U.S. DEPARTMENT OF ENERGY

Technology Transfer Execution Plan 2016 – 2018

Report to Congress
October 2016

United States Department of Energy
Washington, DC 20585

Message from the Secretary

On behalf of the U.S. Department of Energy (DOE), I am pleased to present the Department's Technology Transfer Execution Plan (TTEP). This plan is intended to guide DOE, particularly it's Office of Technology Transitions (OTT), in promoting scientific and technical innovation that advances the economic, energy and national security interests of the country.

OTT was established in February 2015 to expand the commercial impact of DOE's portfolio of Research, Development, Demonstration and Deployment (RDD&D) activities over the short, medium and long term. Through these efforts, the OTT will work to increase the return-on-investment from federally-funded scientific and energy research. Its mission, which complements DOE's efforts to speed scientific discovery and strengthen national security, has grown increasingly important in a highly competitive global economy.

Pursuant to statutory requirements, this report is being provided to the following Members of Congress:

- **The Honorable Joseph Biden**
  President of the Senate

- **The Honorable Paul Ryan**
  Speaker of the House

- **The Honorable Thad Cochran**
  Chairman, Senate Committee on Appropriations

- **The Honorable Barbara Mikulski**
  Vice Chairwoman, Senate Committee on Appropriations

- **The Honorable Harold Rogers**
  Chairman, House Committee on Appropriations

- **The Honorable Nita M. Lowey**
  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 Mike Simpson**
  Chairman, Subcommittee on Energy and Water Development
  House Committee on Appropriations

- **The Honorable Marcy Kaptur**
  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 Maria Cantwell**
  Ranking Member, Senate Committee on Energy and Natural Resources

- **The Honorable Fred Upton**
  Chairman, House Committee on Energy and Commerce

- **The Honorable Frank Pallone**
  Ranking Member, House Committee on Energy and Commerce

- **The Honorable Lamar Smith**
  Chairman, House Committee on Science, Space, and Technology

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

If you have any questions or need additional information, please contact me or Mr. Brad Crowell, Assistant Secretary for Congressional and Intergovernmental Affairs, at (202) 586-5450.

Sincerely,

Ernest J. Moniz

Executive Summary

On February 11, 2015, the Secretary of Energy announced the formation of the Office of Technology Transitions (OTT), with the charge to expand the commercial impact of the Department of Energy's (DOE or Department) portfolio of research, development, demonstration and deployment (RDD&D) activities in the short, medium and long term.[1]

Specifically, OTT was charged with: 1) executing the "technology transfer leadership and coordination roles and responsibilities for the key duties assigned to the Technology Coordinator by EPACT 2005;" 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."[2]

The *Technology Transfer Execution* Plan (TTEP) is designed to guide and strengthen the Department's technology transition efforts and reinforce the importance of supporting these activities occurring across DOE's facilities and programs. This document is a reporting requirement of the Energy Policy Act of 2005, and it presents a strategic framework of goals and activities to advance DOE's technology transitions mission.

It is important to note that, for the purposes of this document, the term "technology transitions" incorporates "technology transfer." Technology transitions includes, but is broader than previously described by former DOE Secretary Steven Chu as, "the process by which knowledge, intellectual property or capabilities developed at the DOE's National Laboratories, single-purpose research facilities, plants, and other facilities are transferred to other entities, including private industry, academia, state or local governments."[3]

"Technology transitions" more accurately reflects the wider scope of the efforts to which DOE is committed. The OTT has been established not to simply guide singular acts of technology transfer, but rather to foster multiple handoffs between scientists and innovators and investors that make up the dynamic process of technology transitions and nurture the Nation's innovation ecosystem.

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[1] *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 Franklin M. Orr Jr., dated February 10, 2015.

[2] Ibid.

[3] *Secretarial Policy Statement on Technology Transfer at DOE Facilities*, The Honorable Steven Chu, Secretary, Department of Energy, 2011 http://energy.gov/sites/prod/files/gcprod/documents/Policy_Statement_on_TT.pdf.

The document begins by describing OTT's leadership role in developing and guiding policies that will advance technology maturation and deployment of DOE-supported research. Next, the TTEP details the office's three key activities that are imperative to mission success – data management and analysis, evidence-based impact evaluations, and stakeholder engagement. It then describes the overarching goals, objectives, and key activities for DOE and contractor personnel nationwide related to technology transitions. Finally, this plan provides the framework for the Energy Technology Commercialization Fund (TCF) and clarifies OTT's role in the overseeing and distributing the funds associated with the TCF.

The TTEP reinforces OTT's leadership and management role in developing and guiding DOE's technology transfer policy. This responsibility extends throughout the Department's programs, 17 National Laboratories, and other research and production facilities across the country, hereafter referred to as DOE National Laboratories. The office works closely with stakeholders and personnel at all of these locations, as well as in collaboration with departmental elements like NNSA's Office of Strategic Partnerships and the Office of Energy Efficiency and Renewable Energy's Technology-to-Market Sub-program, to ensure the development of the best policies and to maintain awareness of the latest issues. Additionally, the OTT Director serves in a dual capacity as the statutory Technology Transfer Coordinator[4] to ensure that the OTT is aligned with the Secretary's vision and that the Secretary is advised on all matters relating to technology transfer and commercialization activities.

> ***"Through technology transfer, commercialization, and deployment activities, the Department of Energy has made significant contributions to economic growth in the United States. The Office of Technology Transitions will give the Department the opportunity to increase the American people's return on investment in federally-funded science and energy research."***
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> **–Secretary of Energy Ernest Moniz, February 2015**

The TTEP also highlights key Departmental activities for OTT. First, the office conducts data collection and analysis. Specifically, OTT develops statutorily mandated technology transfer-related reports annually that consist of data collected from across the DOE enterprise. This information is used to encourage laboratory planning, evaluation, and professional development. Second, the OTT conducts evidence-based impact evaluations. The office helps analyze evaluation metrics, outputs and outcomes, and other information from DOE's National Laboratories and DOE grantees to understand the Department's impact on the commercial sector. Third, OTT pursues stakeholder engagement through roundtables, workshops, and other

[4] Energy Policy Act of 2005, Public Law 109-58, August 8, 2005
http://energy.gov/sites/prod/files/2013/10/f3/epact_2005.pdf

meetings to exchange information. The office also engages with DOE's National Laboratories and stakeholders to promote rapid technology transitions to U.S. commercial sectors through pilot programs and services focused on connecting DOE's National Laboratories with external stakeholders.

The plan then describes DOE's two overarching goals in technology transition that will direct mission success. The first goal is to increase the commercial impact of DOE investments through the transition of national laboratory-developed technologies to the private sector. The second goal is to increase the commercial impact of DOE investments through private sector utilization of the facilities and expertise of DOE's National Laboratories. These two goals contain a total of eight objectives and key activities that support each objective for fiscal years 2016-2018. DOE will pursue these goals using a combination of centralized and decentralized approaches. The former focuses on ensuring Administrative direction and accountability to taxpayers regarding the activities of DOE's National Laboratories, and the latter enables individual DOE National Laboratories to be responsive to the full range of needs from their stakeholders.

Finally, the TTEP provides an update on the statutorily-created TCF, which is overseen by OTT and is focused on commercializing promising energy technologies developed by DOE's National Laboratories in accordance with the Energy Policy Act of 2005.[5] OTT began to implement the TCF in the second quarter of FY16 and will manage it in providing matching funds with private entities to advance and mature energy technologies for further use in the private sector.

This first iteration of the TTEP is focused on activities happening at DOE's National Laboratories, as they play an important role in DOE's broader technology transitions mission. However, since DOE's technology transition activities extend beyond its National Laboratories and encompass a wide array of extramural stakeholders, future editions of the TTEP may be expanded to encompass these broader activities. Each year, the TTEP will incorporate lessons learned from the prior year's activities to shape subsequent technology transition plans, policies and actions, reevaluating and updating objectives and priority activities for maximum impact.

This TTEP benefited from a broad stakeholder engagement process conducted by the OTT since the beginning of 2015. The office was able to incorporate input from a variety of public and private sector stakeholders. This feedback process included:

- 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;
- Engagement at summits and conferences; and
- Monthly HQ and field-site meetings and calls with DOE Technology Transfer managers.

[5] Energy Department Announces New Office of Technology Transitions, U.S. Department of Energy press release: February 11, 2015. http://energy.gov/articles/energy-department-announces-new-office-technology-transitions.

TECHNOLOGY TRANSFER EXECUTION PLAN: FY 2016-2018

Table of Contents

I. Legislative Language

This report is prepared in accordance with the requirements of Section 1001(g) of the Energy Policy Act of 2005 (42 U.S. Code § 16391(g)), which states:

> *(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*[6]
> *(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).*

Section 1001(e) of the Energy Policy Act of 2005 also established an Energy Technology Commercialization Fund, as follows:[7]

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

II. Introduction

OTT was established in February 2015 to expand the commercial impact of DOE's portfolio of RDD&D activities over the short, medium and long term. Through these efforts, the OTT will work to increase the return-on-investment from federally-funded scientific and energy research. Its mission, which complements DOE's efforts to speed scientific discovery and strengthen national security, has grown increasingly important in a highly competitive global economy.

