabling Autonomous Wind Plants through Consensus Control	RES Group	\$250,000	\$500,000
NREL	Fusion Joining of Thermoplastic Composites Using Energy Efficient Processes	GE Global Research, US	\$150,000	\$300,000
NREL	High-Temperature Sensing Electronics for Downhole Smart Drilling	NOV Wellbore Technologies, Wolfspeed, a Cree Company	\$150,000	\$300,000
NREL	Enabling interoperability for PV inverter controllers	Triangle Microworks Inc.	\$150,000	\$299,995
NREL	Significant Cost Reduction Potential for Wave Energy Conversion Devices with Variable Geometry Modules		\$102,096	\$204,185
NREL	Atomic Layer Deposition Scale Up of Extended Thin Film Electrocatalyst Structures	ALD NanoSolutions	\$100,000	\$200,000
NREL	Wind Turbine Drivetrain Reliability Assessment and Remaining Useful Life Prediction	EDF, Nordex USA Inc., WindESCo	\$100,000	\$200,000
NREL	"DUSST": NREL's Low Maintenance Soiling Station	Atonometrics Inc., First Solar Inc., Groundwork Renewables Inc.	\$50,000	\$100,000
ORNL	Li-ion batteries with Safer Current Collectors	Soteria Battery Innovation Group	\$789,375	\$1,539,375
ORNL	Enabling Cobalt-Free Battery Solution for Behind the Meter Storage		\$789,375	\$1,539,375
ORNL	Scaling-up and Commercialization of Renewable Supertough Poly(lactic Acid) formulation for Durable Large-Scale Additive Manufacturing Applications	Natureworks	\$750,000	\$1,500,000
ORNL	Environmental Insights Explorer for Buildings	Google	\$750,000	\$1,500,000
ORNL	Fabrication and Testing of Solid-solution Strengthened Corrosion Resistant Alloys for Service in Molten Fluoride Environments	Haynes International, Kairos Power, MetalTek International	\$625,000	\$1,250,000
ORNL	Enhanced Steam Condenser for Power Generation Applications	IsoTherm Inc.	\$185,000	\$335,000
ORNL	High-temperature/high-pressure heat exchanger for natural gas-based modular power generation	Atrex Energy, IsoTherm Inc.	\$165,000	\$315,000
ORNL	Autonomous Benthic Macroinvertebrate and Larval Fish Imaging and Identification System	OceanSpace LLC	\$150,612	\$300,612

Lead Laboratory	Title of Project	Partners	Cost-Share (\$)	Total Budget (\$)
ORNL	Multifunctional Intensified Reactor Device with Integrated Heat and Mass Transfer for Effective CO2 Capture	AristoSys LLC, Georgia Institute of Technology, Volunteer Aerospace	\$150,000	\$300,000
ORNL	Ionic liquids as novel lubricant additives for HVAC compressors for enhanced efficiency and durability	Ingersoll Rand	\$150,000	\$300,000
ORNL	Self-Sensing Fiber Reinforced Composites		\$150,000	\$300,000
PNNL	Optimization and Peak Demand Limiting in large multi-family apartments building	NextWatts	\$750,000	\$1,500,000
PNNL	Accelerated Data Analytics for Power-system Time-series (ADAPT)	Bonneville Power Administration, Dominion Energy, PingThings	\$600,000	\$1,200,000
PNNL	Deploying Intra-hour Uncertainty Analysis Tools to ABB's GridView	ABB Power Consulting	\$500,000	\$1,000,000
PNNL	Surface Acoustic Wave Sensor for Refrigerant Leak Detection	Parker and Hannifin	\$375,000	\$750,000
PNNL	Advanced Membranes for Redox Flow Batteries	The Chemours Company, UniEnergy Technologies LLC	\$300,000	\$600,000
PNNL	Integrated Capture and Conversion of CO2 to Methanol (ICCCM) Process Technology	Southern California Gas Company	\$300,000	\$600,000
PNNL	Deception Defense Platform for Cyber-Physical Systems	Attivo Networks	\$150,045	\$300,045
PNNL	Autonomous acoustic receiver system for 3D tracking and monitoring real-time fish survival	Advanced Telemetry Systems	\$150,000	\$300,000
PNNL	Extending Magnetic Core Shell Nanoparticle Extraction Technology to Cesium and Antimony Removal from Geothermal Brines in New Zealand	GEO40 Limited	\$150,000	\$300,000
PNNL	A miniaturized long-life low-frequency acoustic transmitter for fish tracking in marine environment	Advanced Telemetry Systems	\$150,000	\$300,000
PNNL	Development of low-cost magnetocaloric materials	General Engineering and Research, L.L.C.	\$150,000	\$300,000
SLAC	Improved tools for consumer load profiling to build resilience into the electric grid	Holy Cross Energy	\$150,000	\$300,000
SNL	Development and Full Load Demonstration of a 1000°C Solid Particle Receiver for Concentrating Solar Power Applications	German Aerospace Center	\$752,620	\$1,502,620
SNL	Commercial Transfer of Sandia HTHP Downhole Electrochemical System	Thermochem Inc.	\$250,000	\$500,000
SNL	Advancing Particle Receiver Design for Commercialization of Solar Thermochemical Fuels and Ammonia Production	German Aerospace Center	\$225,000	\$375,000

Table D-7. TCF Projects for FY 2018

Lead Laboratory	Title of Project	Partners	Cost-Share (\$)	Total Budget (\$)
ANL	Machine Learning workflow tools for rapid optimization of product designs and manufacturing processes	Convergent Science Inc., Parallel Works Inc.	\$1,455,000	\$2,205,000

