U.S. DEPARTMENT OF ENERGY

Report on the Utilization of Federal Technology

Fiscal Years 2016 and 2017

Report to Congress
October 2019

United States Department of Energy
Washington, DC 20585

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

The Report on Utilization of Federal Technology for Fiscal Years (FY) 2016 and FY 2017 ("*Report*") is prepared in accordance with the requirements of the Technology Transfer and Commercialization Act of 2000:

> *It is the continuing responsibility of the Federal Government to ensure the full use of the results of the Nation's federal investment in research and development. To this end, the Federal Government shall strive where appropriate to transfer federally owned or originated technology to State and local governments and to the private sector.*
>
> *Each Federal agency which operates or directs one or more Federal laboratories or which conducts activities under sections 207 and 209 of title 35, United States code, shall report annually to the Office of Management and Budget, as part of the agency's annual budget submission, on the activities performed by that agency and its Federal laboratories under the provisions of this section and of sections 207 and 209 of title 35, United States Code.*

Pursuant to the legislative language this report is being submitted to OMB before being released to the public and provided to the following Members of Congress:

- **The Honorable Michael Pence**
  President of the Senate

- **The Honorable Nancy Pelosi**
  Speaker of the House of Representatives

- **The Honorable Richard C. Shelby**
  Chairman, Senate Committee on Appropriations

- **The Honorable Patrick Leahy**
  Vice Chairman, Senate Committee on Appropriations

- **The Honorable Nita M. Lowey**
  Chairwoman, House Committee on Appropriations

- **The Honorable Kay Granger**
  Ranking Member, House Committee on Appropriations

- **The Honorable Lamar Alexander**
  Chairman, Subcommittee on Energy and Water Development
  Senate Committee on Appropriations

- **The Honorable Dianne Feinstein**
  Ranking Member, Subcommittee on Energy and Water Development
  Senate Committee on Appropriations

- **The Honorable Marcy Kaptur**
  Chairwoman, Subcommittee on Energy and Water Development
  House Committee on Appropriations

- **The Honorable Mike Simpson**
  Ranking Member, Subcommittee on Energy and Water Development
  House Committee on Appropriations

- **The Honorable Lisa Murkowski**
  Chair, Senate Committee on Energy and Natural Resources

- **The Honorable Joe Manchin**
  Ranking Member, Senate Committee on Energy and Natural Resources

- **The Honorable Frank Pallone, Jr.**
  Chairman, House Committee on Energy and Commerce

- **The Honorable Greg Walden**
  Ranking Member, House Committee on Energy and Commerce

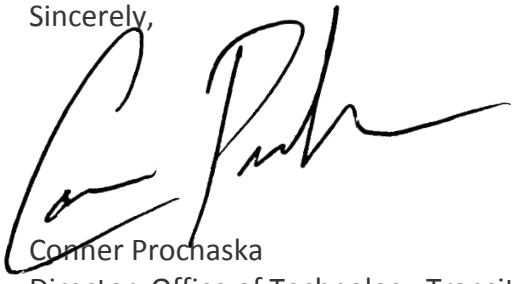
- **The Honorable Eddie Bernice Johnson**
  Chairwoman, House Committee on Science, Space, and Technology

- **The Honorable Frank Lucas**
  Ranking Member, House Committee on Science, Space, and Technology

Technology partnering is an active component of the Department of Energy's (DOE) overall mission to promote scientific and technological innovation that advances the economic, energy, and national security interests of the United States and the overall impact of DOE research and development. This *Report* describes these activities and outlines DOE's procedures and organizational management structure for ensuring appropriate management and oversight of such activities, in accordance with prevailing policy and authorities.

If you have any questions or need additional information, please contact Mr. Chris Morris, Deputy Assistant Secretary for House Affairs or Mr. Shawn Affolter, Deputy Assistant Secretary for Senate Affairs, Office of Congressional and Intergovernmental Affairs, at (202) 586-5450 or Ms. Katie Donley, Deputy Director for External Coordination, Office of the Chief Financial Officer, at (202) 586-0176.

Sincerely,



Conner Prochaska
Director, Office of Technology Transitions
and Chief Commercialization Officer

Executive Summary

DOE is one of the largest supporters of technology transfer within the federal government. The work conducted at its National Laboratories, production facilities, plants and sites has provided the scientific and technical foundation for many technologies in the market today. In addition to that foundational work, technology transition activities support the acceleration of the transfer of federally-funded research from the laboratory to the commercial marketplace. The successes are confirmation of DOE's robust technical enterprise, which is a result of continuous outreach and partnering with the private sector. They contribute to fulfilling DOE's mission and further strengthen the capabilities of DOE's laboratories and facilities. The magnitude of this work is also a reflection of the continued confidence in DOE held by thousands of public and private partners who work with DOE. This Report describes DOE's technology transfer activities and outlines how DOE ensures appropriate management and oversight with prevailing policy and authorities. A summary of the technology transfer-related transactions in Fiscal Years 2016 and 2017 is presented in Table ES-1 below.

Table ES-1. Summary of Technology Transfer Activities in FY 2016 and FY 2017

Technology Transfer Related Transactions	**FY 2016**	**FY 2017**
Active Cooperative Research and Development Agreements (CRADAs)	739	910
Active Non-Federal Entity (NFE) Strategic Partner Projects (SPP)	2,234	2,047
Active Agreements for Commercializing Technology (ACT)	78	98
Active Licenses of Intellectual Property	5,410	4,045
User Projects	11,939	9,468
Additional Technology Transfer Statistics	**FY 2016**	**FY 2017**
Patent Applications Filed	999	937
U.S. Patent Applications Filed	911	841
Foreign Patent Applications Filed	88	96
Patents Issued	856	817
U.S. Patents Issued	661	627
Foreign Patents Issued	195	190
Commercialized Technologies	483	955
CRADA NFE sponsor "funds-in"	$60.4 Million	$60.7 Million
SPP NFE sponsor "funds-in"	$255.4 Million	$200.6 Million
ACT NFE "funds-in"	$17.1 Million	$23.8 Million

The Office of Technology Transitions (OTT) would like to acknowledge the valuable role played by the many professional practitioners of technology transfer throughout DOE's program offices, labs and facilities who are committed to helping technologies transition to the market and foster connections among stages of research, development, demonstration and deployment (RDD&D) that are needed to reach commercial impact. DOE encourages these practitioners and their management to continue this excellent work. The resulting contributions of their work add significantly to our Nation's economic competitiveness and to OTT's mission to expand the commercial impact of DOE's portfolio of RDD&D activities over the short, medium and long term.

Report on the Utilization of Federal Technology

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1. Introduction

Technology transfer is an active focus of the Department of Energy's (DOE) efforts to promote scientific and technological innovation that advances the economic, energy, and national security interests of the United States. The report summarizes DOE's technology transfer activities during FY 2016 and FY 2017 and plans for conducting technology transfer, including ensuring appropriate intellectual property protection for laboratory innovations with commercial promise and managing intellectual property so as to advance the agency's mission and benefit the competitiveness of United States industry. Also included are statistics on DOE's FY 2012 - 2017 technology transfer activities.