[6] PL 109-58-291, SEC 1001, IMPROVED TECHNOLOGY TRANSFER OF ENERGY TECHNOLOGIES. Section 1001 (g) of the Energy Policy Act of 2005 http://energy.gov/sites/prod/files/2013/10/f3/epact_2005.pdf.
[7] P.L. 113-291, SEC. 3144. TECHNOLOGY COMMERCIALIZATION FUND. Section 1001(e) of the Energy Policy Act of 2005 (42 U.S.C. 16391(e)) was amended by inserting ''based on future planned activities and the amount of the appropriations for the fiscal year'' after ''fiscal year.''

The mission of OTT is described in its founding memorandum.[8] That memo called for OTT to "execute technology transfer leadership and coordination roles and responsibilities for the key duties assigned to the Technology Coordinator by EPACT 2005."[9] It added that OTT would "develop and oversee 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 would also, "coordinate Department-wide technology transitions activities to derive the maximum impact for the Department's investments."[10]

In following that directive, at a corporate level, the Technology Transfer Execution Plan (TTEP) will provide direction to OTT as it works to enhance the Department's and the Administration's ability to transition technologies to the market. At the program level, it will guide coordination and optimization of technology transition activities across the Department, thereby securing the greatest public benefit from the work being performed in all of DOE's RDD&D efforts.

DOE is committed to strengthening its technology transfer capabilities and recognizes that technology transfer is just one component of its mission to promote scientific and technological innovation that advances the economic, energy, and security interests of the U.S., but it needs to have a broader approach to how technologies make it to the market.

This is why OTT is focused on the "transition" of technology, specifically recognizing the multiple, interlinked connections among different stages of research and demonstration that are needed to reach commercial impact. Technology transfer related activities are just one category of activities needed to bridge early stage research to commercial impact.

OTT has Department-wide responsibilities, and this document will serve as a touchstone for the office as it conducts its three key activities – stakeholder engagement,[11] evidence-based impact evaluations and data collection and analysis. While actionable, this report is also intended to be flexible and aspirational as OTT and the Department continuously improves through engaging stakeholders and identifying best practices, while balancing the Department's ambitions with constrained resources both at the program and laboratory level.

[8] *Recommendation to Recast the Office of Technology Transfer Coordinator as the Office of Technology Transitions*, Franklin M. Orr, JR., Under Secretary for Science and Energy, Department of Energy: Memorandum for the Secretary, EXEC-2014-008671 2015.
[9] Ibid.
[10] Ibid.
[11] "Stakeholder" will be understood broadly in this report, as a person or a party who either has or may have an interest in DOE technology transition activities.

III. OTT Management Role

OTT's management role in guiding technology transition policy supports the maturation and deployment of DOE discoveries and innovations. The transition of scientific and technical outputs from the DOE's National Laboratories to private sector partners has always been an important driver of national prosperity and an integral part of the Department's mission. The 2014-2018 DOE Strategic Plan addressed this portion of the mission by committing to "maximize the impact of federal R&D investment in the laboratories, accelerate the transfer of technology into the private and government sectors, and better respond to opportunities and challenges."[12]

OTT works closely with DOE's Senior Leadership, Program Offices, National Laboratories, and other stakeholders – including industry – to plan, prioritize and execute its mission. To ensure that OTT is strongly aligned with the Secretary and senior leadership, the OTT Director serves in a dual capacity as the Technology Transfer Coordinator. In this role, he or she performs statutory responsibilities described in EPAct 2005 and serves as the Secretary's primary advisor on all matters relating to technology transfer and commercialization activities.

The Mission of the Office of Technology Transitions is to expand the commercial impact of DOE's portfolio of RDD&D activities over the short, medium and long term.

OTT also oversees and coordinates technology transitions involving Departmental programs, and works with corporate staff offices to ensure that best practices in technology transitions are identified and implemented. OTT coordinates technology transitions across all Departmental programs, including the National Nuclear Security Administration (NNSA), and the Office of Environmental Management (EM) and facilitates exchange of information regarding innovative technology and commercialization with entities such as the Advanced Research Projects Agency-Energy (ARPA-E) and the Loan Programs Office (LPO), and is responsible for statutorily mandated programs and reports regarding technology transfer.

OTT's close coordination with the Office of Nuclear Energy's (NE's) Gateway for Accelerated Innovation in Nuclear (GAIN) is an example of OTT supporting a program office's efforts to commercialize its R&D. NE's mission to advance nuclear power as a resource capable of meeting the nation's energy, environmental and national security needs is impacted by traditionally lengthy and expensive RD&D. To help boost the effectiveness of innovators in the private sector, NE and OTT launched GAIN. It is an approach to more effectively engage with private sector stakeholders, speeding consideration of their innovative ideas toward a less expensive, nearer term level of commercial readiness of NE-related technologies. In addition to technology development

[12] *Strategic Plan for the Department of Energy for 2014-2018*, U.S. Department of Energy, http://www.energy.gov/sites/prod/files/2014/04/f14/2014_dept_energy_strategic_plan.pdf.

support, NE closely coordinates with the Nuclear Regulatory Commission through GAIN to help innovators understand the necessary licensing processes. Through OTT's involvement, GAIN can help innovators fast-track less expensive maturation of nuclear technologies. This, in turn, allows an efficient, cost-effective pathway for stakeholders to achieve faster development of innovative nuclear energy technologies for commercial readiness.[13] OTT provides the cross-cutting platform for the private sector, while NE supplies the technology specific information to ensure technological expertise is being tapped to accelerate the commercialization of nuclear technologies.

In addition, OTT implements national policy priorities associated with technology transfer as enacted into law by Congress and as identified by Administration policies. Specifically, OTT activities accomplish important priorities as set out in: (1) Climate Action Plan: Deploying Clean Energy, Unlocking Long-Term Investment in Clean Energy Innovation;[14] (2) Cross-Agency Priority Goal on Lab-to-Market: Accelerating and improving the transfer of new technologies from the laboratory to the commercial marketplace;[15] and (3) Presidential Memorandum 2011: Accelerating Technology Transfer and Commercialization of Federal Research in Support of High-Growth Businesses.[16] OTT activities also align with the Department's Strategic Goal #1, Objective #3: "Deliver the scientific discoveries and major scientific tools that transform our understanding of nature and strengthen the connection between advances in fundamental science and technology innovation."[17] Through the creation of its Clean Energy Investment Center (CEIC), OTT also plays an important Departmental role in the Mission Innovation initiative, a multi-national effort to dramatically accelerate global clean

> ***""We have to do everything we can to encourage the entrepreneurial spirit, wherever we find it. We should be helping American companies compete and sell their products all over the world. We should be making it easier and faster to turn new ideas into new jobs and new businesses. And we should knock down any barriers that stand in the way. Because if we're going to create jobs now and in the future, we're going to have to out-build and out-educate and out-innovate every other country on Earth."***
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> **–President Barack Obama, September 2011**

[13] Gateway for Accelerated Innovation in Nuclear homepage https://gain.inl.gov/SitePages/Home.aspx.
[14] *President Obama's Climate Action Plan*: https://www.whitehouse.gov/sites/default/files/image/president27sclimateactionplan.pdf.
[15] *Cross Agency Priority Goal on Lab-to-Market*: http://www.performance.gov/content/lab-market#overview.
[16] *Presidential Memorandum 2011: Accelerating Technology Transfer and Commercialization of Federal Research in Support of High-Growth Businesses*: https://www.whitehouse.gov/the-press-office/2011/10/28/presidential-memorandum-accelerating-technology-transfer-and-commerciali.
[17] *Department of Energy's Strategic Plan 2014-2018*: Goal #1, Objective #3: http://energy.gov/sites/prod/files/2014/04/f14/2014_dept_energy_strategic_plan.pdf.

energy innovation to address climate change.[18] The CEIC's role in Mission Innovation is 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 development. The CEIC became operational in January of 2016, and OTT began to engage with cleantech investors across the private sector.[19]

OTT Program Areas

Data Management and Analysis

The Department is required by statute to develop annual reports on DOE's technology transfer activities which are sent to the Congress and made available to the taxpayers.[20] These reports consist of data collected from across the DOE enterprise including all of the DOE National Laboratories. DOE collects over 70 different technology transfer-related data points for these reports (see Appendix B. for more information on DOE reporting metrics). OTT is focused on streamlining these activities to enable more accurate communication of this information. The data collection and analysis help establish clear goals and objectives for DOE's National Laboratories, other partners, and the Department by facilitating the evaluation of best practices and effective metrics. The information is used to continually improve the delivery of the DOE missions over the short, medium, and long term, and it also is used to help understand and encourage laboratory planning, evaluation, and professional development of Laboratory staff.[21]

Evidence-Based Impact Evaluations and Analyses

OTT emphasizes how DOE's long-term investments in science and technology have grown into critical technologies that support the economic, energy, environment, and national security missions of the Department. The OTT analyzes and evaluates programs and collects metrics for technology transitions across the Department. Evaluation metrics, outputs and outcomes, and other information from DOE's National Laboratories and DOE funding recipients are analyzed to understand the Department's impact on the commercial sector. Studies are conducted on the programs and activities, such as the Agreements for Commercializing Technology pilot, to inform DOE decision-making and policy-setting. Additionally, in-depth case studies are conducted on specific technology areas to be used to evaluate the impact of DOE's RDD&D portfolio.