Lead Laboratory	Title of Project	Partners	Cost-Share (\$)	Total Budget (\$)
ANL	SAM Co-Development to Support Fluoride-salt-cooled High-temperature Reactor Design and Licensing	Kairos Power LLC	\$750,000	\$1,500,000
ANL	Adapter for Smart EV Charging to Improve Vehicle Grid Integration and Interoperability	California Energy Commission, Planet Innovation, Qmulus LLC, Zen Ecosystems	\$590,349	\$1,180,698
ANL	Small-Scale Recycling of Irradiated Uranium and Transuranic Elements (Np, Pu) Using 3D-Printed Centrifugal Contractors	Niowave, Inc	\$502,222	\$1,002,222
ANL	Integration of Thermal Energy Storage with a Combined Heat and Power System	Capstone Turbine Corporation	\$393,000	\$773,000
ANL	Software Defined Submeter System for Building and Electric Vehicle Charging Applications	Amzur Technologies, Flexible Manufacturing Inc.	\$375,000	\$750,000
ANL	Qualification of System-Level Advanced Reactor Safety Analysis Software for Lead Systems	Westinghouse Electric Company	\$250,000	\$500,000
ANL	A user-friendly commercial machine learning based software for large scale simulations and real time 3-D analysis and visualization		\$300,000	\$450,000
ANL	Enhancing unconventional reservoir ultimate recoveries with in-situ nano-catalysts	Greyhorse Engineering and Technology	\$286,500	\$436,500
ANL	SIS Biofuel Adsorbents		\$150,000	\$300,000
ANL	Stabilization of High Energy Lithium-ion Cathodes using Nanocomposite Coatings		\$150,000	\$300,000
ANL	Novel Composite Material Production for Energy Applications		\$150,000	\$300,000
Fermi	Downhole Accelerator-Sourced X-ray Imaging of Multiple Casing Strings	PetroMar Technologies, Inc.	\$288,484	\$575,311
INL	Pilot Demonstration of a Wireless Valve Position Indication Sensor System in Nuclear Power Plants	Exelon Generation Company, LLC	\$750,000	\$1,500,000
INL	Enable Safe and Reliable Operations of Nuclear Power Plants through a Highly Dynamic and Integrated Work Management System	LeanPower	\$750,000	\$1,500,000
INL	Prognostic Inspection Analysis at Nuclear Power Plants through an Advanced Imaging Service	LPI, Inc.	\$325,000	\$650,000
INL	High Temperature Irradiation Resistant Thermocouple	Idaho Laboratories Corporation	\$300,000	\$600,000
INL	Direct Electrochemical Valorization of Captured Carbon Dioxide	Carbon Clean Solutions	\$150,000	\$300,000
INL	Active Measurement Cancellation		\$75,000	\$150,000
INL	Mobile Efficient Modified Delta Robotic Non-Destructive Examination Platform		\$73,404	\$146,808
LBNL	Lignin-Derived Ionic Liquids: Synthesis and Application in Biopolymer Processing	Domtar Corp., Ilium Technologies, LLC, Natural Fiber Welding, Proionic, GmbH	\$500,000	\$1,000,000
LBNL	Sulfur Electrode Design for Lithium-Sulfur Rechargeable Battery	General Motors LLC	\$100,000	\$200,000
LBNL	Low-cost roll-to-roll manufacturing of metal-supported solid oxide fuel cells		\$100,000	\$200,000

Lead Laboratory	Title of Project	Partners	Cost-Share (\$)	Total Budget (\$)
LLNL	Grid-Scale, Long-Term Energy Storage: Repurposing Hydrocarbon Reservoirs, Resources, and Infrastructure to Store CO2 and Heat	Echogen Power Systems, Inc., Enviro Ambient, TerraCOH, Inc., University of Minnesota, Twin Cities	\$1,705,000	\$2,455,000
LLNL	Accelerating Qualification of Additively Manufactured Metal Parts	GE GRC	\$758,587	\$1,501,623
LLNL	Incorporating Microencapsulated Sorbents into Bioreactor Chips for CO2 Capture, Conversion, and Air Purification	Arteveli	\$630,000	\$1,260,000
LLNL	NanoDeposit: Rapid Manufacturing of Ordered Nanocrystal Devices	Voxtel Inc.	\$150,000	\$300,000
LLNL	New Amplifier for Increased Capacity in Optical Fiber to Improve Grid Reliability and Resiliency		\$150,000	\$300,000
NETL	Co-operative Development of Technologies to Improve Small-Scale Solid Oxide Fuel Cell Systems	Watt Fuel Cell	\$572,700	\$1,145,400
NETL	Improving Accuracy Through Uncertainty Quantification and Communication	Varigrid Explorations Inc.	\$470,000	\$940,000
NREL	Development of a Cloud-Based Parametric Building Energy Modeling Platform with Advanced HVAC Design Capabilities	Autodesk	\$5,883,000	\$6,227,638
NREL	Advanced Cellobiohydrolases	Novozymes, Inc.	\$750,000	\$1,500,000
NREL	Demonstration of NREL Modeling Capability to Design the Next Generation of Floating Offshore Wind Turbines	Stiesdal LLC	\$612,500	\$1,112,500
NREL	Full-Scale Hydrogen Mitigation Installation and Testing at Nevada Solar One	Acciona Energy USA Global LLC	\$543,333	\$1,039,675
NREL	Ubiquitous Traffic Volume Estimation through Machine Learning Procedures	Colorado Department of Transportation, I-95 Corridor Coalition, TomTom	\$525,000	\$1,025,000
NREL	Air conditioner with integrated phase-change composite material	Ingersoll-Rand, International Copper Association, NETenergy	\$500,000	\$1,000,000
NREL	Distribution Function in Time Series Simulation	HOMER Energy Inc.	\$300,000	\$600,000
NREL	An Energy Rating Index Software Tool for the Residential Buildings Industry	Wrightsoft	\$268,190	\$534,695
NREL	Fully Renewable Polyurethane Resins Produced from Algae and other Feedstocks	Patagonia	\$150,527	\$300,511
NREL	Model Test of an Innovative Offshore Floating Wind System		\$150,000	\$300,000
NREL	Deployment of the Aerial Distant Observer Tool to Survey Optical Performance of CSP Parabolic Trough Solar Fields	Solar Dynamics, LLC	\$150,000	\$300,000
NREL	Sustainable Graphite for Lithium-Ion Batteries	Ensyn Technologies, Inc.	\$150,000	\$299,935
NREL	Commercializing sputtered Zn (O, S) buffers in flexible CIGS solar cells		\$102,225	\$202,225
NREL	Commercializing Perovskite/CIGS Tandems	Ascent Solar Technologies, Inc.	\$101,423	\$201,423
NREL	Hydrogen Wide Area Monitor (HyWAM)	Compressed Gas Association, KJW Engineering, Linde Group	\$100,000	\$200,000