This report has been prepared in response to the statutory requirement for an annual "agency report on utilization" (15 U.S.C. Section 3710(f))[1] established under Section 10 of the Technology Transfer Commercialization Act of 2000 (Pub. L. 106-404). All Federal agencies that operate or direct one or more Federal laboratories or conduct other activities are to report, per Sections 207 and 209 of Title 35 of the United States Code, annually to the Office of Management and Budget, as part of the agency's annual budget submission, on the activities performed by that agency and its Federal laboratories under the provisions of this section and of sections 207[2] and 209[3] of title 35, United States Code.

This report provides the two types of statutorily required information, a description of the current technology transfer programs and plans of DOE's Federal laboratories, and statistics and other relevant data that describe the Federal laboratories' activities and achievements in technology transfer for the fiscal year of the report and the 4 years prior.

[1] 15 U.S.C. Section 3710(f), law.cornell.edu/uscode/text/15/3710
[2] 35 U.S.C. Section 207, law.cornell.edu/uscode/text/35/207
[3] 35 U.S.C. Section 209, law.cornell.edu/uscode/text/35/209

2. DOE's Technology Transfer Program and Plan

Technology transfer is a key mission of the DOE and its laboratories, plants, and sites. The DOE National Laboratories, plants, and sites, those operated by the Government-Owned Contractor-Operated (GOCO) model as well as the National Energy Technology Laboratory,[4] are empowered[5] to use a diverse set of technology transfer activities including, but not limited to: protecting intellectual property,[6] negotiating licensing agreements, negotiating all aspects of and entering into Cooperative Research and Development Agreements (CRADAs),[7] Strategic Partnership Projects (SPP)[8] and Agreements for Commercializing Technology (ACT),[9] providing information exchanges, providing technical consulting and personnel exchanges, conducting science education activities and making available laboratory user facilities.

DOE headquarters coordinates with each laboratory to achieve an effective and productive technology transfer program including external engagements through licensing activities and partnerships.

DOE's OTT is integral to the success of DOE's technology transfer strategy and activities. OTT was established to expand the commercial impact of the Department's portfolio of research and development (R&D). Specifically, OTT is charged with: 1) executing the technology transfer leadership and coordination roles and responsibilities for the key duties assigned to the Technology Coordinator by the Energy Policy Act of 2005 (Pub.L. 109–58); 2) developing and overseeing delivery of the DOE strategic vision and goals for technology commercialization and engagement with the business and industrial sectors across the U.S., such as manufacturing, energy and technology; and 3) coordinating Department-wide technology transitions activities to derive the maximum impact for the Department's investments.
One of OTT's responsibilities is the development and publication of the statutorily mandated Technology Transfer Execution Plan (TTEP)[10], designed to guide and strengthen the Department's technology transition efforts and reinforce the importance of supporting these

[4] The National Energy Technology Laboratory (NETL) is the only DOE National Laboratory focused on the development of advanced fossil energy technologies. As a Government-Owned Government-Operated (GOGO) National Laboratory, the only one within the DOE complex, NETL can quickly identify and bring together the resources necessary to address complex technical problems, as well as market analysis and environmental impact issues. This enables the development of regulatory and technology-based solutions for problems that limit current use of domestic energy resources. NETL utilizes a diverse set of activities to accomplish technology transfer, similar to the GOCOs. Furthermore, as a GOGO, NETL is the only DOE National Laboratory authorized to issue Funding Opportunity Announcements (FOA's) on behalf of the Department; a means by which NETL awards hundreds of new financial assistance awards each year.
[5] 48 C.F.R. 970.5227-3 Technology Transfer Mission
[6] Under the Bayh-Dole Act, a DOE laboratory operated by a non-profit entity may retain title to its inventions empowering the laboratories to manage their intellectual property.
[7] Stevenson-Wydler Technology Innovation Act of 1980, as amended (15 U.S.C. 3710a)
[8] Section 33 of the Atomic Energy Act (AEA), 42 U.S.C. Section 2053
[9] energy.gov/articles/secretary-energy-rick-perry-announces-expanded-partnership-opportunities-national (Note: NETL as a Government-Owned, Government-Operated Lab is not authorized to enter into ACTs.)
[10] energy.gov/sites/prod/files/2016/10/f33/TTEP%20Final.pdf

activities across DOE's facilities and programs. The TTEP provides the status of DOE's plan for enhancing its technology transfer activities in order to accelerate technology transfer and commercialization of Federal research in support of high-growth businesses. The TTEP is intended to guide and strengthen the Department's technology transition efforts and reinforce the importance of supporting these activities across DOE's facilities and programs. The TTEP presents a strategic framework of goals, objectives, and key activities to advance DOE's technology transitions mission.

At the Departmental level, the TTEP provides direction to enhance the transition of technologies to the market. It guides coordination and optimization of technology transition activities across DOE, thereby securing the greatest public benefit from the work being performed in all of DOE's R&D efforts.

3. Technology Transfer Statistics and Other Relevant Data

The following tables provide statutorily required statistics and other relevant data that describe the DOE National Laboratories', plants', and sites' activities and achievements in technology transfer for FY 2012 - 2017.[11]

The Department gathers data on several technology transfer performance measures that are used to evaluate technology partnership activities at its facilities. A complete list of data elements and their definitions is available in the DOE Technology Transfer Working Group (TTWG) Reporting and Appraisal Guide for DOE Technology Transfer Activities.[12] Among these measures are those related to intellectual property (IP). IP includes, but is not limited to, invention disclosures, patents, copyrights, tangible research products, mask works, trademarks, and trade secrets. Table 1 provides the total number of invention disclosures and patents reported by the DOE National Laboratories.

[11] Technology transfer data is typically adjusted over time to account for new information resulting from changes in reporting procedures, patent decisions, programmatic changes, etc. Throughout this report, data prior to FY 2016 has been adjusted, where necessary, to reflect the most accurate estimates for each year reported.
[12] energy.gov/technologytransitions/downloads/ttwg-reporting-and-appraisal-guide

Table 1. Invention Disclosures and Patents

		FY12	FY13	FY14	FY15	FY16	FY17
	Invention Disclosures						
1	Number of new inventions disclosed	1,661	1,796	1,588	1,645	1,760	1,794
	Patents[1]						
2	Number of patent applications filed	933	944	1,144	949	999	937
3	Number of patents received	676	713	822	755	856	817

[1]Includes domestic and international patents

Income bearing licenses are defined as licenses containing provisions for payments of licensing income. They may be exclusive income-bearing, partially-exclusive income-bearing or non-exclusive income bearing licenses.[13] Table 2 provides annual total numbers of active income-bearing licenses and total earned royalty incomes reported by DOE National Laboratories in the past years.