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[18] *Announcing Mission Innovation*, White House press release: https://www.whitehouse.gov/blog/2015/11/29/announcing-mission-innovation.

[19] CEIC homepage http://energy.gov/technologytransitions/us-department-energys-clean-energy-investment-center

[20] *Energy Policy Act of 2005*, Public Law 109-58, August 8, 2005 http://energy.gov/sites/prod/files/2013/10/f3/epact_2005.pdf.
Stevenson-Wydler Technology Innovation Act of 1980, Public Law 96–480, October 21, 1980 https://www.gpo.gov/fdsys/pkg/STATUTE-94/pdf/STATUTE-94-Pg2311.pdf.

[21] *Fiscal Year 2016 Science and Energy Plan,* U.S. Department of Energy, September 2015, p.81 http://www.energy.gov/sites/prod/files/2015/10/f27/SEP-book-10-7-2015.pdf.

OTT Stakeholder Engagement

OTT engages with a range of external and internal stakeholders in order to promote more effective transfer of technologies to the market, and to grow the opportunities for private sector innovators to engage with its laboratory resources.

OTT annually conducts several stakeholder roundtables, workshops, and other meetings in Washington, D.C., as well as across the country. These engagements with stakeholders and DOE's National Laboratories provide the Department with feedback on how to promote the transition of technology to U.S. commercial sectors through, for example, streamlined partnering mechanisms and increased information exchanges on DOE-funded technologies. OTT's development of programs and activities like a 'partnering service' that can help break down barriers of engagement with federal scientists by facilitating effective communication with potential partners about the capabilities of its DOE's National Laboratories also enhance DOE's engagement with the private sector. Additionally, the OTT encourages regional economic development by holding workshops in regions and engaging and connecting laboratory leaders to state and regional organizations.[22] Examples of engagement activities are listed in Appendix A.

OTT has a range of internal stakeholders. They include the statutorily-created Technology Transfer Working Group (TTWG)[23], which is comprised of federal and contactor employees from DOE headquarters, site offices and DOE National Laboratories involved in the technology transition mission, and the Technology Transfer Policy Board (TTPB), which consists of representatives from DOE Headquarters programs and offices. Other important internal stakeholders are the Laboratory Policy Council (LPC), which includes senior DOE officials and select laboratory directors; the National Laboratory Director's Council (NLDC), which is comprised of the directors of DOE's 17 National Laboratories, and the working group of National Laboratory Technology Transfer executives (NL-TT), which is made up of representatives focused on technology transitions that are appointed by laboratory directors.

In addition to being important stakeholders in themselves, all of these groups are important for engaging and exchanging information. For instance, the TTPB is one way in which OTT shares the information it receives from its engagements with the technology transition community at DOE Headquarters programs and offices. In turn, CEIC's inventor interface will serve as a connecting point for engaging with external investment and philanthropic stakeholders and internal program offices. Through these efforts and many others, OTT serves as 'connective tissue' for technology transition efforts across the Department and out to its many external stakeholders.

[22] Ibid. p.80.

[23] Energy Policy Act of 2005, Public Law 109-58, August 8, 2005 http://energy.gov/sites/prod/files/2013/10/f3/epact_2005.pdf.

OTT is also engaged with a variety of external stakeholders including universities, non-profits, state and local governments, private sector entities and others.

IV. Execution of Department of Energy Technology Transitions Mission

Goals Definition

DOE has defined two overarching goals to guide its technology transitions efforts, both of which are already being pursued by a variety of proven efforts in the field.

Goal 1: Increase the commercial impact of DOE investments through the transition of national laboratory-developed technologies into the private sector.

DOE's support of national laboratory research results in the invention and development of new products, novel technologies and a variety of forms of intellectual property. Even with the hundreds of new patents granted every year, and the thousands of licenses maintained by DOE's National Laboratories, there remains a large reservoir of laboratory-developed intellectual property that has not successfully transitioned to industry. Objectives that support Goal 1 aim to increase the number and rate of technology transition of laboratory-developed innovations to the private sector to advance both energy and non-energy applications.

Goal 2: Increase the commercial impact of DOE investments through private sector utilization of national laboratory facilities and expertise.

DOE's National Laboratories are innovation powerhouses, featuring world-class user facilities, cutting-edge scientific instruments and leading scientists and engineers. These outstanding technical and intellectual assets are available to entrepreneurs in the private sector through a variety of means including access to user facilities and shared R&D facilities, collaborative research with scientists and the creation of strategic partnerships. Private sector companies have already formed thousands of active agreements with DOE facilities, making discoveries, solving technical problems and developing innovations. Objectives that support Goal 2 seek to further promote private sector utilization to encourage U.S. industry to make use of these world-class facilities and assets, which will keep U.S. industry and DOE at the forefront of scientific and technological advancements.

Objectives and Key Activities

The Department advances these two overarching goals through a mix of centralized and decentralized strategies. Centralized activities are designed to ensure both Administrative direction and taxpayer accountability. They enable DOE leadership to set priorities and coordinate the complementary strengths of DOE's National Laboratories, while ensuring that DOE acts as one enterprise focused on making its work more transparent to external partners.

Decentralizing activities, in contrast, enables individual DOE National Laboratories to be more responsive to their full constituent base within the terms of their contracts. Giving DOE's National Laboratories more flexibility to interact with local, state and regional innovation ecosystems helps leverage federally stewarded capabilities for innovation-based economic growth. By allowing for a greater latitude of operational possibilities, a decentralized approach may attract more talent into the ranks of DOE's National Laboratories, which increases their effectiveness and competitiveness. And by sharing information about those strategies with internal and external stakeholders, OTT helps the Department fulfill its overarching goals.

Each year, the TTEP will include tracking, assessing, and incorporating lessons-learned from the prior year's activities to shape planning for the following years. As part of this development process, the TTEP objectives and priority activities will be re-evaluated annually, and updated as needed to achieve optimal impact.

DOE has defined several objectives which fall into three primary areas (see Table 1 below):[24]

A. Central Policies and Procedures: Activities by the Department's management, program and legal offices to clarify and streamline relevant technology transition activities and private-sector laboratory access and engagement policies and procedures.

B. Information and Connectivity: Activities that assist the private sector in navigating the national laboratory system and identifying relevant assets. Collection of industry input to better understand market needs and prioritize the types of technology transition activities requiring focus to achieve the best commercial impact. Sharing this information in accordance with OTT's broader mission of technology transitions.

C. Capabilities and Resources: Activities that guide interactions between DOE's National Laboratories and the private sector, which encompass collaborative research, strategic partnerships, and facilities access.

Each objective is described in more detail below, followed by specific activities that support the respective objectives.[25] The objectives and activities are based on key existing DOE activities, planned activities, and recommended activities from DOE's advisory groups, Requests for Information (RFI)[26], and other stakeholder inputs. As indicated in Table 1, most of the objectives contain elements that advance both Goal 1 and Goal 2. Fulfillment of those objectives, and the key activities supporting them, will serve as one measure of the success of this plan.

[24] These categories are based in part on the 2015 *Essential Practices for Managing National Laboratory Technology Transfer Programs* paper, originally developed for the Quadrennial Technology Review (QTR).

[25] It should be noted that this framework represents major objectives and activities for the TTEP; however, it is not intended to provide an exhaustive list of all activities that the DOE is pursuing related to national laboratory technology transitions.

[26] *Summary of Input Request for Information DE-FOA-0001346,* September 2015 http://energy.gov/sites/prod/files/2015/10/f27/OTT%20RFI%20Summary%20of%20Input_Public_Oct%202015.pdf

Table 1: List of Objectives
A. Central Policies and Procedures
Objective 1: Define and elevate the Department's Technology Transitions mission across DOE's National Laboratories.
Objective 2: Increase the ease of industry access to national laboratory capabilities and intellectual property.
Objective 3: Enable and encourage national laboratory management and personnel to pursue technology transition activities.
B. Information and Connectivity
Objective 4: Provide clearer, more accessible, and more comprehensive information on available national laboratory resources to the private sector.
Objective 5: Increase the level and quality of connectivity between DOE's National Laboratories and the private sector.
C. Capabilities and Resources
Objective 6: Enhance the capabilities of national laboratory researchers and technology transfer offices to advance technology transitions.
Objective 7: Support DOE's National Laboratories to provide active collaborative research, strategic partnerships, and facilities access to the private sector.
Objective 8: Support DOE's National Laboratories to mature and subsequently transition federally sponsored technologies for commercial uptake.