Lead Laboratory	Title of Project	Partners	Cost-Share (\$)	Total Budget (\$)
NREL	Transfer & Validation of Copyrighted NREL Spectroscopy IP for Rapid Biomass Composition to Next-Generation Ultra Low-Cost Near-Infrared (NIR) Spectrometers	KS Technologies, Texas Instruments	\$88,244	\$170,827
ORNL	Scale-up of Recycling Process to Develop Domestic Resources of High Purity Rare Earth Elements from E-Waste	Momentum Technologies	\$730,000	\$1,460,000
ORNL	Enhanced Performance Aluminum Alloys through Energy Efficient Thermomagnetic Processing	Ajax TOCCO Magnethermic, American Magnetics, Inc., Eck Industries, Inc.	\$200,000	\$400,000
ORNL	A Novel Catalyst for the Synthesis of Electrochemical Fuels	Reactwell, LLC	\$200,000	\$350,000
ORNL	Novel Catalyst for Low Temperature Emissions Control		\$150,000	\$300,000
ORNL	Used (spent) nuclear fuel management and analysis tool		\$150,000	\$300,000
PNNL	Integration of PNNL Synchrotron Analysis Tools into V&R Energy Real-Time Platform	V&R Energy Systems Research, Inc.	\$750,000	\$1,500,000
PNNL	Cold Spray Process Development for In Situ Repair and Mitigation of Cavitation Erosion	Bonneville Power Administration	\$300,000	\$600,000
PNNL	Reactive Distillation: Alcohol-to-Jet Application	LanzaTech	\$300,000	\$450,000
PNNL	High Efficiency Magnetocaloric Natural Gas Liquefaction		\$150,000	\$300,000
PNNL	Developing a Path Forward for the Integration of the Coordinated Real-time Sub-Transmission Volt-Var Control Tool (CREST-VCT) into Energy Management Systems (EMS)	ABB US Corporate Research Center, North Carolina State University	\$150,000	\$300,000
PNNL	Lab-on-a-fish for accelerating hydropower deployment		\$150,000	\$300,000
PNNL	Assembly of Aluminum and steel sub-components using Friction Stir Assisted Scribe technique (FAST)	TWB Company, LLC	\$150,000	\$300,000
PNNL	Maturation of nontoxic, durable, economical coatings for control of biofouling and corrosion on MHK Devices	BioBlend Renewable Resources, LLC	\$113,200	\$213,200
PNNL	Maturation of nontoxic, durable, economical coatings for control of invasive mussels at hydropower facilities		\$113,200	\$213,200
PNNL	Process Intensification for Nanocomposite Aluminum Extrusions	SCM Metal Products	\$105,000	\$210,000
PNNL	Molecularly optimized neutral electrolyte for rechargeable aqueous-based Zn-MnO2 batteries	Duracell Inc.	\$100,000	\$200,000
SNL	Testing of a Grid Compatible 1 MWe sCO2 Power Generation System for Commercial Distributed Energy Applications	Peregrine Turbine Technologies, LLC	\$750,000	\$1,500,000
SNL	Ducted Fuel Injection for the Next Generation of High-Efficiency, Fuel-Flexible, Clean, and Cost-Effective Engines	Caterpillar, Inc., Ford Motor Company	\$415,000	\$830,000

Table D-8. TCF Projects in FY 2017

Lead Laboratory	Title of Project	Partners	Cost-Share (\$)	Total Budget (\$)
Ames	Gas Atomization Nozzle Design for Controlled Particle Production	AMPAL Inc.	\$392,000	\$784,000

Lead Laboratory	Title of Project	Partners	Cost-Share (\$)	Total Budget (\$)
ANL	Development of a Scalable Process for Recovery of Polymers and Residual Metals from Mixed Polymer Content Scrap	Global Electric Electronic Processing International	\$2,044,000	\$2,794,000
ANL	Two-Tier Tube-Trailer Consolidation Technology for Fast Fueling of Hydrogen Fuel Cell Electric Vehicles	FirstElement Fuel, Gas Technology Institute, PDC Machines, Inc.	\$1,650,000	\$2,361,000
ANL	Lithium Anodes for Electric Vehicles	alpha-En Corporation	\$800,000	\$1,550,000
ANL	The Application of Catalytically Active Nano-composite Coatings to increase the Service Interval of Automotive Powertrain Applications	Magna Services of America	\$712,450	\$1,424,900
ANL	Graphene based solid lubricants for automotive applications	Magna International Inc.	\$712,540	\$1,352,540
ANL	Advanced Physics-Based Fluid System Performance Monitoring to Support Nuclear Power Plant Operations	LPI Inc.	\$500,000	\$1,000,000
ANL	Joint Development of SAS4A Code in Application to Oxide-fueled LFR Severe Accident Analysis	Westinghouse Nuclear	\$400,000	\$800,000
ANL	Passive, High Efficiency Ventilation for the DRACS and other Natural Circulation Systems	General Atomics	\$100,000	\$200,000
ANL	NRC Qualification of Advanced Reactor Safety Analysis Software		\$75,000	\$150,000
BNL	Commercial Scale-Up and Demonstration of SulCrete, a clean, energy efficient alternative to Conventional Portland Cement Concrete	SulCrete, Roman Stone Construction Co. Inc.	\$1,049,277	\$1,799,277
INL	Highly Scalable Computer-Based Procedure System for Field Workers	NextAxiom Technology	\$818,128	\$1,568,128
INL	Seismic Isolation of Major Advanced Reactor Systems for Economic Improvement and Safety Assurance	Southern Company Services Inc., TerraPower, X-energy	\$710,000	\$1,420,000
INL	Pathway to Commercialization of Weather Based Dynamic Line Rating with CFD using INL's General Line Ampacity State Solver (GLASS) software.	Schneider Electric DTN, WindSim Americas Inc.	\$387,650	\$619,650
INL	Integration of PHISICS into the AREVA reactor design suite for commercial application to High Temperature Reactors	AREVA NP Inc.	\$300,000	\$600,000
INL	RAVEN Code Commercial Deployment for Industrial Related Applications	FPoliSolutions	\$250,000	\$500,000
INL	Produced Water Treatment using the Switchable Polarity Solvent Forward Osmosis (SPS FO) Process		\$150,000	\$300,000
INL	Event Model Risk Assessment using Linked Diagrams (EMRALD)		\$61,906	\$123,812
LANL	Development of A Micro-Reactor for Generator of Nuclear Power	Westinghouse Electric Company	\$773,680	\$1,523,680
LBNL	Cooperative Development of a High Efficiency Anaerobic Electroporation Apparatus for Biofuel Generation from Waste Gases	Lanzatech	\$500,799	\$999,799
LBNL	Advancing the Commercial Building Energy Saver to Provide Actionable Insights into Building Retrofits and to Enable Broad-Based Commercialization		\$150,000	\$300,000
LLNL	Implementing Coupled Transmission and Distribution Simulation	Eaton Corporation	\$837,841	\$1,587,841
LLNL	Additive Manufacturing of Thermoelectric Generators	TTEC LLC	\$215,507	\$365,000
LLNL	Microencapsulated Sorbents for Biogas Upgrading	Delta Diablo	\$150,000	\$300,000
LLNL	Rare Earth Metal Extraction for Clean Technologies		\$150,000	\$300,000