Table 2. Income Bearing Licenses

		FY12	FY13	FY14	FY15	FY16	FY17
	Income Bearing Licenses						
4	Number of income bearing licenses	3,340	3,709	4,215	4,577	3,963	3,057
5	Exclusive licenses	344	199	141	98	231	190
6	Partially exclusive licenses	N/A	133	136	138	165	120
7	Non-exclusive licenses	N/A	1,253	1,130	744	1,320	908
	Elapsed Time to Grant Licenses[1]						
8	Average (months)[2]	N/A	3.2	3.2	2.1	2.6	2.3
	Earned Royalty Income (ERI)[3]						
9	Total amount of ERI (millions)	$28.7	$27.7	$23.4	$21.2	$16.3	$13.2

N/A = data not available at time of report

[1] DOE does not report on the minimum and maximum elapsed time to grant licenses

[2] DOE data reported as the average number of days to grant a license, by National Laboratory. The average months to grant a license was calculated by, (# of days to grant a license) * (365 days per year) / 12 months per year.

[3] Data on ERI from top one percent of licenses; five percent of licenses; and 20 percent of licenses, the minimum, maximum, and median ERI, the percentage of ERI income distributed to investors, agencies, or laboratories, and the number of licenses terminated for cause are withheld to protect proprietary information.

A Cooperative Research and Development Agreement (CRADA) is any agreement between one or more Federal facilities and one or more non-Federal parties under which the Government, through its facilities, provides personnel, services, facilities, equipment, intellectual property, or other resources, with or without reimbursement (but not funds to non-Federal parties), and the non-Federal parties provide funds, personnel, services, facilities, equipment, intellectual property, or other resources toward the conduct of specified research or development efforts consistent with the mission of the facility; except that such terms do not include a procurement contract or cooperative agreement. The DOE Laboratories execute and manage hundreds of

[13] Ibid

CRADAs annually.[14] Table 3 provides total annual active CRADAs reported by the DOE National Laboratories.

Table 3. Cooperative Research and Development Agreements

	Cooperative Research and Development Agreements (CRADAs)[1]	FY12	FY13	FY14	FY15	FY16	FY17
10	Number of Active CRADAs**	742	742	698	732	739	910
11	Number of newly executed CRADAs	184*	142	162*	188	246*	320
12	Active CRADAs with small business involvement**	265*	237	243*	255*	282	398
13	Number of small businesses involved in active CRADAs**	n/r	n/r	200*	201*	224	326

* Value updated vs prior reporting based on correction in subsequent fiscal year data collection.
** Reporting of Active CRADAs clarified in FY 2016 to only include agreements that are legally in force during the specified fiscal year.

The DOE National Laboratories, plants, and sites conduct work for other Federal agencies and non-Federal customers on a 100 percent reimbursable basis. This work is defined as Strategic Partnership Projects (SPP).[15] An SPP uses laboratory personnel and/or facilities; pertains to the mission of the laboratory; does not conflict or interfere with the achievement of DOE program objectives; does not place the laboratory in direct competition with the domestic private sector; and does not create a potential future burden on DOE resources. Table 4 provides SPP related data reported annually by the DOE National Laboratories, plants, and sites for non-Federal sponsors.

Table 4. Strategic Partnership Projects with non-Federal entities

	Strategic Partnership Projects (SPP) with non-Federal entities	FY12	FY13	FY14	FY15	FY16	FY17
14	Number of Active SPPs (non-Federal)	2,519	2,733	1,819	2,259	2,234	2,047
15	Number of newly executed SPPs (non-Federal)	747	992	805	773	754	689
16	Active SPPs with small business involvement	429	439	350	400	383	403
17	Number of small businesses involved in active SPPs	N/A	N/A	288	314	294	312

The Agreement for Commercializing Technology (ACT), a technology transfer mechanism implemented by DOE beginning in 2012, was developed to facilitate flexible engagement between contractors that manage DOE Laboratories and Facilities and industry on research and technology transfer projects.[16] Through ACT, third parties can negotiate terms and conditions (T&Cs) more consistent with industry practice that are otherwise not permitted under the T&Cs

[14] Traditional CRADAs involve collaborative research and development projects by a federal laboratory and nonfederal partners. Non-traditional CRADAs involve laboratory accreditations, material transfer agreements, and calibration services, directives.doe.gov/directives-documents/400-series/0483.1-BOrder-B
[15] labpartnering.org/p/partnering
[16] energy.gov/technologytransitions/frequently-asked-questions-about-act

of CRADAs and SPP agreements. Table 5 presents ACT-related data reported by the Management & Operating (M&O) Contractors of participating DOE National Laboratories.

Table 5. Agreements to Commercialize Technology

	Agreements to Commercialize Technology (ACT)	FY12	FY13	FY14	FY15	FY16	FY17
18	Number of Active ACTs	2	54	66	75	78	98
19	Number of newly executed ACTs	N/A	N/A	25	23	21	35
20	Active ACTs with small business involvement	N/A	N/A	9	4	8	4
21	Number of small businesses involved in active ACTs	N/A	N/A	8	4	8	4

Note: ACTs were approved as a pilot program and were only available as a tech transfer contract mechanism at eight of the DOE National Laboratories and Facilities. After the period of this report, ACT were made a permanent mechanism.

4. FY 2016 and FY 2017 Technology Transfer Activities and Achievements

The mission of the Energy Department is to ensure America's security and prosperity by addressing its energy, environmental and nuclear challenges through transformative science and technology solutions. DOE technology transfer programs support the DOE mission by enhancing U.S. economic competitiveness through a broad range of partnerships across the entirety of the Nation's R&D landscape, providing science and technology expertise to the Federal government, academia, and private sector partners. As a result, DOE and its National Laboratories manage a number of technology transfer activities.

The Technology Transfer Working Group (TTWG)[17] under the oversight of the Department's Technology Transfer Coordinator and in conjunction with the DOE Technology Transfer Policy Board[18], addresses technology transfer activities, issues, and concerns at the working level across the complex. It enhances DOE technology transfer efforts by coordinating technology transfer activities across the Labs and with DOE Headquarters and Field Offices, exchanging information about technology transfer activities and challenges, and developing and disseminating information about DOE technology transfer policies, plans and procedures, and new and existing programs to the public and prospective technology partners.
In FY 2016 and FY 2017, DOE successfully deployed and participated in several technology transfer and commercialization initiatives and activities including:

[17] Established by the Energy Policy Act of 2005, Title X, Sec. 1001, gpo.gov/fdsys/pkg/PLAW-109publ58/pdf/PLAW-109publ58.pdf

[18] U.S. Department of Energy, "Report on Technology Transfer and Related Technology Partnering Activities at the National Laboratories and Other Facilities, Fiscal Year 2015, Report to Congress", pp. 6-7.

4.1 R&D 100 Awards and Selected Highlights from DOE Technology Transfer Activities

An important metric of the success of DOE's technology commercialization activities is the quality and impact of the technologies that reach the commercial sector. It often requires many years, even decades, to realize the full impact after an initial discovery. In tracking outcomes, we are best able to quantify impact at the point of handover of a specific technology to the commercial sector; therefore, we have to use indirect assessments to follow any continuing impacts thereafter.