A. Central Policies and Procedures

Objective 1: Define and elevate the Department's Technology Transitions mission across DOE's National Laboratories.

Description

Leaders of DOE must work together with leaders at DOE's National Laboratories to ensure an enterprise-wide emphasis on technology transitions as one of the expected outcomes of the nation's investment in national laboratory research and development. With clearly enunciated enterprise-wide emphasis and leadership support, OTT will work with DOE's program offices to integrate mission-appropriate technology transition goals into their strategic activities where appropriate. In addition, OTT will work with the Department's management and legal offices to clarify and streamline relevant policies and procedures, defined more specifically below.

Key Activities

- Issue a Secretarial Policy Statement on Technology Transitions reflecting the Department's updated priorities and policies.[27]
- For labs operating under M&O contracts, reiterate technology transition objectives in the national laboratory management and operating (M&O) contracts and as part of the Mission and Operational Goals and Objectives of Performance and Evaluation Measurement Plans (PEMPs) as appropriate.[28]
- Integrate technology transition objectives through the annual laboratory planning process. This activity is part of a broader effort to implement a coordinated and uniform annual laboratory planning process for the applied energy programs and DOE's National Laboratories modelled after the Office of Science's annual process.
- Pilot an inter-laboratory benchmarking study using readily available laboratory data (as determined by the participating DOE National Laboratories) to track and study the impact that laboratories are having on industry. The study will use selected impact metrics and will focus on the mission specific performance of peer laboratories (i.e. NNSA, SC, or Applied/EM laboratories).This will be initiated by DOE's National Laboratories. This activity follows from recommendation 3.5 of the interim report of the Secretary of Energy Advisory Board (SEAB) National Laboratory Task Force, "Each DOE National Laboratory should track its impact on the industry."[29]
- Pursue regular, ongoing engagement between Department leadership and DOE's National Laboratory leadership and staff to communicate the importance of technology transition objectives and to identify priorities. This includes enhanced engagement with the TTWG, LPC, NLDC, TTPB, NL-TT, and other forums. This has been started and will continue moving forward.

[27] The Secretary and National Laboratory Policy Council are expecting an updated Secretarial Policy Statement from OTT. In recommendation 3.1, the SEAB Task Force Interim Report specifically recommended an updated Secretarial statement, "Issue policy statement that technology transfer activities are part of the DOE National Laboratories' mission." *Interim Report of the Secretary of Energy Advisory Board National Task Force*, June 17, 2015 http://www.energy.gov/sites/prod/files/2015/06/f23/SEAB%20Lab%20Task%20Force%20Interim%20Report%20Final_0.pdf.

[28] The need to elevate the importance of the Technology Transitions/Transfer mission in Lab management/evaluation plans is recommended across several sources, including the *Essential Practices* document, the 2015 OTT RFI, and the 2013 EERE RFI. The TTWG Executive Committee August, 2015 meeting recognized this as an Under Secretary for Science and Technology lead, with input sought from Program Element Directors, the LPC, and the NLDC/NLTT http://energy.gov/sites/prod/files/2015/10/f27/OTT%20RFI%20Summary%20of%20Input_Public_Oct%202015.pdf

[29] *Interim Report of the Secretary of Energy Advisory Board National Task Force*

Objective 2: Increase the ease of industry access to the capabilities and intellectual property at DOE's National Laboratories

Description

For the Department and its National Laboratories to be more accessible to industry, there must be an ongoing, enterprise-wide commitment to enabling successful partnerships. This requires strong senior Departmental and national laboratory leadership support, and it must be followed by commitment throughout the Department and its National Laboratories to emphasize successful partnerships as an important part of mission success. Industrial awareness of the resources at DOE's National Laboratories is also important, a topic addressed in Objective 4. With DOE leadership support, OTT will coordinate actions across DOE's management and legal stakeholders to increase industry partnerships with DOE's National Laboratories.

The importance of doing so was recognized by the National Laboratory Commission to Review the Effectiveness of the National Energy Laboratories (CRENEL), which found that the "National Laboratories represent a national asset of inestimable value," but noted that more can be done to tap the capabilities of the laboratories, especially in support of economic competitiveness.[30] The SEAB report also found that the DOE National Laboratories have "further opportunities to significantly improve in the area" of creating value for the private sector.[31]

Specifically, the Department and its National Laboratories must assess concerns that its management chain has gradually adopted an overly conservative stance of risk-avoidance.[32] Opportunities to potentially eliminate low-risk requirements were identified by the CRENEL report, and included activities related to human resources, foreign travel approvals, and data

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[30] *Securing America's Future: Realizing the Potential of the Department of Energy's National Laboratories,* Commission to Review the Effectiveness of the National Energy Laboratories, Volume 1, October 2015: http://energy.gov/sites/prod/files/2015/10/f27/Final%20Report%20Volume%201.pdf.

[31] *Interim Report of the Secretary of Energy Advisory Board National Task Force*.

[32] *Securing America's Future: Realizing the Potential of the Department of Energy's National Laboratories,* Commission to Review the Effectiveness of the National Energy Laboratories, Volumes 1 and 2, October 2015: (Volume 2) http://energy.gov/sites/prod/files/2015/10/f27/Final%20Report%20Volume%202.pdf.

Volume 1 pg. 26, "DOE's requirements often also involve multiple levels of approvals rather than allowing decisions to be made at the lowest possible level. It is sometimes said that virtually anyone in the chain can say "no," but only the highest level has the authority to say "yes." The Commission also notes that the multi-layered approval process at DOE builds a culture of excessive conservatism because a margin of safety is added at every step."

Volume 2 pg. 29, "Public perception remains an important aspect of oversight and enforcement and, over time, has led to a Departmental culture of risk aversion and overcompliance with requirements …. In circumstances when tides shift toward stringency, trust across the entire DOE complex declines, increasing risk aversion and overly conservative interpretations of requirements."

Volume 2 pg. 70, "DOE headquarters, field elements, and laboratories should work together to address conservative interpretations of contractor requirements by establishing effective mechanisms to discuss intent, implementation, and assess relevancy of requirements to laboratory settings."

requests.[33] Low-risk requirements such as travel to conferences have also been identified as barriers to increased technology transition activities.[34] Additionally, the Department and its National Laboratories must also assess perceived inconsistencies among site offices regarding contract clauses and requirements.

The Department and its National Laboratories have taken important steps in recent years toward improving engagement and strategic partnerships which help reduce or shift risk with private sector engagements, such as with the adoption of the Agreement for Commercializing Technology (ACT) partnering mechanism for industry sponsored research and the Fast Track Cooperative Research and Development Agreements (CRADA) process. ACT and Fast Track CRADAs represent concrete steps taken by the Department and its National Laboratories to increase flexibility and reduce agreement processing times.

Efforts to appropriately balance risk and streamline processes across the laboratory enterprise require DOE to strategically assess its current framework for engagement with the private sector. Reports from the U.S. Government Accountability Office (GAO) requesting more DOE oversight on Strategic Partnerships Projects (SPPs)[35] and a DOE Inspector General report recommending increased oversight on CRADA reporting should be seen as opportunities to review our management system of these important tools of engagement and not just recommendations for additional requirements. [36]

Key Activities

- Evaluate, and if appropriate, extend, the Agreements for Commercializing Technology (ACT) Pilot.[37]
- Develop a recommendation to the Secretary on the creation of a potential ACT-like agreement mechanism for federally-funded private sector entities.[38]
- Identify additional opportunities to create flexibility through revised policies and procedures that facilitate laboratory-industry engagements, including multi-

[33] Ibid.
[34] The Department of Energy has begun to address this issue.
[35] Strategic Partnership Projects were formerly known as Work For Others.
[36] *DOE Needs to Improve Oversight of Work Performed for Non-DOE Entities,* GAO Report, October 2013. http://www.gao.gov/products/GAO-14-78 and Cooperative Research and Development Agreements at the Department of Energy's Office of Science Laboratories, Audit Report of the U.S. Department of Energy Office of Inspector General, September 2009. http://energy.gov/sites/prod/files/igprod/documents/IG-0826.pdf.
[37] *Department of Energy Agreements for Commercializing Technology*, IDA Science and Technology Policy Institute, April 2013 https://www.ida.org/~/media/Corporate/Files/Publications/STPIPubs/ida-p-5006.ashx.
[38] *Turning The Page: Reimagining The National Labs In The 21st Century Innovation Economy;* Matthew Stepp, Sean Pool, Nick Loris, and Jack Spencer from The Information Technology and Innovation Foundation, The Center for American Progress, and The Heritage Foundation, June 2013 http://www2.itif.org/2013-turning-the-page.pdf

laboratories, at the speed and scale of business. This includes reviewing the fast-track CRADA guidance from 2012. [39] [40]

- Assess the potential for OTT to assist in resolving issues requiring clarification or Department approval regarding industry partnership with DOE's National Laboratories.[41] [42]

Objective 3: Enable and encourage the management and personnel at DOE's National Laboratories to pursue technology transition activities.