Lead Laboratory	Title of Project	Partners	Cost-Share (\$)	Total Budget (\$)
LLNL	Earth Battery: Storing Energy with Compressed Air and Heated Brine in Porous Rock	Pacific Gas and Electric Company, The Ohio State University	\$150,000	\$300,000
LLNL	Assessment of water ingress impact on efficiency degradation in photovoltaic modules		\$150,000	\$300,000
NETL	Commercialization of Immobilized Amino-Silane/Amine or Biochar Sorbents for the Capture of Carbon Dioxide from Various Methane Gas Streams	BioEnergy Development LLC	\$1,105,000	\$1,855,000
NETL	Safer drilling — Reducing risks and costs with real time, downhole kick detection	Saudi Aramco	\$700,000	\$1,400,000
NETL	Simultaneous extraction of nickel and vanadium from petcoke waste byproducts	Sumitomo Chemical	\$347,684	\$695,368
NETL	Commercialization of the CuO-Fe2O3 oxygen carrier for hydrogen and carbon/syngas production from natural gas	Applied Minerals Inc., Columbian Chemicals Company	\$150,000	\$300,000
NETL	Slag Management of Carbon Feedstock Used in Gasification	Eastman Chemical Company	\$125,000	\$250,000
NREL	Optimal, Reliable Building-Integrated Energy Storage	Eaton Corporation	\$525,000	\$1,050,000
NREL	Biomaterials from non-woody biomass	Sustainable Fiber Technologies	\$500,000	\$1,000,000
NREL	Spatial atomic layer deposition (ALD) to scale the manufacturing of tailored and robust catalysts for biofuel and biochemical production	Forge Nano	\$150,000	\$300,000
NREL	Development of an Integrated Model for a Greenfield Hybrid Geothermal and CSP System	U.S. Geothermal Inc., Power Engineers	\$100,000	\$200,000
ORNL	Wireless Power Transfer Technology for Autonomous Vehicle Platform	Local Motors	\$650,000	\$1,300,000
ORNL	Technology Validation of Innovative Dissimilar Materials Joining Processes in Automotive Production Environment	Cosma Eagle Bend Manufacturing Plant	\$633,827	\$1,267,654
ORNL	Polymer-Based Adsorbents for the Recovery of Uranium from Desalination Facilities	S25 Solutions Inc.	\$622,000	\$1,244,000
ORNL	Thermoelectric Heat Pump Heat Recovery System for Domestic Dishwashers	Samsung Electronics America	\$500,000	\$1,000,000
ORNL	Cost lowering and scale up of a very low thermal conductivity material		\$150,000	\$300,000
ORNL	Development of cost-effective quantum key distribution systems for the U.S. power grid		\$150,000	\$300,000
ORNL	Carbon Capture via Crystallization with a Guanidine Ligand		\$150,000	\$300,000
PNNL	Improving Cloud-Based Performance of Distribution Planning Tools	GridUnity (formerly Qado Energy Inc.)	\$300,000	\$600,000
PNNL	Commercialization of Sensor Fish Technology to support hydropower development	Advanced Telemetry Systems	\$246,000	\$396,000
PNNL	Video Analysis Software Development		\$150,000	\$300,000
PNNL	Low-cost Battery Health Monitoring and Diagnosis system	UniEnergy Technologies	\$150,000	\$300,000
PNNL	Air Braze Optimization for Markets Targeted by Aegis Technology, Inc.	Aegis Technology Inc.	\$125,000	\$250,000
PNNL	Cold Spray Magnetostrictive Sensor	Innerspec	\$75,000	\$150,000
SNL	Consolidation of Commercial Spent Nuclear Fuel into a Universal Canister for Storage, Transportation, and Disposal	NAC International	\$801,800	\$1,551,800
SNL	Memzyme Technology for Cost-Effective CO2 Separations in Enhanced Oil Recovery	Angstrom Thin Film Technologies LLC, Occidental Petroleum Company	\$300,000	\$600,000