The number of R&D 100 Awards illustrates the success and visibility of the DOE National Laboratories' commercialization activities. The R&D 100 Awards are given annually by R&D Magazine to recognize exceptional new products or processes that were developed and introduced into the marketplace during the previous year. To be eligible for an award, the technology or process must be in working and marketable condition – no proof of concept prototypes are allowed – and had to be first available for purchase or licensing during the year prior to the award. The awards are selected by an independent panel of judges from across industry, government, and academia based on the technical significance, uniqueness, and usefulness of the technology.

DOE researchers won 33 of the 100 awards in 2017, 32 awards in 2016, 33 awards in 2015, 31 awards in 2014, 36 awards in each of 2013, 2012 and 2011, and 46 in 2010, for a total of 283 from 2010 to 2017. FY 2017 R&D 100 Awards are summarized on DOE's website.[19]
A hyperlink to success stories of other developed technologies is available in Section 0. These represent a spectrum of commercial applications stemming from DOE's core mission areas in energy, basic science and innovation, and nuclear safety and security. They include advances in areas such as automotive technology, aeronautical technology, manufacturing technology, medical technology, microwave technology, semiconductor and information technology, and broad applications in cyber security and sensing/control systems.

4.2 Interagency Working Group for Technology Transfer (IAWGTT)

DOE participates in the Interagency Working Group for Technology Transfer (IAWGTT), which serves as an interagency forum for the exchange of information and as a vehicle for raising and addressing issues and concerns related to technology transfer across the Federal Government. DOE coordinated with the IAWGTT to provide information on the DOE Labs' and Facilities' current technology transfer practices and policies. Information from the DOE Labs and plants was aggregated with comparable information from other federal labs to produce a federal-wide summary of technology transfer practices. As a participating member in the Federal Laboratory Consortium (FLC), DOE helped to develop the "FedTech in Your Life" virtual environment marketing tool which showcases federal technologies that have successfully been transferred to

[19] U.S. Department of Energy. "U.S. Department of Energy Projects Win 33 R&D 100 Awards in 2017." November 20, 2017. energy.gov/articles/us-department-energy-projects-win-33-rd-100-awards-2017

industry. DOE co-led the FLC Energy Technology Focus which provided substantive information on energy-related technologies developed at the DOE labs and available for further development. The Director of Technology and Innovation in the Office of Science and Technology Policy (OSTP) and the Director of OTT co-chair the subcommittee of the National Science and Technology Council's Cross-Agency Priority goal on Lab-to-Market (L2M) in its cross-agency efforts that aim to increase the economic impact of federally-funded R&D by accelerating and improving the transfer of new technologies from the laboratory to the commercial marketplace. Key DOE activities in FY 2016 included DOE and DOE National Lab collaboration with the White House and the OSTP, the Maker Interagency Working Group chartered under the National Science and Technology Council for demonstrations of DOE-available technologies at 2016 Bay Area Maker Faire[20], and the White House National Week of Making, and National Maker Faire. Other key activities of the L2M subcommittee included identification of achievements that advance the five strategies: Identify regulatory impediments and administrative improvements in Federal technology transfer policies and practices; Increase engagement with private sector technology development experts and investors; Build a more entrepreneurial R&D workforce; Support innovative tools and services for technology transfer; and Improve understanding of global science and technology trends and benchmarks.

4.3 Technology Transfer Opportunities (TTO)

Technology Transfer Opportunities (TTO) exist through the DOE Small Business Innovation Research and Small Business Technology Transfer (SBIR/STTR) programs, which transfer inventions made by DOE National Laboratories or universities to small businesses for commercialization. DOE develops and issues specific technical topics each year to help move technologies from DOE R&D funded research institutions to the commercial sector while also supporting SBIR/STTR-funded small businesses in accelerating technologies to market. Awardees receive an SBIR/STTR grant and an option to license the technology. In FY 2016, DOE issued five new technical topics with TTOs and awarded two FY 2016 Phase I projects from those topics. DOE also awarded four Phase II projects in FY 2016 from prior year Phase I topics with TTOs. In FY 2017, DOE issued two new technology topics with TTOs with 31 subtopics and awarded three FY 2017 Phase I projects from those topics. DOE did not award any Phase II TTO projects in FY 2017 from FY 2016 Phase I topics with TTOs.

4.4 Small Business Vouchers (SBVs)

DOE's Small Business Vouchers program provides clean energy small businesses access to select national labs—simplifying the contracting process, making lab practices transparent, and providing access to the labs' unique facilities.[21] Small businesses compete to receive vouchers, which together with their matching funds, allow them to access the state-of-the-art facilities and experts at participating DOE national labs. The SBV program expands the labs' knowledge of and involvement with the private sector, helping small businesses with advanced

[20] Office of Technology Transitions, Make Energy at the Bay Area Maker Faire

[21] Small Business Voucher, sbv.org/

technologies contribute to American competitiveness and economic growth. In FY 2016 and FY 2017, DOE awarded vouchers worth a combined $22 million to 114 U.S. small businesses in 32 U.S. states.

4.5 Energy I-Corps (formerly Lab-Corps)

Energy I-Corps aims to accelerate the deployment of energy technologies by granting DOE laboratory scientists and engineers direct market feedback on their technology offerings.[22] Inspired by the National Science Foundation Innovation Corps (I-Corps) model, the two-month Energy I-Corps program empowers teams with the tools, resources, and relationships necessary to discover potential market pathways for their innovations. Teams return to the lab with a framework for industry engagement to guide future research and inform a culture of market awareness within the labs. In this way, Energy I-Corps is ensuring that our investment in the national labs is maintaining and strengthening U.S. competitiveness in the long-term. In FY 2016 and FY 2017, DOE supported 71 teams from 10 different National Laboratories through the Energy I-Corps program.