Description

The Department must ensure that its policies, procedures, and incentives enable and encourage researchers across the national laboratory system to pursue technology transition activities to the fullest extent authorized, while minimizing the impact on their other mission-critical work. These policies and procedures should foster an environment and culture that manages risk intelligently while not being overly burdensome or discouraging for private sector stakeholders to engage with DOE researchers.

Key Activities

- Establish a Departmental Awards/Recognition Program to elevate and incentivize excellence in technology transitions across DOE's National Laboratories.[43] [44]
- Propose a set of actions that DOE should consider in order to facilitate use of best practices across the laboratory complex and help minimize barriers to the laboratories' adoption of successful Entrepreneurial Leave of Absence policies.[45]
- Assess current conflict of interest policies for DOE's National Laboratories, in areas such as outside employment, working with licensees and reconciling technology assistance programs and identify opportunities to modify these policies to reduce barriers to lab-industry partnerships.[46]

[39] DOE identified numerous barriers to productive Lab-industry agreements through its 2008 RFI. Several of these were repeated in the recent Interim Commission Report (page 55), OTT RFI Input, and in Recommendation #3.2 of the Interim (SEAB) Report for DOE to "consider flexibility in such agreements to facilitate rapid Laboratory-industry engagements" and #3.3 on creating fast-track CRADA and WFO processes.

[40] The need to improve consistency and standardization across national laboratory agreement processes is an emphasis of the Interim Commission Report and the Interim SEAB Report (see Barrier 2 on page 29).

[41] Recommended by the *Essential Practices for Managing National Laboratory Technology Transfer Programs* and National Laboratory input on the 2015 OTT RFI http://energy.gov/sites/prod/files/2015/04/f21/QTR%20Public%20Webinar%20Chapter%2013%20FINAL.pdf.

[42] TTWG Executive Committee minutes, August 2015.

[43] The Secretary has approved this activity for implementation in OTT's FY17 budget, pending appropriations, based on ongoing input, including recommendations from the 2013 EERE Commercialization RFI and 2015 OTT RFI.

[44] TTWG Executive Committee minutes, August 2015.

[45] Recommendation #3.4 of the Interim SEAB Report. For additional background and ideas on potential approaches, see TTWG's June 2015 White Paper, "Implementing an Entrepreneurial Leave Program."

[46] Recommended in 2013 EERE Commercialization RFI and 2015 OTT RFI.

- Assess current policies on equity stakes and royalty income, and identify opportunities to modify these policies to incentivize entrepreneurial activity and industry partnerships.[47] [48]
- Assess current policies on DOE funding of Offices of Research and Technology Application (ORTA) – a.k.a. technology transfer offices – and technology maturation activities at DOE's National Laboratories, and identify potential opportunities for additional support.[49] [50]

B. Information and Connectivity

Objective 4: Provide clearer, more accessible and more comprehensive information on DOE's National Laboratory assets available to the private sector.

Description

To increase industry engagement with DOE's National Laboratories, the private sector must have access to clear and comprehensive information about their assets that are available for potential use. These assets include intellectual property, facilities and equipment, and technical expertise. Meeting this objective requires identifying and characterizing relevant assets, developing usable datasets and materials, and creating user-friendly information portals. In recent years, the Department has made progress toward providing more information on its national laboratory assets, including the creation of the Energy Innovation Portal, the Facilities Database, and other open data resources. [51]

Key Activities

- Improve TTWG's Guide to Partnering with DOE's National Laboratories to help prospective partners better understand DOE processes and requirements.[52] The current Guide can be found on the OTT homepage http://energy.gov/technologytransitions/office-technology-transitions.[53]

[47] Efforts are currently underway by DOE management to assess these topics.
[48] TTWG Executive Committee minutes, August 2015.
[49] Recommendation from the 2015 OTT RFI and 2013 EERE Commercialization RFI.
[50] ORTAs were established by Section 11 (b) of the *Stevenson-Wydler Technology Innovation Act of 1980*, Public Law 96–480, October 21, 1980 https://www.gpo.gov/fdsys/pkg/STATUTE-94/pdf/STATUTE-94-Pg2311.pdf.
[51] It should be noted that the Energy Innovation Portal consist of all intellectual property from DOE's National Laboratories, not just that in the area of clean energy.
[52] Recommended by the *Essential Practices for Managing National Laboratory Technology Transfer Programs, and the QTR workshop process.*
[53] Note: This update was initiated by the members of the TTWG, and OTT is supporting their effort.

- Maintain a consolidated OTT web portal as a central point of information discovery for commercial customers of national laboratory assets, building upon the existing Energy Innovation Portal and Facilities Database.[54] [55]
- Develop Application Program Interfaces (API) for key information on national laboratory assets and ensure that data is available in machine-readable format.[56]
- Establish a Clean Energy Investment Center working with the National Laboratories which as part of its scope will provide information on relevant national laboratory expertise and data for mission-oriented investors in this research area.[57]

Objective 5: Increase quality of connectivity between DOE's National Laboratories and the private sector.

Description

In addition to providing openly available information to all interested parties, the Department must work to directly and proactively engage with the private sector to establish stronger connections and long-term relationships between DOE's National Laboratories and industry; actively assist the private sector in navigating the national laboratory system and in identifying relevant assets; and collect industry input to better understand market needs and prioritize the types of technology transition activities for commercial impact. In doing so, the Department will be assessing and supporting the technology transition efforts that have proven to be valuable to all parties. One example of this was the November 2015 the launch of the Gateway for Accelerated Innovation in Nuclear initiative.[58]

Key Activities

- Establish a DOE "partnering service" to facilitate connections between industry, investors, and DOE's National Laboratories (encompassing part of the Clean Energy Investment Center).[59]
- Continue to support EERE in the ongoing implementation of the Technologists in Residence Pilot to catalyze new Lab-industry interactions and evaluate the pilot to

[54] Key recommendation from national laboratory and other stakeholder input to 2015 OTT RFI and the 2015 *Essential Practices* document.

[55] This was a priority activity to meet the Administration's Lab-to-Market Cross-Agency Priority (CAP) Goal and Open Data Policy.

[56] Priority activity to meet the Administration's Lab-to-Market CAP Goal and Open Data Policy

[57] The CEIC has been established within OTT http://energy.gov/technologytransitions/us-department-energys-clean-energy-investment-center.

[58] https://gain.inl.gov/SitePages/Home.aspx

[59] Based on ideas that have come from the (1) TTWG, (2) SEAB's recommendation to pursue a decentralized approach to tech transfer so that industry and Laboratory participants can interact directly, (It is already decentralized, at least in the SC Laboratories), and (3) The Commission's preliminary recommendations on how DOE's National Laboratories partner with industry and conduct technology transfer activities.

determine if and how it should be scaled.[60] OTT will also continue to assist EERE in informing stakeholders about this effort.

- Encourage ongoing lab-industry events and strategically coordinate these events as a portfolio of complementary opportunities for industrial engagement. This will be initiated in FY16 and will continue into the future. [61]

C. Capabilities and Resources

Objective 6: Enhance the capabilities of DOE National Laboratory researchers and technology transfer offices to successfully transition technologies.[62]

Description

The success of DOE's National Laboratory technology transition activities relies on the capabilities of the laboratory's R&D performers and technology transfer professionals. All federal laboratories are required to have a central Office of Research and Technology Applications to support both intellectual property (IP) management and industrial partnerships.[63] These offices represent a basic underpinning of DOE's National Laboratory technology transition activities.

Key Activities

- Identify opportunities to strengthen the technology transitions capabilities of national laboratory technology transfer offices and researchers engaged in technology transitions, modelled on efforts like ARPA-E's required Technology-to-Market Plans.[64]
- Continue to work with EERE as it implements the Lab-Corps Pilot as another avenue to empower researchers engaged in technology transitions to commercialize national laboratory technologies and evaluate the pilot to determine if and how it should be continued and possibly expanded strategically across the Department.[65] OTT will also

[60] The EERE Technologists in Residence Pilot was announced in FY 2015 and will be implemented in FY 2016 and 2017, aimed at catalyzing stronger Lab-Industry relationships that result in significant growth in high-impact collaborative R&D.