Lead Laboratory	Title of Project	Partners	Cost-Share (\$)	Total Budget (\$)
SNL	Downhole Rotation for Small-Diameter Drilling Applications	Ditch Witch (A Charles Machine Works Company)	\$149,000	\$297,955
SNL	Optimal Headers for Diffusion Bonded Heat Exchangers	Vacuum Process Engineering Inc.	\$100,000	\$200,000
SNL	Evaluation of Wattjoule's Vanadium redox flow battery employing SNL' membranes	Wattjoule Corporation	\$50,000	\$100,000

Table D-9. TCF Projects in FY 2016

Lead Laboratory	Title of Project	Partners	Cost-Share (\$)	Total Budget (\$)
Ames	Manufacturing of Advanced Alnico Magnets for Energy Efficient Traction Drive Motors	Arnold Magnetic Technologies Corporation, Carpenter Powder Products, Ford Motor Company, Iowa Energy Center, Iowa State University, UQM Technology Inc	\$325,000	\$650,000
ANL	Application of Resin-Wafer Electrodeionization Technology in Biorefineries		\$639,000	\$1,200,000
ANL	Graphene Coating for Dry Gas Seal Applications	John Crane Inc.	\$579,992	\$1,159,844
ANL	Advanced Manufacturing of Ultra-High-Density Interposers	ICAMR (International Consortium for Advanced Manufacturing Research)	\$250,000	\$500,000
ANL	Ultrathin Nanoparticle Membranes to Remove Emerging Hydrophobic Trace Organic Compounds in Water with Low Applied Pressure and Energy Consumption	Metropolitan Water Reclamation District of Greater Chicago	\$150,000	\$300,000
ANL	UNCD-Based Electron Field Emission Source for Accelerator Applications		\$150,000	\$300,000
BNL	Direct Fabrication of Fuel Cell Electrodes by Electrodeposition of High-performance Core-shell Catalysts		\$100,000	\$200,000
BNL	Nitride-Stabilized Pt Core-Shell Electrocatalysts for Fuel Cell Cathodes		\$100,000	\$200,000
INL	Enhanced and Miniaturized Wireless Valve Position Indicator Prototype	Analysis and Measurement Services Corporation, Electric Power Research Institute, Rolls Royce, Westinghouse Electrical Corporation	\$299,600	\$449,200
INL	Additive Manufacturing as an Alternative Fabrication Technique for the Fabrication of Uranium Silicide Fuel	Westinghouse Electric Company	\$150,000	\$300,000
INL	Computer-Based Procedure System for Field Workers		\$170,000	\$300,000

Lead Laboratory	Title of Project	Partners	Cost-Share (\$)	Total Budget (\$)
INL	Vehicle Controller Area Network (CAN) Bus Network Safety and Security System	Mercedes-Benz Research and Development North America Inc.	\$150,000	\$300,000
INL	Vibro-acoustic Testing for Microstructure Characterization and Metrology		\$150,000	\$300,000
INL	Enhancing Lithium-Ion Battery Safety for Vehicle Technologies and Energy Storage		\$123,165	\$242,170
INL	Development of In-Core Three-Omega Thermal Conductivity Probe	Radiation Detection Technologies Inc.	\$75,000	\$149,911
INL	Commercialization Research and Development of Change Detection Systems for Nuclear Applications		\$62,500	\$125,000
INL	Advanced Outage Control Center Dashboard with Predictive Tools		\$60,500	\$121,000
LBNL	Flame-Powered SOFC Generators		\$150,000	\$300,000
LBNL	Large Area Polymer Protected Lithium Metal Electrodes with Engineered Dentrite-Blocking Ability		\$73,831	\$147,662
LLNL	Cryo-Compressed Hydrogen Tank Technology in an Internal Combustion Engine Application	GoTek Energy Inc.	\$495,000	\$990,000
LLNL	Fire- and Water-Resistant Pre-filter		\$150,000	\$300,000
LANL	Efficient Groundwater Restoration at Uranium In-Situ Recovery Sites to Enable Domestic Uranium Production for Nuclear Energy	Cameco Resources Inc.	\$700,000	\$1,400,000
LANL	FracMan/dfnWorks: From Geological Fracture Characterization to Multiphase Subsurface Flow and Transport Simulation	Golder Associates Inc.	\$180,000	\$330,000
NETL	Development of Spouting Bed Reactor for Reduction of Hematite to Magnetite	Siox, LLC.	\$750,000	\$1,499,781
NETL	Cooperative Development of NETL Electrode Engineering Process for SOFC Commercialization	Atrex Energy Inc. (formerly Acumentrics)	\$250,256	\$500,512
NETL	Laser induced breakdown spectroscopy (LIBS) subsurface sensor maturation	Applied Spectra Inc.	\$246,423	\$492,846
NETL	Raman Gas Analyzer Cooperative Development	Oxergy Inc.	\$106,000	\$212,640
NREL	Scaled production of high-octane biofuel from biomass-derived dimethyl ether	Enerkem	\$760,000	\$1,500,000
NREL	Improved Wind Plant Energy Production by Application of Wind-Plant Integrated Systems Engineering Model (WISDEM™) to Wind Plant Controls (A Demonstration Project)	NextEra Energy Resources, Ystrategies	\$275,000	\$500,000
NREL	Thermal Management for Planar Package Power Electronics	John Deere Electronic Solutions	\$250,000	\$500,000
NREL	New DC Power System Topology for Telecommunications Facilities	Verizon Wireless	\$140,000	\$280,000
ORNL	Residential Gas Heat Pump (RGHP)	Alagasco, Blue Mountain Energy, Intellichoice Energy, Mestex	\$750,000	\$1,500,000
ORNL	Liquid Salt Environment Creep Testing System Development and Commercialization	Applied Testing Systems Inc.	\$700,000	\$1,400,000
ORNL	The ENABLE (Environmentally Neutral Automated Building Electric Energy) Platform	Flex Power Control	\$625,000	\$1,250,000
ORNL	Additive Manufacturing of Thermoset Cellular Structures	Magnum Venus Products	\$500,000	\$1,000,000
ORNL	Carbon Fiber Plasma Surface Treatment	RMX Technologies, LLC., C.A. Litzler Company, LLC	\$500,000	\$1,000,000