4.6 Technologist in Residence (TIR) Program

The TIR program catalyzes long-term, strategic relationships between industry and DOE's National Laboratories that result in high-impact collaborative early stage research and development (R&D). In FY 2016, EERE dedicated $2 million to fund six competitively selected lab-industry pairs (No additional funds were dedicated in FY 2017.). These pairs, at five different National Labs (Oak Ridge National Laboratory (ORNL), Argonne National Laboratory (ANL), Idaho National Laboratory (INL), Sandia National Laboratories (SNL), Brookhaven National Laboratory (BNL)), work together for periods of 18 to 24 months to accomplish several goals:

1) Identify the participating company's (or companies') technical priorities and challenges, and the resources and capabilities across all of DOE's National Laboratories that may be highly suitable to address them;

2) Propose collaborative R&D efforts to develop science-based solutions to the company's (or companies') most strategic scientific, technological, and business issues; and

3) Develop a general framework agreement and begin developing specific scopes of work for the proposed collaborative R&D efforts. The proposed R&D then takes place outside of the program and does not use TIR program funds.[23]

[22] Energy I-Corps, energy.gov/eere/technology-to-market/energy-i-corps
[23] Technologist In Residence Program, energy.gov/eere/amo/technologist-residence-program

4.7 Nuclear Energy Voucher Program[24]

The Office of Nuclear Energy's Gateway for Accelerated Innovation in Nuclear (GAIN) initiative launched the Nuclear Energy Voucher Program as a pilot to assist new entrants into the nuclear field as they build the collaborations necessary to accelerate the development and deployment of innovative nuclear technologies by granting them access to the extensive nuclear research capabilities and expertise available at DOE's National Laboratories. Eight small businesses in partnership with five DOE National Laboratories facilities were selected for awards with a total value of approximately $1.8 million in FY 2016. The pilot program was considered a success and was transitioned to a continuing program to include businesses of all sizes in FY 2017 with award of 14 vouchers with a total value of approximately $4.2 million.

4.8 Lab-Bridge

Lab-Bridge, part of the Office of Energy Efficiency and Renewable Energy's (EERE) Technology-to-Market program, was developed and launched in FY 2016.[25] The program enabled the National Laboratories to explore new solutions for identified, persistent barriers to collaborating with outside partners and moving lab-developed technologies to market. Participating labs rapidly implemented and tested new tools and approaches for increasing access to National Laboratory resources and preparing lab innovations for market readiness. In FY 2016 and FY 2017, eight projects involving 12 different DOE labs were awarded a combined total of $2.5 million.

4.9 Agreement for Commercializing Technology (ACT)[26]

DOE established the ACT pilot to complement existing technology transfer mechanisms available to DOE laboratories.[27] The ACT is intended to provide DOE laboratory M&O contractors with increased flexibility for modifying certain terms and conditions found in traditional partnering agreements, such as CRADAs)and non-Federal SPPs. The ACT pilot allows DOE M&O contractors to independently enter into agreements with sponsors of work in the private and non-Federal public sectors, provided Federal funding is not involved. In exchange for a fee above what the laboratory is reimbursed under traditional mechanisms, M&O contractors can accept financial and performance-based risks and negotiate terms and conditions that are more in line with industry practices. Between FY 2012 and FY 2017, the four active pilot laboratories (Pacific Northwest National Laboratory, Lawrence Livermore National Laboratory, National Renewable Energy Laboratory and Brookhaven National Laboratory) have established a total of 104 ACT agreements.

[24] NE Voucher Program, https://www.energy.gov/ne/articles/department-energy-fostering-public-private-partnerships-eight-small-businesses-selected

[25] Lab Bridge, energy.gov/technologytransitions/articles/8-ways-energy-department-removing-barriers-make-national-lab

[26] While it is understood that ACT was a pilot mechanism for the period of this report, ACT is now a permanent mechanism.

[27] Agreement for Commercializing Technology (ACT), nrel.gov/docs/gen/fy16/65717.pdf

4.10 Technology Commercialization Fund (TCF)

The TCF is administered by the U.S. Department of Energy's (DOE's) Office of Technology Transitions (OTT) which works to expand the commercial impact of DOE's portfolio of research, development, demonstration, and deployment activities. In February 2016, OTT announced the first solicitation to the DOE National Laboratories for TCF funding in two topic areas:

- Topic Area 1: Projects for which additional technology maturation is needed to attract a private partner; and
- Topic Area 2: Cooperative development projects between a lab and industry partner(s), designed to bolster the commercial application of a lab developed technology.

The U.S. Department of Energy (DOE) provided nearly $16 million in funding in FY 2016 to help businesses move promising energy technologies from DOE's National Laboratories to the marketplace. OTT received 104 applications from across the laboratory system in response to that first Department-wide round of funding. Fifty-four projects at 12 National Labs involving 52 private-sector partners were selected for award in 2016.[28] In FY 2017, $19.7 million in TCF funding went to support 54 projects selected for award from more than 235 proposals. The FY 2017 selections went to 12 National Laboratories, and involved more than 30 private-sector partners. All projects selected for the TCF receive an equal amount of non-federal funds to match the federal investment.

4.11 Chain Reaction Innovations

Chain Reaction Innovations (CRI) was launched at Argonne National Laboratory in FY 2016 as an expansion of DOE's Lab-Embedded Entrepreneurship Programs.[29,30] Like the other lab-embedded entrepreneurial programs, CRI is a two-year program that accelerates the progress of innovators focused on developing energy and science technologies into businesses by "spinning into" the national lab. The annual call for the first cohort of innovator teams began in FY 2016, through an application process followed by a semi-final and final event. DOE's Advanced Manufacturing Office committed $110,000 in funding, and ANL committed $220,000 in royalty revenues for each of the four to six teams selected.

4.12 Selected Highlights from DOE's Technology Transfer Activities

DOE plays a key role in moving innovative technologies developed in research labs across the country into the commercial marketplace, fueling the innovation engine that powers the U.S. economy. Bridging the gap between research and development (R&D) and commercial

[28] Technology Commercialization Fund (TCF), energy.gov/technologytransitions/services/technology-commercialization-fund
[29] Chain Reaction Innovations, chainreaction.anl.gov/
[30] Lab-Embedded Entrepreneurship Programs, energy.gov/eere/amo/lab-embedded-entrepreneurship-programs

deployment is crucial to the Department's mission, because it creates globally competitive industries in the United States, enables significant cost-savings for industries and consumers, and creates good jobs for Americans.

The DOE's National Laboratories tackle critical scientific challenges – from water security to discovering the origins of our universe – and possess unique instruments and facilities, many of which are found nowhere else in the world. These challenges address large scale, complex R&D challenges with a multidisciplinary approach that places an emphasis on translating basic science to innovation. Specifically, the National Laboratories:

- Conduct research of the highest caliber in physical, chemical, biological, and computational and information sciences that advances our understanding of the world around us;
- Advance U.S. energy independence and leadership in energy technologies to ensure the ready availability of clean, reliable, and affordable energy;
- Enhance global, national, and homeland security by ensuring the safety and reliability of the U.S. nuclear deterrent, helping to prevent the proliferation of weapons of mass destruction, and securing the nation's borders; and
- Design, build, and operate distinctive scientific instrumentation and facilities, and make these resources available to the research community.

DOE oversees the construction and operation of some of the Nation's most advanced R&D facilities, located at National Laboratories and universities. These state-of-the-art facilities are shared with the science community worldwide and offer technologies and instrumentation that are available nowhere else. In FY16, these facilities were used by over 33,000 researchers from universities, National Laboratories, private industry, and other federal science agencies.[31] In FY 2017 that number increased to over 34,400.

The DOE's system of National Labs, user facilities, research centers and shared research facilities, makes the pursuit of discovery -- and the many solutions that result -- both a collaborative enterprise and a shared national resource that supports the commercialization process. DOE collaboration with industry, academia, and other federal and state agencies is essential to develop, demonstrate, deploy, and commercialize the output from DOE's broad R&D investments.