[61] Key recommendation from national laboratory and other stakeholder input to 2015 OTT RFI and the 2015 *Essential Practices* document.

[62] Note that these refer to the Offices of Research and Technology Application which were established by Section 11 (b) of the *Stevenson-Wydler Technology Innovation Act of 1980*, Public Law 96–480, October 21, 1980 https://www.gpo.gov/fdsys/pkg/STATUTE-94/pdf/STATUTE-94-Pg2311.pdf.

[63] Ibid.

[64] Key recommendation from the *Essential Practices* document and national laboratory input to the 2013 EERE Commercialization RFI. This approach also aligns with the Interim SEAB Report on strengthening decentralize National Laboratory capacity for industry engagement.

[65] EERE's Lab-Corps Pilot is a specialized training curriculum aimed at accelerating the transfer of clean energy technologies from national laboratories into the commercial marketplace. The program focuses on establishing a set of proven training methods that will equip DOE laboratory scientists with a better understanding of the commercialization process. It currently underway and will continue to be implemented and then evaluated in FY 2016, with the potential to be continued, modified, and/or scaled up.

continue to inform stakeholders about the Lab-Corps Pilot and amplify its opportunities and achievements.

- Identify other opportunities for technology transitions training and professional development for technology transfer staff and researchers across DOE's National Laboratories.[66]

Objective 7: Support the ability of DOE's National Laboratories to provide active collaborative research, strategic partnerships and facilities access to the private sector.

Description

In order to increase private sector utilization of the national laboratories and facilities for commercial impact, it is also necessary for the Department to actively support the national laboratories in offering their technical assistance and facilities to engage the private sector in ways that complement or enhance programmatic mission needs. This objective complements other objectives within this Plan. One example of this is the High Performance Computing for Manufacturing effort at Lawrence Livermore National Laboratory.[67] This example of lab/industry collaboration can be a model for future and enhanced efforts across the Department.

Key Activities

- Continue to work with EERE as it implements the Small Business Vouchers Pilot to support small business utilization of laboratory assets, and evaluate the pilot to determine if and how it should be continued. Launch a nuclear energy focused voucher program in FY16. [68]
- Support the implementation of Office of Science facility-focused programs such as its new Accelerator R&D Stewardship program and its ongoing efforts to improve industry access to SC's Advanced Scientific Computing Research (ASCR) Facilities.[69] [70]

[66] Based on recommendations in the 2013 EERE Commercialization RFI, 2014 Lab-Corps Workshop, *Essential Practices* document, and 2015 OTT RFI.

[67] https://hpc4mfg.llnl.gov/

[68] The voucher program was launched on January 27, 2016 http://energy.gov/articles/new-national-labs-pilot-opens-doors-small-businesses.

[69] SC is currently developing an Accelerator Stewardship program for implementation in upcoming fiscal years. It is focused on improving access to SC accelerator R&D infrastructure for industrial and other users; near-term translational R&D to adapt accelerator technology for medical, industrial, security, defense, energy and environmental applications; and long-term R&D for the science and technology needed to build future generations of accelerators.

[70] Both the Interim Commission Report and the Interim SEAB Report recognize the importance of national laboratory computing research facilities for industry.

- Support ongoing NNSA's efforts to evaluate the opportunities to develop outreach centers or "microlabs" outside of the security areas to overcome the additional challenges posed by their necessary security posture.[71] This should be done by NNSA in collaboration with OTT.

Objective 8: Support DOE's National Laboratories in maturing and transitioning federally sponsored technologies for commercial uptake.

Description

OTT has identified two key gaps in the technology commercialization cycle that hinder the transition of national laboratory technologies into the private sector. First, national laboratories have consistently reported a lack of sufficient funding to develop technologies with sufficient robustness to attract private sector interest. In many cases, DOE or other public funding may support R&D activities up to an early Technology Readiness Level (TRL), but then it ends before the technology is matured to a point where a business would enter into a cooperative R&D agreement, strategic partnership project, or license the technology. A 2013 report commissioned by the White House Office of Science and Technology Policy concluded, "Many promising early-stage technologies developed at Department of Energy national laboratories require 'maturation' in the form of additional development, testing, or prototyping before companies are willing to invest in them for commercial purposes."[72]

Second, there is also a gap in early-stage seed funding available to commercialize technologies emerging from national laboratories at higher TRL levels. Traditionally, this gap has been known as the "first valley of death."[73] In contrast to the technology maturation phase inside a laboratory, this "first valley" exists primarily at the seed funding stage for a new venture to help it engage in early commercialization activities.[74] For example, this gap has widened significantly in recent years as early-stage (Seed and Series A) venture capital investment in clean energy has experienced a major decline, falling 85 percent from 2007 to 2014.[75]

[71] Joint Explanatory Statement to Accompany S. 1356, the *National Defense Authorization Act for FY16*, Section 3120.
[72] *Department of Energy Technology Maturation Programs*, a report from the IDA Science and Technology Policy Institute, May 2013. https://www.ida.org/~/media/Corporate/Files/Publications/STPIPubs/ida-p-5013.ashx
[73] U.S. Small Business Administration. "Bridging the Valley of Death: Financing Technology for a Sustainable Future." 1994. https://clu-in.org/download/supply/bridging.pdf
[74] *Bridging the Valley of Death: Transitioning from Public to Private Sector Financing*, Murphy, L.M. and Edwards, P.L., at the National Renewable Energy Laboratory May 2003. http://www.nrel.gov/docs/gen/fy03/34036.pdf.
[75] Figure based on data from Bloomberg New Energy Finance, 2016 http://about.bnef.com/content/uploads/sites/4/2016/01/BNEF-2015-Annual-Investment-Numbers-FINAL.pdf.

Key Activities

- Implement a forward-looking approach to the Energy Technology Commercialization Fund (TCF) to commercialize high impact energy technologies from the national laboratories in current and out years.[76]
- Identify opportunities for DOE Program Offices to facilitate the maturation of national laboratory-developed technologies within the scope of existing programmatic funding and activities.[77]

V. Technology Commercialization Fund

1. Background

The Energy Technology Commercialization Fund (TCF) authorized in Section 1001 of the Energy Policy Act of 2005 (42 U.S. Code § 16391(e))[78] states the following:

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

DOE previously complied with Section 1001 by retroactively accounting for Applied Program Office funding for national laboratory CRADAs matched by a non-federal partner.[79] Former DOE Under Secretary Raymond Orbach reported this in a letter to Congress in 2008.[80] DOE CRADAs are also reported in the annual reports on federal technology transfer prepared by the National Institutes of Standards and Technology.[81] n 2011, Secretary Chu signed a Secretarial Policy

[76] This activity is based on a Secretary-level commitment, IG recommendation, and recent changes to how DOE has chosen to implement EPAct 2005 Section 1001, including requiring a forward-looking approach to the Technology Commercialization Fund (TCF). For more background, see the TCF Options paper for CFO (June 2015). First selections for the first department wide TCF were made June 21, 2016 http://energy.gov/technologytransitions/articles/doe-announces-16-million-54-projects-help-commercialize-promising.

[77] Based on input from the TTWG, OTT RFI, EERE RFI, and ongoing recommendations from DOE's National Laboratories. For more details on potential approaches, see *Technology Maturation: A key element of improving technology transfer and commercialization, a 2015 PowerPoint presentation by the TTWG's* Bruce Harrer, Poorinima Upadhya, and Roger Werne.

[78] P.L. 113-291, SEC. 3144. TECHNOLOGY COMMERCIALIZATION FUND. Section 1001(e) of the Energy Policy Act of 2005 (42 U.S.C. 16391(e)) was amended by inserting ''based on future planned activities and the amount of the appropriations for the fiscal year'' after ''fiscal year.''

[79] EERE independently established a proactive, EERE-level fund in FY 2007 and FY 2008.

[80] Raymond Orbach, DOE Under Secretary for Science, letter to Senator Jeff Bingaman, Chairman of the Committee on Energy and Natural Resources, October 24, 2008.

[81] Federal Laboratory Technology Transfer Summary Reports to the President and The Congress, National Institute of Standards and Technology http://www.nist.gov/tpo/publications/federal-laboratory-techtransfer-reports.cfm.