Lead Laboratory	Title of Project	Partners	Cost-Share (\$)	Total Budget (\$)
ORNL	Molten Salt Reactor Neutronics Tools		\$150,000	\$300,000
ORNL	Novel High Permeability Membranes for CO2 Capture		\$150,000	\$300,000
ORNL	On-Vehicle Emission Sensor		\$150,000	\$300,000
ORNL	New High-Strength Ni-based Alloys for High Temperature Service in Liquid Fluoride Salt Environments	Haynes International	\$135,000	\$270,000
PNNL	Dish-STARSTM Commercialization	Infinia Technology Corporation, Barr Engineering, DiverSolar LLC, Southern California Gas Company, STARS LLC	\$1,316,000	\$2,000,000
PNNL	Demonstration of a kW class Redox Flow Battery using an Advanced Bi-additive Vanadium Sulfate Electrolyte	ITN Energy Systems Inc.	\$600,000	\$1,200,000
PNNL	Direct Extruded High Conductivity Copper for Electric Machines Manufactured Using the SHAPE Process	General Motors R&D	\$600,000	\$1,200,000
PNNL	Reliability and Durability Testing of Glass Ceramic Seals for Praxair's Oxygen Transport Membranes	Praxair	\$600,000	\$1,200,000
PNNL	Assembly of dissimilar aluminum alloys for automotive application		\$500,000	\$1,000,000
PNNL	Development of electrolytes for lithium-ion batteries in wide temperature range applications	Farasis Energy, Inc., Navitas Systems	\$375,000	\$750,000
PNNL	Commercialization of Uncertainty Prediction Tools for Wind and Solar Energy for Probabilistic Electric Power Grid Operations	California Independent System Operator, AWS Truepower)	\$290,000	\$580,000
PNNL	Solid State Processing for Improved Performance of Current and Next-Generation Hydropower Components		\$200,000	\$400,000
PNNL	A Self-Powered Acoustic Transmitter	Advanced Telemetry Systems Inc., Grant County Public Utilities District, Idaho Power Company	\$170,000	\$320,000
PNNL	Controlled-release solid nitride fertilizer from coal fly ash: demonstrating fluidized-bed synthesis and environmental performance		\$125,000	\$250,000
PNNL	Development of Protective Coatings for 1 kW Hot Zone	Protonex Technology Corporation	\$124,332	\$248,664
PNNL	Glass Seals with Low or Zero Boron Content for High Temperature SOFC Applications	LG Fuel Cell Systems Inc.		\$175,000
SNL	Commercialization of the Sandia Cooler	Wakefield-Vette Thermal Solutions	\$332,000	\$500,000
SNL	High Temperature BA-BZT-BT Capacitors	TPL, Inc.	\$50,000	\$100,000

Appendix C: OTT's Organizational Structure and Summaries of Major OTT Milestones and Implementation Activities from FY 2015 to FY 2020

This appendix provides background on OTT's organizational structure and summaries of major milestones regarding the origins and evolution of OTT, as well as the progress and implementation of the office's activities from FY 2015 to FY 2020. Section A describes OTT's organizational structure. Section B describes the major OTT milestones since OTT's establishment in FY 2015. This section also summarizes implementation of relevant programs and activities for FY 2019 and FY2020 in accordance with requirements provided EAct of 2005 and EA2020 (summarized in Figure C-2).

A. OTT Organizational Structure

For the first few years of OTT's existence, OTT had a flat organizational structure with a small staff reporting directly to the Director and, subsequently, to a Deputy Director. Over time, OTT's leadership worked to discretely define strategic goals and establish functional teams to focus on specific dimensions of DOE's technology transfer and commercialization mission. OTT's current organizational structure provides a firm foundation in support of its mission through five key functional teams (Figure C-1)—

- **Front Office**—Manages communications and public affairs, executes special projects and strategic initiatives, as well as develops key partnerships.
- **Commercialization Programs**—Manages OTT funding and support programs, including the Technology Commercialization Fund (TCF), and acts as a test bed and clearinghouse for information about innovative program designs and funding mechanisms.
- **Market Analysis**—Coordinates and develops data collection and analyses to support understanding of market dynamics and drivers, commercialization factors, and inform strategy and decision-making.
- **Policy & Practice**—Identifies impediments to OTT's mission and implements improvements through policy analysis, coordination, and engagement with stakeholders, as well as develops Congressional reports and strategic plans.
- **Operations**—Supports the overall OTT mission by coordinating key back-office activities, such as human capital management, budget planning and execution, information technology, and procurement.