Selected highlights from DOE's technology transfer activities may be found at DOE Laboratories' and Facilities' Activities, Highlights, and Achievements in Technology Transfer**.**

[31] Department of Energy, Office of Science. *User Facilities.* science.energy.gov/user-facilities/

APPENDIX A: FY 2016 and FY 2017 Technology Commercialization Fund Selections

2016 Technology Commercialization Fund Selections					
Funding Office	Lead Laboratory	Project Title	Topic	Total Budget	Partners
EE	Ames Laboratory	Manufacturing of Advanced Alnico Magnets for Energy Efficient Traction Drive Motors	Topic 2	$650,000	Carpenter Powder Products Arnold Magnetic Technologies Corporation UQM Technology Inc. Ford Motor Company Iowa Energy Center Iowa State University
EE	Argonne National Laboratory	Ultrathin Nanoparticle Membranes to Remove Emerging Hydrophobic Trace Organic Compounds in Water with Low Applied Pressure and Energy Consumption	Topic 1	$300,000	Metropolitan Water Reclamation District of Greater Chicago
EE	Argonne National Laboratory	UNCD-Based Electron Field Emission Source for Accelerator Applications	Topic 1	$300,000	Euclid TechLabs
EE	Argonne National Laboratory	Advanced Manufacturing of Ultra-High Density Interposers	Topic 2	$500,000	ICAMR (International Consortium for Advanced Manufacturing Research)
EE	Argonne National Laboratory	Application of Resin-Wafer Electrodeionization Technology in Biorefineries	Topic 2	$1,200,000	
EE	Brookhaven National Laboratory	Direct Fabrication of Fuel Cell Electrodes by Electrodeposition of High-performance Core-shell Catalysts	Topic 1	$200,000	
EE	Brookhaven National Laboratory	Nitride-Stabilized Pt Core-Shell Electrocatalysts for Fuel Cell Cathodes	Topic 1	$200,000	
EE	Idaho National Laboratory	Enhancing Lithium-Ion Battery Safety for Vehicle Technologies and Energy Storage	Topic 1	$242,170	
EE	Idaho National Laboratory	Vehicle Controller Area Network (CAN) Bus Network Safety and Security System	Topic 2	$300,000	Mercedes-Benz Research and Development North America Inc.
EE	Lawrence Berkeley National Laboratory	Large Area Polymer Protected Lithium Metal Electrodes with Engineered Dentrite-Blocking Ability	Topic 1	$147,662	
EE	Lawrence Livermore National Laboratory	Cryo-Compressed Hydrogen Tank Technology in an Internal Combustion Engine Application	Topic 2	$994,958	GoTek Energy Inc.
EE	National Renewable Energy Laboratory	New DC Power System Topology for Telecommunications Facilities	Topic 1	$280,000	Verizon Wireless
EE	National Renewable Energy Laboratory	Improved Wind Plant Energy Production by Application of Wind-Plant Integrated Systems Engineering Model (WISDEM™) to Wind Plant Controls (A Demonstration Project)	Topic 2	$500,000	NextEra Energy Resources Ystrategies

2016 Technology Commercialization Fund Selections					
Funding Office	Lead Laboratory	Project Title	Topic	Total Budget	Partners
EE	National Renewable Energy Laboratory	Thermal Management for Planar Package Power Electronics	Topic 2	$500,000	John Deere Electronic Solutions (JDES)
EE	National Renewable Energy Laboratory	Scaled production of high octane biofuel from biomass-derived dimethyl ether	Topic 2	$1,500,000	Enerkem
EE	Oak Ridge National Laboratory	On-Vehicle Emission Sensor	Topic 1	$300,000	
EE	Oak Ridge National Laboratory	Additive Manufacturing of Thermoset Cellular Structures	Topic 2	$1,000,000	Magnum Venus Products
EE	Oak Ridge National Laboratory	Carbon Fiber Plasma Surface Treatment	Topic 2	$1,000,000	RMX Technologies, LLC. C.A. Litzler Company, LLC.
EE	Oak Ridge National Laboratory	The ENABLE (Environmentally Neutral Automated Building Electric Energy) Platform	Topic 2	$1,250,000	Flex Power Control
EE	Oak Ridge National Laboratory	Residential Gas Heat Pump (RGHP)	Topic 2	$1,500,000	Blue Mountain Energy Intellichoice Energy Alagasco and Mestex
EE	Pacific Northwest National Laboratory	A Self-Powered Acoustic Transmitter	Topic 1	$320,000	Advanced Telemetry Systems Inc. Idaho Power Company Grant County Public Utilities District
EE	Pacific Northwest National Laboratory	Solid State Processing for Improved Performance of Current and Next-Generation Hydropower Components	Topic 1	$400,000	
EE	Pacific Northwest National Laboratory	Commercialization of Uncertainty Prediction Tools for Wind and Solar Energy for Probabilistic Electric Power Grid Operations	Topic 2	$580,000	California Independent System Operator (CAISO) AWS Truepower (AWST)
EE	Pacific Northwest National Laboratory	Development of electrolytes for lithium ion batteries in wide temperature range applications	Topic 2	$750,000	Farasis Energy, Inc. Navitas Systems
EE	Pacific Northwest National Laboratory	Assembly of dissimilar aluminum alloys for automotive application	Topic 2	$1,000,000	
EE	Pacific Northwest National Laboratory	Direct Extruded High Conductivity Copper for Electric Machines Manufactured Using the ShAPE Process	Topic 2	$1,200,000	General Motors R&D
EE	Pacific Northwest National Laboratory	Dish-STARSTM Commercialization	Topic 2	$2,000,000	STARS LLC Southern California Gas Company Infinia Technology Corporation Barr Engineering DiverSolar LLC
EE	Sandia National Laboratory	High Temperature BA-BZT-BT Capacitors	Topic 1	$100,000	TPL, Inc.