Determination memo directing the Department to "take a more forward-looking approach to implementing the TCF that will enhance the effectiveness of the Department's expenditures in commercialization." Additionally, the Secretary directed the Technology Transfer Coordinator to "work closely with the Under Secretaries, the Assistant Secretaries, and their program managers to focus on maximizing the impact of their investments on technology transfer and commercialization. [82] This includes making the best possible use of national laboratories as partners with the private sector in research and development that lead to the commercialization of energy technologies."[83]

In 2014, DOE's Inspector General issued an audit report recommending DOE management "develop and implement a forward-looking approach to plan and execute the Energy Technology Commercialization Fund."[84] In its response, DOE management concurred with the recommendation and committed to establishing the TCF as a high-priority goal.[85] In addition, the 2015 National Defense Authorization Act included an amendment clarifying the Department should base the TCF on "future planned activities."[86]

2. Updated TCF Approach

With the establishment of OTT, the Secretary clarified the office would "be responsible for statutorily mandated programs and reports regarding technology transfer."[87] The Department's announcement of OTT also stated that it "will be responsible for the statutorily-created Energy Technology Commercialization Fund, a nearly $20 million fund that will leverage the R&D funding in the applied energy programs to pursue high impact commercialization activities."[88]

To comply with Congress' new language on "future planned activities" DOE's first forward-looking TCF began in FY16 with the core Applied Energy Program Offices – Energy Efficiency, Fossil Energy, Nuclear Energy, and Office of Electricity – including 0.9% from each office's R&D budget. The TCF was focused on commercializing promising energy technologies from the

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[82] Energy Policy Act of 2005 (42 U.S.C. 16391). The Director of the OTT is also the Technology Transfer Coordinator.
[83] Sean A. Lev, Acting General Counsel, Department of Energy: Memorandum for the Secretary - *Implementation of the Technology Commercialization Fund under Section 1001 of the Energy Policy Act of 2005;* EXEC-2011-003373. 2011.
[84] U.S. Department of Energy Office of Inspector General. "Technology Transfer and Commercialization Efforts at the Department of Energy's National Laboratories." Audit Report OAS-M-14-02. February 2014. http://energy.gov/ig/downloads/audit-report-oas-m-14-02
[85] Ibid, Appendix 3.
[86] NDAA FY 2015 Amendment: "P.L. 113-291, SEC. 3144. TECHNOLOGY COMMERCIALIZATION FUND. Section 1001(e) of the Energy Policy Act of 2005 (42 U.S.C. 16391(e)) is amended by inserting ''based on future planned activities and the amount of the appropriations for the fiscal year'' after 'fiscal year.'"
[87] *Recommendation to Recast the Office of Technology Transfer Coordinator as the Office of Technology Transitions*, Franklin M. Orr, JR., Under Secretary for Science and Energy, Department of Energy: Memorandum for the Secretary, EXEC-2014-008671 2015.
[88] *Energy Department Announces New Office of Technology Transitions*, U.S. Department of Energy press release. February 11, 2015. http://energy.gov/articles/energy-department-announces-new-office-technology-transitions.

national laboratories to comply with the Energy Policy Act of 2005 and improve DOE's technology transitions strategy. OTT coordinated – and will continue to coordinate TCF implementation with the program offices and relevant DOE management offices.

3. TCF Compliance Reporting

Prior to establishing its first forward-looking TCF in FY16, DOE complied with Section 1001 of the Energy Policy Act of 2005 by accounting for relevant activity supported by DOE's applied energy program offices. Specifically, it ensured that a private sector match was achieved for the 0.9% of federal funds allocated for the TCF in previous fiscal years using applied energy RD&D budgets provided by DOE's Chief Financial Officer. Those calculations showed that in FY14, $2.323 billion was made available to the Department for applied energy research, development, demonstration and commercial application.

From there, the amount of matching funds provided by the Department with private partners to promote promising energy technologies for commercial purposes was determined using information from the Office of Technology Transitions' FY14 DOE National Lab Agreements Data Call. Due to the requirement that funds be matched, the lower of the DOE dollar contribution and the total participant contribution (including dollar and in-kind contribution) was used. The FY14 agreements data show that there were $40.733 million of CRADA matching funds to private partners to promote promising energy technologies for commercial purposes. Dividing the $40.733 million in FY14 CRADA matching funds by the $2,323 billion in FY14 DOE applied energy RD&D indicates that DOE achieved compliance and exceeded the 0.9% EPACT 2005 requirement. It did so by using 1.75% of the amount made available to the Department for applied energy research, development, demonstration, and commercial application for FY14 to provide matching funds with private partners to promote promising energy technologies for commercial purposes.

In February 2016, OTT issued the first-forward looking solicitation for TCF funding to DOE's National Laboratories, and followed that with the first department-wide selections of TCF funding the following June.[89] [90] In future years, DOE looks to continue achieving the overall goals of the law through annual solicitations and funding selections for forward-looking TCFs.

VI. Conclusion

The Department of Energy is one of the largest supporters of technology transition efforts across the federal government according to the Fiscal Year 2013 Technology Transfer Summary Report to the President and the Congress, which was issued in October 2015. That report showed that in FY13, DOE had the largest number of invention disclosures, patent applications,

[89] http://energy.gov/articles/doe-s-office-technology-transitions-issues-first-call-launch-new-energy-technologies
[90] http://energy.gov/technologytransitions/articles/doe-announces-16-million-54-projects-help-commercialize-promising

patents issued, licenses and income-bearing licenses (the last was 3,709, far higher than the combined total from all other agencies) compared to other federal agencies.[91] It also noted that DOE is responsible for almost 90 percent of the total number of active licenses, and has supported the most startups of any agency.[92]

Those efforts are, and have been, a crucial component of DOE's overall mission to promote scientific and technological innovation that advances the economic, energy and national security interests of the country. The Office of Technology Transitions (OTT) was established to lead DOE in more effectively achieving this important mission. This *Technology Transfer Execution Plan* (TTEP) was written to guide DOE and OTT in fulfilling its mission, thereby helping the Department reach its goals and ultimately serving the nation's citizens.

The TTEP will serve as an important marker as OTT develops the Department's policy and vision for expanding the commercial impact of its research investments, and as it streamlines information and access to DOE's national laboratories to foster partnerships that will move innovations from DOE's National Laboratories into the marketplace. It will also serve as a touchstone for OTT in building on its three pillars of stakeholder engagement, data collection and analysis and evidence-based impact evaluations. And it will be updated as OTT grows, reflecting new metrics and revealing better practices.

Ultimately, this plan is intended to guide the Department of Energy in nurturing the Nation's innovation ecosystem, thereby strengthening the Department's overall mission.

[91] *Fiscal Year 2013 Technology Transfer Summary Report to the President and Congress*, The National Institute for Standards and Technology in the U.S. Department of Congress, October 2015 http://www.nist.gov/tpo/publications/upload/FY2013FedTechTransfReportFINAL-3.pdf.
[92] Ibid.

APPENDIX A. OTT Stakeholder Engagement

To promote the rapid transition of technology to U.S. commercial sectors, OTT regularly engages with a range of public and private-sector stakeholders to exchange information on DOE technology transfer opportunities and outcomes/successes.

These internal stakeholders include the national laboratory-wide DOE Technology Transfer Working Group (TTWG), the Technology Transfer Policy Board (TTPB), the Laboratory Policy Council (LPC) and the National Laboratory Directors' Council (NLDC) The TTWG is comprised of the various laboratories' Technology Transfer Office managers. The TTPB includes representatives from the various DOE Headquarters (HQ) offices which are engaged with the OTT, including the Program offices and the Support offices. The LPC has as its members senior DOE officials and select laboratory directors. The NLDC's roster includes each of the 17 national laboratory's respective directors.

External stakeholder groups include the Association of State Energy Research and Technology Transfer Institutions, the National Association of State Energy Officials (NASEO) and many others. The overview of outreach actions across DOE below, as well as the stakeholder meetings held at DOE HQ, demonstrated wide the range of input OTT sought for the TTEP.

Outreach Actions in 2015

An ACT workshop on April 27 included participants from the Office of Technology Transitions, the Office of the Chief Financial Officer, the Office of the General Council, the Office of Management, the Office of Science, the National Nuclear Security Administration and the Office of Environmental Management as well as the Brookhaven Site Office, the Chicago Office, the Livermore Field Office, the Golden Field Office, the Pacific Northwest Site Office, the Ames Laboratory, Brookhaven National Laboratory, Idaho National Laboratory, Lawrence Livermore National Laboratory, the National Renewable Energy Laboratory, Oak Ridge National Laboratory and Pacific Northwest National Laboratory. Agenda topics discussed included the goals of sharing best practices and lessons learned in ACT Pilot management, identification of opportunities for improved management and performance, and collection of initial input to inform the pilot evaluation plan.

The Better Buildings Summit on May 27-29, included OTT, NREL, LBNL, ORNL, and SNL. The forum offered laboratory leaders to feature their successes and results, as well as highlight the impacts of their organization's energy efficiency efforts. Discussion points included the value of working with DOE's national laboratory's specific programs or initiatives that TT stakeholder audience would be interested in learning about; myth busting of any specific perceived difficulties of working with the national laboratories; and lab-specific guidance on how TT stakeholders can access the national laboratories.

The Association of State Energy Research and Technology Transfer Institutions (ASERTTI) Federal Energy Outreach Meeting Washington, D.C. on June 4 included OTT, EERE, EPSA, and ARPA-E. It discussed Quadrennial Energy Review recommendations and implementation, and

offered ASERTTI guests the chance to engage with DOE HQ managers from a range of technology-focused offices.