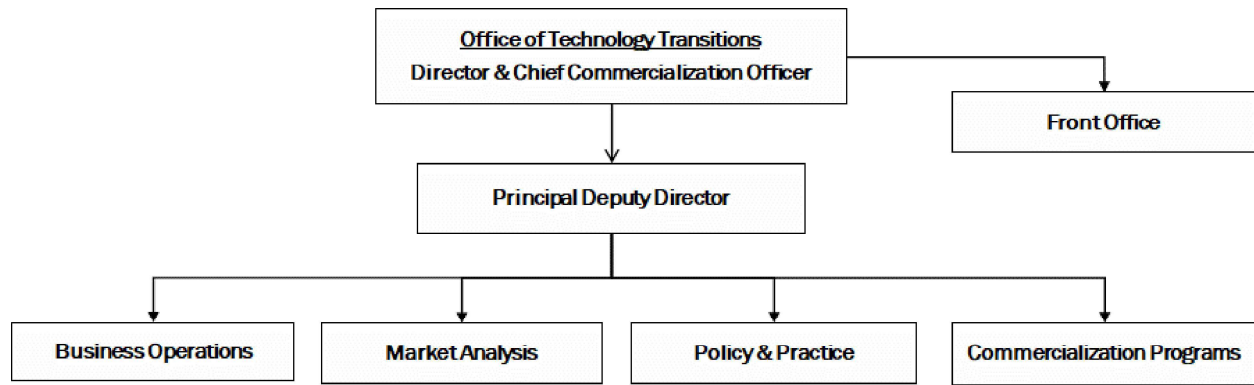


Figure C-1. OTT Organizational Structure, current as of June 2023

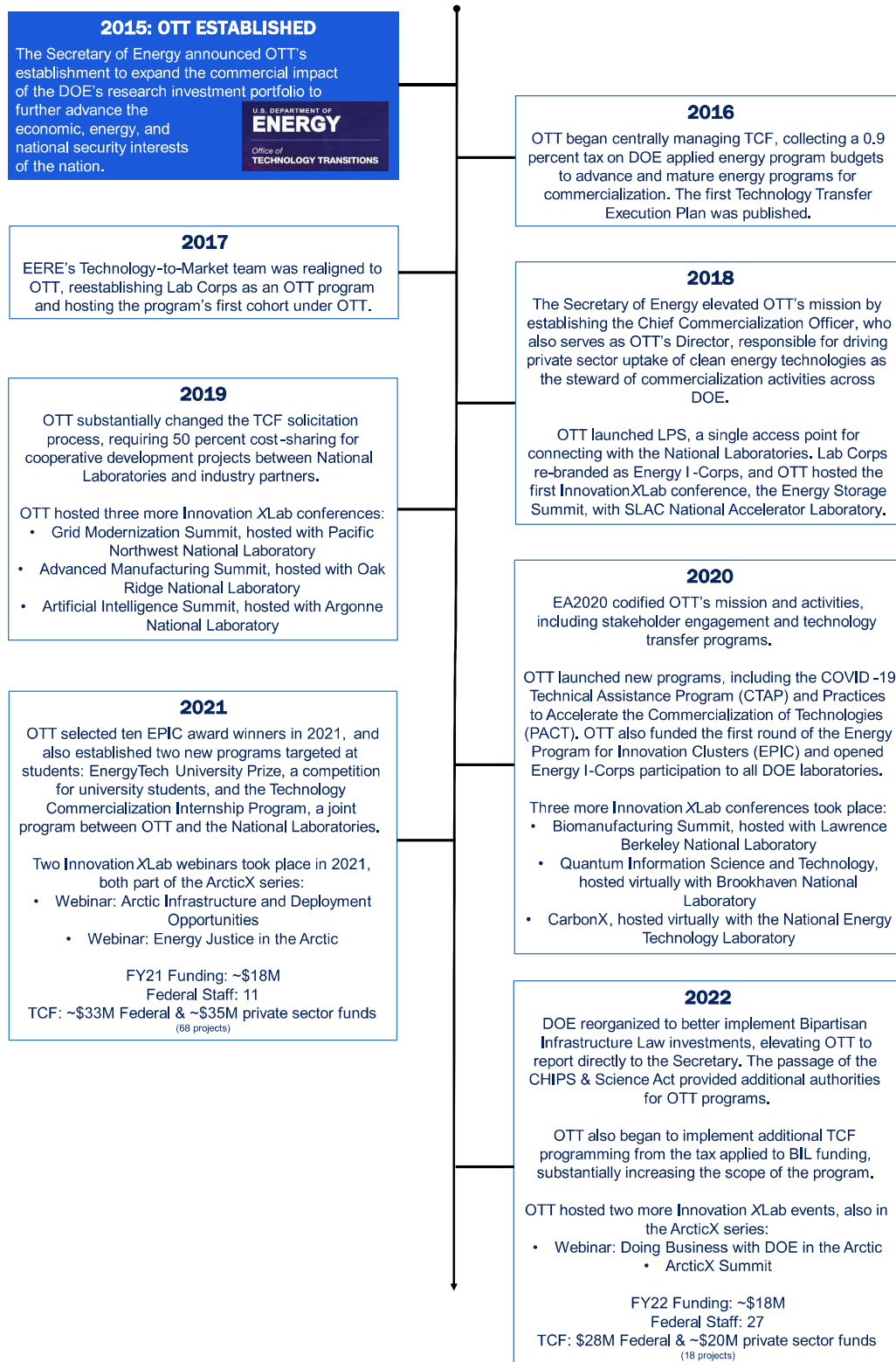


Figure C-2. Key Milestones Related to DOE Technology Transfer and OTT's Mission

B. FY 2015 Summary

On February 11, 2015, the Secretary of Energy announced the formation of OTT, with the charge to expand the commercial impact of DOE's portfolio of RDD&D activities in the short-, medium-, and long-term.⁷⁷ OTT's mission was to expand the commercial impact of DOE's research investment portfolio to further advance the economic, energy, and national security interests of the Nation.⁷⁸ OTT's first director took office in February 2015.

C. FY 2016 Summary

OTT formally began implementing and centrally managing TCF starting in FY 2016, collecting a 0.9 percent tax on applied energy program budgets within DOE to advance and mature energy technologies for use in the private sector.

Over the course of FY 2016, OTT conducted a stakeholder outreach strategy to inform strategic planning. This effort included a formal Request for Information (RFI) with 55 submissions, including 12 from DOE National Laboratories; four DOE National Laboratory workshops; three roundtables on regional-state technology transition opportunities; and regular engagement with DOE technology transfer managers.

In January 2016, OTT stood up the Clean Energy Investment Center, a program intended to provide public information and connections to subject matter experts for the investment community in an effort to increase and catalyze private sector investment in energy technology.

OTT also coordinated across DOE to participate in targeted outreach and engagement at prominent events. In May 2016, OTT led DOE's presence at the Bay Area Maker Faire in San Mateo, California, along with the Advanced Research Projects Agency-Energy (ARPA-E), Office of Energy Efficiency and Renewable Energy (EERE), the National Nuclear Security Administration (NNSA), and the Office of Science. DOE's Energy Pavilion was a major attraction at the event, which had 175,000 people in attendance.

D. FY 2017 Summary

As part of a DOE-wide realignment, EERE staff who had been managing commercialization programs on EERE's Technology-to-Market team were formally brought into OTT, following the path of OTT's first director. Lab Corps, the predecessor to Energy I-Corps, was reestablished as an OTT program managed by these new staff.