2016 Technology Commercialization Fund Selections					
Funding Office	Lead Laboratory	Project Title	Topic	Total Budget	Partners
EE	Sandia National Laboratory	Commercialization of the Sandia Cooler	Topic 2	$500,000	Wakefield-Vette Thermal Solutions
FE	Argonne National Laboratory	Graphene Coating for Dry Gas Seal Applications	Topic 2	$1,159,844	John Crane Inc.
FE	Lawrence Berkeley National Laboratory	Flame-Powered SOFC Generators	Topic 1	$300,000	
FE	National Energy Technology Laboratory	Raman Gas Analyzer Cooperative Development	Topic 1	$212,640	Oxergy Inc.
FE	National Energy Technology Laboratory	Laser induced breakdown spectroscopy (LIBS) subsurface sensor maturation	Topic 2	$492,846	Appliced Spectra Inc.
FE	National Energy Technology Laboratory	Cooperative Development of NETL Electrode Engineering Process for SOFC Commercialization	Topic 2	$500,512	Acumentrics
FE	National Energy Technology Laboratory	Development of Spouting Bed Reactor for Reduction of Hematite to Magnetite	Topic 2	$1,499,781	Siox, LLC.
FE	Oak Ridge National Laboratory	Novel High Permeability Membranes for CO2 Capture	Topic 1	$300,000	
FE	Pacific Northwest National Laboratory	Development of Protective Coatings for 1 kW Hot Zone	Topic 1	$248,664	Protonex Technology Corporation
FE	Pacific Northwest National Laboratory	Controlled-release solid nitride fertilizer from coal fly ash: demonstrating fluidized-bed synthesis and environmental performance	Topic 1	$250,000	
FE	Pacific Northwest National Laboratory	Glass Seals with Low or Zero Boria Content for High Temperature SOFC Applications	Topic 2	$350,000	LG Fuel Cell Systems Inc.
FE	Pacific Northwest National Laboratory	Reliability and Durability Testing of Glass Ceramic Seals for Praxair's Oxygen Transport Membranes	Topic 2	$1,200,000	Praxair
NE	Idaho National Laboratory	Advanced Outage Control Center Dashboard with Predictive Tools	Topic 1	$121,000	
NE	Idaho National Laboratory	Commercialization Research and Development of Change Detection Systems for Nuclear Applications	Topic 1	$125,000	
NE	Idaho National Laboratory	Development of In-Core Three-Omega Thermal Conductivity Probe	Topic 1	$149,911	Radiation Detection Technologies Inc. (RDT)
NE	Idaho National Laboratory	Additive Manufacturing as an Alternative Fabrication Technique for the Fabrication of Uranium Silicide Fuel	Topic 1	$300,000	Westinghouse Electric Company
NE	Idaho National Laboratory	Computer-Based Procedure System for Field Workers	Topic 1	$300,000	
NE	Idaho National Laboratory	Vibro-acoustic Testing for Microstructure Characterization and Metrology	Topic 1	$300,000	
NE	Idaho National Laboratory	Enhanced and Miniaturized Wireless Valve Position Indicator Prototype	Topic 1	$449,200	Analysis and Measurement Services Corporation (AMS) Rolls Royce Westinghouse Electrical Corporation (WEC)

2016 Technology Commercialization Fund Selections					
Funding Office	Lead Laboratory	Project Title	Topic	Total Budget	Partners
					Electric Power Research Institute (EPRI)
NE	Lawrence Livermore National Laboratory	Fire and Water Resistant Pre-filter	Topic 1	$300,000	
NE	Los Alamos National Laboratory	FracMan/dfnWorks: From Geological Fracture Characterization to Multiphase Subsurface Flow and Transport Simulation	Topic 1	$330,000	Golder Associates Inc.
NE	Los Alamos National Laboratory	Efficient Groundwater Restoration at Uranium In-Situ Recovery Sites to Enable Domestic Uranium Production for Nuclear Energy	Topic 2	$1,400,000	Cameco Resources Inc.
NE	Oak Ridge National Laboratory	New High-Strength Ni-based Alloys for High Temperature Service in Liquid Fluoride Salt Environments	Topic 2	$270,000	Haynes International
NE	Oak Ridge National Laboratory	Molten Salt Reactor Neutronics Tools	Topic 1	$300,000	
NE	Oak Ridge National Laboratory	Liquid Salt Environment Creep Testing System Development and Commercialization	Topic 2	$1,400,000	Applied Testing Systems Inc.
OE	Pacific Northwest National Laboratory	Demonstration of a kW class Redox Flow Battery using an Advanced Bi-additive Vanadium Sulfate Electrolyte	Topic 2	$1,200,000	ITN Energy Systems Inc.

2017 Technology Commercialization Fund Selections					
Funding Office	Lead Laboratory	Project Title	Topic	Total Budget	Partners
EE	Ames Laboratory	Gas Atomization Nozzle Design for Controlled Particle Production	Topic 2	$784,000	AMPAL Inc.
EE	Argonne National Laboratory	Graphene based solid lubricants for automotive applications	Topic 2	$1,352,450	Magna International Inc.
EE	Argonne National Laboratory	The Application of Catalytically Active Nano-composite Coatings to increase the Service Interval of Automotive Powertrain Applications	Topic 2	$1,424,900	Magna Services of America
EE	Argonne National Laboratory	Lithium Anodes for Electric Vehicles	Topic 2	$1,550,000	alpha-En Corporation
EE	Argonne National Laboratory	Two-Tier Tube-Trailer Consolidation Technology for Fast Fueling of Hydrogen Fuel Cell Electric Vehicles	Topic 2	$2,399,434	FirstElement Fuel Gas Technology Institute PDC Machines, Inc.
EE	Argonne National Laboratory	Development of a Scalable Process for Recovery of Polymers and Residual Metals from Mixed Polymer Content Scrap	Topic 2	$2,794,000	Global Electric Electronic Processing International
EE	Idaho National Laboratory	Produced Water Treatment using the Switchable Polarity Solvent Forward Osmosis (SPS FO) Process	Topic 1	$300,000	
EE	Idaho National Laboratory	Pathway to Commercialization of Weather Based Dynamic Line Rating with CFD using INL's General Line Ampacity State Solver (GLASS) software.	Topic 2	$687,650	Schneider Electric WindSim Americas Inc.
EE	Lawrence Berkeley National Laboratory	Advancing the Commercial Building Energy Saver to Provide Actionable Insights into Building Retrofits and to Enable Broad-Based Commercialization	Topic 1	$300,000	Lucid Design Group
EE	Lawrence Berkeley National Laboratory	Cooperative Development of a High Efficiency Anaerobic Electroporation Apparatus for Biofuel Generation from Waste Gases	Topic 2	$999,799	Lanzatech
EE	Lawrence Livermore National Laboratory	Microencapsulated Sorbents for Biogas Upgrading	Topic 1	$300,000	Delta Diablo
EE	Lawrence Livermore National Laboratory	Earth Battery: Storing Energy with Compressed Air and Heated Brine in Porous Rock	Topic 1	$300,000	Pacific Gas and Electric Company The Ohio State University,