The National Laboratories Chief Research Officers (NLCRO) working group, including invitees from across the laboratory complex, was hosted by DOE on June 15 to provide feedback to the DOE and to the NLDC on TT best-practices and coordinate strategic planning for programs.

The White House Clean Energy Investment Initiative meeting on June16 was where the DOE's Deputy Secretary announced the Clean Energy Investment Center (CEIC) and engaged with the philanthropic and private sector investment community on how the Department could re-catalyze private funds back into the energy sector.

The Small Business Association's June 17 SBIR National Conference included panelists from NASA, PNNL, the U.S. Army, and Samsung. The topics included: How can partnering help a small business, what are the differences between partnering with a federal laboratory and another private sector entity, what opportunities exist for partnering with laboratories and private companies, how do you discuss/handle sensitive topics like IP when partnering, and what is the first step to partnering with laboratories and private companies?

The Technology Transfer Working Group (TTWG) met on June 17 and speakers included the Undersecretary for Science and Energy, PNNL, OTT, EERE, SC, NNSA, ED, GC, BNL, NREL, Y12, and Fermilab.

The Patent Counsel meeting on June 18, 2015, enabled stakeholder discussion on best practices in Cost-Share & IP Management, tech maturation: clarification of 15 USC § 3710, TCF, IG Report on Equity, ACT and FedACT Working Group, issues with endorsement, conflict of interest and fairness of opportunity, definition of a foreign entity, manufacturing competitiveness, streamlining data collection/reporting, Shared Facility Agreements, and the CRADA Builder.

The NREL Regional Roundtable on June 29 included stakeholders including investors, small-businesses, non-profits, incubators, large businesses, DOE HQ, DOE laboratories, universities, and state and local governments. Discussion included identification high-potential opportunities for enhancing DOE's commercial impact, updates on the OTT, and solicitation of input on topics referenced in its 2015 Request for Information (RFI), which sought feedback from public and private sector stakeholders regarding opportunities to enhance the commercial impact of DOE's portfolio of Research, Development, Demonstration & Deployment (RDD&D) activities.

The White House Supply Chain Innovation Roundtable on July 9 included manufacturing company executives, SBA, DOC, DOE, and DOD to discuss how to best leverage U.S. innovation assets, like the national laboratories, the Manufacturing Extension Partnership, and federal financing programs, to strengthen small manufacturers and supply chains.

The National Association of State Energy Offices (NASEO) roundtable on July 22 included 17 states, and a number of private, and state- research institutions, and a state legislative representative. Input was gathered to advance NASEO members' efforts with the OTT. It included initial information to the states and OTT on technology transition gaps, existing state efforts, and new approaches to better leverage resources.

The Small Business Voucher Pilot (SBVP) Kickoff meeting on Aug 4 included OTT, and participant laboratories LBNL, NREL, ORNL, PNNL, and SNL followed from the original SBVP concept's source – the National Laboratory Directors Council. Its goals include acceleration and improvement of the transfer of new technologies from the laboratory to the commercial marketplace. NEC seeks SBVP to be a model for DOE, other agencies, and states.

OTT and the TTEG Executive board met at Fermi lab to discuss the TTEP on August 14th. The labs gave OTT feedback on the draft TTEP framework and discussed the TTWG's concerns with resources need to accomplish the items in the TTEP.

The Nevada Accelerating Clean Energy Economic Development Roundtable was held on August 25. OTT, EERE, CI and Sandia National Laboratories presented information on how the stakeholders could engage with DOE programs and labs.

The Request for Information from OTT was published in September incorporated feedback regarding opportunities to enhance the commercial impact of DOE's portfolio of research, development, demonstration & deployment activities. Fifty-five submissions from the public and private sector were returned, including 10 small technology developers, 3 major technology developers, 5 incubator/ accelerators, 3 venture capital firms, and twelve laboratories (NREL, INL, and LLNL submitted a joint response).

FutureFocus, Hawai'i Innovation Initiative's Forum on Energy, Cybersecurity & More was held September 23-34. OTT highlighted the Department's work to transition technologies from the labs to the private sector and received feedback on the TCF and the TTEP.

The Accelerating Clean Energy Innovation through increased public-private linkages and investment DOE-EPSA Workshop on Oct 2 hosted private sector parties interested in advancing energy technology innovation.

A State Energy Advisory Board SEAB meeting in Washington, DC on October 6-7 brought together members of academia, small businesses, large firms, labor unions, energy financing firms, and non-profits, to determine approaches for advancing energy partnerships among the various stakeholders.

The NM Senator Udall Technology Transfer Roundtable on October 14 included also Senator Mikulski and Senator Heinrich and SNL. Discussion included how SNL's model for technology transitions has been shared with other federal laboratories, including the Air Force Research

Laboratory, Army Research Laboratory, and Navy Strategic Systems, as well as the Congressional Research Service.

The White House Forum on Connecting Regional Innovation Ecosystems to Federal and National Laboratories was held on November 3. The workshop brought together DOE's Deputy Secretary, NEC managers, private sector energy technology stakeholders, DOE laboratory directors, and representatives from several other agencies, to discuss how to make the lab to market journey more accessible to parties outside of states that host federal laboratories, and to encourage technology transition activities among all parties.

Appendix B. DOE Reporting Metrics (69)

The metrics in the table for obtaining User Facilities data come directly out of the "Department of Energy Technology Transfer Working Group Reporting and Appraisal Guide for DOE Technology Transfer Activities" last updated and approved on October 20, 2014. OTT will coordinate closely with the DOE programs on all metric development activities.

Green-shaded data is reported to the National Institute of Standards and Technology (NIST).

1	Active CRADAs	24	Total (New Non-Income Bearing)	47	Active (SPP) Agreement (Non-Federal Sponsors)
2	New CRADAs	25	Open Source Products Available for Licensing (No-Cost Software Licensed)	48	New SPP Agreement (Non-Federal Sponsors)
3	*New CRADAs with Small Businesses	26	Open Source Products Licensed (No-Cost Software)	49	Active NFS Agreements with Foreign Sponsors (Non-Federal Sponsors)
4	Actual CRADA Participant Funds-in	27	Other No Cost Software Available for Licensing (No-Cost Software)	50	Active NFS Agreements with Small Business (Non-Federal Sponsors)
5	Active CRADAs with Small Business	28	Other (No-Cost Software)	51	Non-Federal Sponsors Funds-in
6	Patent Licenses (Active Income-Bearing)	29	Patent License Income	52	User Projects Awarded
7	Copyright Licenses (Active Income-Bearing)	30	Copyright License Income	53	*User Projects Awarded to Small Businesses
8	Other Licenses (Active Income-Bearing)	31	Other License Income	54	**User Projects Awarded to Industry
9	Total (Active Income Bearing)	32	Total License Income	55	U.S. Users
10	Patent Licenses (New Income-Bearing)	33	*Elapsed Time for License Execution	56	Foreign Users
11	Copyright Licenses (New Income-Bearing)	34	*Total Licenses Granted to Small Businesses	57	Total Users
12	Other (New Income-Bearing)	35	Total Earned Royalty Income from Patent Licenses	58	*Total Number of Unique Small Businesses Collaborating with the Laboratories
13	Total (New Income Bearing)	36	Total Earned Royalty Income from Copyright Licenses	59	Economic Contribution from Licensed Technologies
14	Exclusive Income Bearing Licenses (New Income-Bearing)	37	Total Earned Royalty Income from Other Licenses	60	Number of Startup Companies
15	*Partially-Exclusive Income Bearing Licenses (New Income-Bearing)	38	Total Earned Royalty Income	61	Commercialized Technologies

16	*Non-Exclusive Income Bearing Licenses (New Income-Bearing)	39	Invention Disclosures	62	Personnel Exchanges Initiated
17	Patent Licenses (Active Non-Income Bearing)	40	U.S. Patent Applications Filed	63	Science Education Activities Performed
18	Copyright Licenses (Active Non-Income Bearing)	41	Foreign Patent Applications Filed	64	Technical Scientific Results Published
19	Other (Active Non-Income Bearing)	42	Total Patent Applications Filed	65	*Literature Review and Summary
20	Total (Active Non-Income Bearing)	43	U.S. Patents Issued	66	*Number of Options Signed as Part of America's Next Top Energy Innovator
21	Patent Licenses (New Non-Income Bearing)	44	Foreign Patents Issued	67	*Number of Options Converted to Licenses as Part of America's Next Top Energy Innovator
22	Copyright Licenses (New Non-Income Bearing)	45	Total Patents Issued	68	*Number of New Material Transfer Agreements
23	Other Licenses (New Non-Income Bearing)	46	Number of Copyright Assertion Requests	69	*Number of Active Material Transfer Agreements

*New FY13 Metric
** New FY14 Metric