⁷⁷ DOE. 2015. Recommendation to Recast the Office of Technology Transfer Coordinator as the Office of Technology Transitions, Memorandum for the Secretary from the Under Secretary for Science and Energy.

⁷⁸ Ibid.

OTT published and transmitted the first Technology Transfer Execution Plan (TTEP) to Congress in October 2016, outlining goals for DOE and to carry out OTT's mission. In addition, OTT hosted its first Lab Corps cohort. The second DOE-wide round of TCF was announced in FY 2017, supporting 54 projects focused on technology maturation and moving technology to the marketplace.

E. FY 2018 Summary

In November 2017, DOE announced the authorization for DOE laboratory contractors to use Agreements for Commercializing Technology (ACT) to facilitate new strategic partnerships, following the conclusion of a six-year pilot program that began in 2011.⁷⁹ Six DOE Laboratories participated in the ACT pilot to develop more flexible partnership agreements with private sector partners with negotiable terms for intellectual property terms, advance payments, and indemnification, among others. In addition, DOE launched a new pilot program called FedACT that expanded the use of ACT to allow organizations to partner with DOE's laboratories on federally funded projects.⁸⁰

In July 2018, OTT launched the Lab Partnering Service (LPS), the first online, single access point platform for external stakeholders to identify, locate, and obtain information from DOE Laboratories.⁸¹ LPS launched with tools to connect users with experts, collections of technical and marketing summaries for pre-validated technologies, and the visual patent search tool for patents available for license from DOE Laboratories.

In FY 2018, Lab-Corps formally rebranded as Energy I-Corps. OTT released a collection of 2017 Energy I-Corps case studies as well as an impact report focused on the second year of the program.

OTT continued to support communication of technology transfer and commercialization successes stemming from DOE investments and engagement with energy innovation ecosystem stakeholders across the Nation. OTT also published *DOE Spotlight: Solving Challenges in Energy Storage*, the first in a series of reports highlighting DOE's work in emerging technology areas, in August 2018. In September 2018, OTT hosted the first InnovationXLab Summit at SLAC National Accelerator Laboratory. The Energy Storage Summit saw expert panels discuss how energy

⁷⁹ For further on the pilot program, see Howieson, S.V., Sergi, B.J., and Shipp, S.S. 2013. Department of Energy Agreements for Commercializing Technology. IDA Paper P-5006. IDA Science and Technology Policy Institute: Washington, D.C.

⁸⁰ DOE. 2017. Secretary of Energy Rick Perry Announces Expanded Partnership Opportunities with the National Laboratories, available at <https://www.energy.gov/articles/secretary-energy-rick-perry-announces-expanded-partnership-opportunities-national>.

⁸¹ DOE, "DOE Launches New Lab Partnering Service," July 18, 2018, available at <https://www.energy.gov/articles/doe-launches-new-lab-partnering-service>.

storage is one of the biggest challenges to unlocking the potential from the next generation of transportation and electricity grid technologies.

F. FY 2019 Summary

In FY 2019, a Secretarial Memorandum to Departmental Elements directed the creation of a working group to implement DOE Policy 482.2, *Laboratory Technology Transfer Data Collection and Management*. The working group later provided recommendations on the process of collecting data from the National Laboratories.

OTT published the next in the spotlight series, *DOE Spotlight: Artificial Intelligence*, in October 2019. OTT's public engagement role also increased in FY 2019, as the office hosted the next two InnovationXLab events. The first of these, the Grid Modernization Summit hosted by Pacific Northwest National Laboratory, brought together industry thought leaders, stakeholders, and DOE experts working on the biggest challenges of grid modernization. The second was the InnovationXLab Advanced Manufacturing Summit at Oak Ridge National Laboratory, which brought together lab and industry stakeholders to explore new manufacturing challenges and opportunities.

OTT made significant changes to the TCF solicitation process in FY 2019, requiring a 50 percent cost-share for project applications under Topic 2, cooperative development projects between a lab and industry partners. This cost-share requirement was subsequently revised in the Energy Act of 2020.

In coordination with OTT, DOE's Office of Science incorporated a technology transfer and commercialization goal for the first time during the FY 2019 Performance Evaluation and Management Plan cycle. The goal applies to the Office of Science's ten National Laboratories and has been used in every subsequent annual laboratory evaluation.

G. FY 2020 Summary

FY 2020 saw numerous milestones for OTT. The office launched "Innovation Powered by DOE," the first public facing dashboard highlighting and providing detailed information on 450 identified technology transfer and commercialization successes of DOE Laboratories. OTT also piloted Solutions Exchange, an online industry-facing outreach tool.

OTT also released several publications, including *Contributions of the U.S. Department of Energy National Laboratories and Facilities to Advance Industry: Medical Imaging, Diagnostics, and Treatment*, published May 2020, and *Spotlight: Quantum Information Science and Technology*, published August 2020. Based on the work of the working group established in FY 2019, DOE Policy 482.2 was also published and implemented.

Two more InnovationXLab events took place in FY 2020. OTT hosted the Artificial Intelligence Summit at Argonne National Laboratory in October 2019 and the Biomanufacturing Summit in January 2020, convening diverse groups of stakeholders to discuss both topics.

In addition, OTT launched new programs, including Practices to Accelerate the Commercialization of Technologies (PACT) and the COVID-19 Technical Assistance Program (CTAP). PACT was a single year funding opportunity to support projects (a) enhancing the potential for commercialization of National Laboratory technologies; or (b) increasing access to laboratory facilities and collaborations between industry and laboratory researchers. CTAP provided targeted funding for National Laboratories to offer short-term engagements with U.S. external entities in response to the COVID-19 pandemic. OTT also funded the first round of the EPIC program, which funds place-based regional innovation incubators and accelerators. In addition, OTT expanded existing programs, opening up Energy I-Corps participation to teams from the Office of Science's and NNSA's laboratories.