2017 Technology Commercialization Fund Selections					
Funding Office	Lead Laboratory	Project Title	Topic	Total Budget	Partners
EE	Lawrence Livermore National Laboratory	Assessment of water ingress impact on efficiency degradation in photovoltaic modules	Topic 1	$300,000	
EE	National Renewable Energy Laboratory	Development of an Integrated Model for a Greenfield Hybrid Geothermal and CSP System	Topic 1	$200,000	U.S. Geothermal Inc. Power Engineers
EE	National Renewable Energy Laboratory	Spatial atomic layer deposition (ALD) to scale the manufacturing of tailored and robust catalysts for biofuel and biochemical production	Topic 1	$300,000	Forge Nano
EE	National Renewable Energy Laboratory	Biomaterials from non-woody biomass	Topic 2	$1,000,000	Sustainable Fiber Technologies,
EE	National Renewable Energy Laboratory	Optimal, Reliable Building-Integrated Energy Storage	Topic 2	$1,050,000	Eaton Corporation
EE	Oak Ridge National Laboratory	Cost lowering and scale up of a very low thermal conductivity material	Topic 1	$300,000	
EE	Oak Ridge National Laboratory	Thermoelectric Heat Pump Heat Recovery System for Domestic Dishwashers	Topic 2	$1,000,000	Samsung Electronics America
EE	Oak Ridge National Laboratory	Technology Validation of Innovative Dissimilar Materials Joining Processes in Automotive Production Environment	Topic 2	$1,267,654	Cosma Eagle Bend Manufacturing Plant
EE	Oak Ridge National Laboratory	Wireless Power Transfer Technology for Autonomous Vehicle Platform	Topic 2	$1,310,000	Local Motors
EE	Pacific Northwest National Laboratory	Cold Spray Magnetostrictive Sensor	Topic 1	$150,000	Innerspec
EE	Pacific Northwest National Laboratory	Video Analysis Software Development	Topic 1	$300,000	
EE	Pacific Northwest National Laboratory	Commercialization of Sensor Fish Technology to support hydropower development	Topic 1	$396,000	Advanced Telemetry Systems

2017 Technology Commercialization Fund Selections					
Funding Office	Lead Laboratory	Project Title	Topic	Total Budget	Partners
EE	Pacific Northwest National Laboratory	Improving Cloud-Based Performance of Distribution Planning Tools	Topic 2	$600,000	GridUnity (formerly Qado Energy Inc.)
EE	Sandia National Laboratory	Downhole Rotation for Small-Diameter Drilling Applications	Topic 1	$297,955	Ditch Witch (A Charles Machine Works Company)
FE	Brookhaven National Laboratory	Commercial Scale-Up and Demonstration of SulfCrete, a clean, energy efficient alternative to Conventional Portland Cement Concrete	Topic 1	$1,799,277	Sulfcrete, Roman Stone Construction Co. Inc.
FE	Idaho National Laboratory	Event Model Risk Assessment using Linked Diagrams (EMRALD)	Topic 1	$123,812	
FE	Lawrence Livermore National Laboratory	Rare Earth Metal Extraction for Clean Technologies	Topic 1	$300,000	
FE	Lawrence Livermore National Laboratory	Additive Manufacturing of Thermoelectric Generators	Topic 1	$365,000	TTEC LLC
FE	National Energy Technology Laboratory	Slag Management of Carbon Feedstock Used in Gasification	Topic 1	$250,000	Eastman Chemical Company
FE	National Energy Technology Laboratory	Commercialization of the CuO-Fe2O3 oxygen carrier for hydrogen and carbon/syngas production from natural gas	Topic 1	$300,000	Applied Minerals Inc. Columbian Chemicals Company
FE	National Energy Technology Laboratory	Simultaneous Extraction of Nickel and Vanadium from Petcoke waste byproducts	Topic 2	$695,368	Sumitomo Chemical
FE	National Energy Technology Laboratory	Commercialization of Immobilized Amino-Siliane/Amine or Biochar Sorbents for the Capture of Carbon Dioxide from Various Methane Gas Streams	Topic 2	$1,855,000	BioEnergy Development LLC
FE	National Energy Technology Laboratory	Safer drilling – Reducing risks and costs with real time, downhole kick detection	Topic 2	$13,974,828	Saudi Aramco
FE	Oak Ridge National Laboratory	Carbon Capture via Crystallization with a Guanidine Ligand	Topic 1	$300,000	

2017 Technology Commercialization Fund Selections					
Funding Office	Lead Laboratory	Project Title	Topic	Total Budget	Partners
FE	Pacific Northwest National Laboratory	Air Braze Optimization for Markets Targeted by Aegis Technology Inc.	Topic 2	$250,000	Aegis Technology Inc.
FE	Sandia National Laboratory	Optimal Headers for Diffusion Bonded Heat Exchangers	Topic 1	$200,000	Vacuum Process Engineering Inc.
FE	Sandia National Laboratory	Memzyme Technology for Cost-Effective CO2 Separations in Enhanced Oil Recovery	Topic 2	$600,000	Angstrom Thin Film Technologies LLC Occidental Petroleum Company
NE	Argonne National Laboratory	NRC Qualification of Advanced Reactor Safety Analysis Software	Topic 1	$150,000	
NE	Argonne National Laboratory	Passive, High Efficiency Ventilation for the DRACS and other Natural Circulation Systems	Topic 1	$200,000	General Atomics
NE	Argonne National Laboratory	Joint Development of SAS4A Code in Application to Oxide-fueled LFR Severe Accident Analysis	Topic 2	$800,000	Westinghouse Nuclear
NE	Argonne National Laboratory	Advanced Physics-Based Fluid System Performance Monitoring to Support Nuclear Power Plant Operations	Topic 2	$1,000,000	LPI Inc.
NE	Idaho National Laboratory	RAVEN Code Commercial Deployment for Industrial Related Applications	Topic 2	$500,000	FPoliSolutions
NE	Idaho National Laboratory	Integration of PHISICS into the AREVA reactor design suite for commercial application to High Temperature Reactors	Topic 2	$600,000	AREVA NP Inc.
NE	Idaho National Laboratory	Seismic Isolation of Major Advanced Reactor Systems for Economic Improvement and Safety Assurance	Topic 2	$1,420,000	Southern Company Services Inc. TerraPower X-energy
NE	Idaho National Laboratory	Highly Scalable Computer-Based Procedure System for Field Workers	Topic 2	$1,568,128	NextAxiom Technology
NE	Los Alamos National Laboratory	Development of A Micro-Reactor for Generator of Nuclear Power	Topic 2	$1,523,680	Westinghouse Electric Company
NE	Oak Ridge National Laboratory	Polymer-Based Adsorbents for the Recovery of Uranium from Desalination Facilities	Topic 2	$1,244,000	525 Solutions Inc.
NE	Sandia National Laboratory	Consolidation of Commercial Spent Nuclear Fuel into a Universal Canister for Storage, Transportation, and Disposal	Topic 2	$1,551,800	NAC International

2017 Technology Commercialization Fund Selections					
Funding Office	Lead Laboratory	Project Title	Topic	Total Budget	Partners
OE	Lawrence Livermore National Laboratory	Implementing Coupled Transmission and Distribution Simulation	Topic 2	$1,587,841	Eaton Corporation
OE	Oak Ridge National Laboratory	Development of cost-effective quantum key distribution systems for the U.S. power grid	Topic 1	$300,000	
OE	Pacific Northwest National Laboratory	Low-cost Battery Health Monitoring and Diagnosis system	Topic 1	$300,000	UniEnergy Technologies
OE	Sandia National Laboratory	Evaluation of WattJoule's Vanadium redox flow battery employing Sandia National Laboratories' membranes	Topic 1	$100,000	WattJoule Corporation