University of Southern California

S&T Analysis and Management of Innovation Activity III (STAMINA III)

Appendix D:
Literature Review of Government Performance Reporting Measures Related to Transition

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DHS Science and Technology Directorate (S&T)
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Contents

1. Indicators of Success (IoS) for Technology Transfer Aspects of Transition Across Government Agencies

The Technology Transfer Commercialization Act of 2000 requires each federal agency to provide an annual performance report of its technology transfer activities for the current fiscal year, as well as data from the four preceding fiscal years (FYs), to the Office of Budget and Management (OMB), with a copy given to the National Institute of Standards and Technology (NIST). In turn, NIST creates an annual summary report that includes the data from all reporting agencies that is sent to the White House and to Congress.

This section summarizes Indicators of Success (IoS) for transition measures related to technology transfer, including inventions, patents, licenses and CRADAs, reported by the four government agencies with the highest R&D budgets, DOD, DOE, HHS, and NASA, plus DHS. Table D-1 summarizes the federal R&D funding for these agencies for FY2020-2022, and Table D-2 summarizes their IoS for 2019, the most recent year for which the data is available. Table D-3 summarizes key characteristics of each of these agencies' transition processes for technology transfer and commercialization.

Quoting from the Congressional source[1] for Table D-1,

> "Funding for R&D is concentrated in a few federal departments and agencies. In FY2021, five agencies received 93.0% of total federal R&D funding, with the Department of Defense (DOD, 40.1%) and the Department of Health and Human Services (HHS, 27.6%) combined accounting for more than two-thirds of all federal R&D funding."

Table D-1. Federal Research and Development Funding by Agency, FY2020-FY2022[1]
(budget authority, dollar amounts in millions)

Department/Agency	FY2020 Actual	FY2021 Estimate	FY2022 Request	FY2021-FY2022	
				Dollar Change	Percentage Change
Department of Defense	62,438a	63,350a	62,800	-550	-0.9%
Dept. of Health and Human Services	44,455	43,494	51,232	7,738	17.8%
Department of Energy	19,476	19,312	21,452	2,140	11.1%
NASA	14,801	13,226	14,565	1,339	10.1%
National Science Foundation	6,800	7,408	8,173	765	10.3%
Department of Agriculture	2,989	2,965	3,609	644	21.7%
Department of Commerce	1,953	2,122	2,743	621	29.3%
Department of Veterans Affairs	1,366	1,420	1,498	78	5.5%
Department of Transportation	1,043	1,024	1,339	315	30.8%
Department of the Interior	1,094	1,033	1,221	188	18.2%
Department of Homeland Security	532	590	627	37	6.3%
Smithsonian Institution	516	524	585	61	11.6%
Environmental Protection Agency	237	445	473	28	6.3%
Department of Education	344	322	346	24	7.5%
Other	582	563	597	34	6.0%
Total	**158,626**	**157,798**	**171,260**	**13,462**	**8.5%**

[1] Federal Research and Development (R&D) Funding: FY2022, Updated January 19, 2022, Congressional Research Service, https://crsreports.congress.gov, R46869.

In its most recent report,[2] dated August 2022, NIST summarized the data from 11 federal agencies – the Department of Agriculture (USDA), Department of Commerce (DOC), Department of Defense (DoD), Department of Energy (DOE), Department of Health and Human Services (HHS), Department of Homeland Security (DHS), Department of the Interior (DOI), Department of Transportation (DOT), Department of Veteran Affairs (VA), and National Aeronautics and Space Agency (NASA) – between FY 2015 and FY 2019 in the following categories: Invention Disclosures and Patenting, Licenses, Income from Licensing, and Collaborative R&D Relationships (CRADAs).

Table D-2 summarizes the IoS for the five agencies listed above for 2019, with data were taken directly from the National Institute of Standards and Technology (NIST) Federal Laboratory Technology Transfer FY 2019 Summary Report to the President and Congress, dated August 2022. Additional details across the FY2015-2019 period are provided in Appendix D-1 at the end of this document.

Table D-2. Summary of IoS for the Four Highest R&D Budgeted Agencies, Plus DHS

IoS	DHS	DOD	DOE	HHS	NASA
Inventions and Patents					
Invention Disclosures	14	830	1,891	268	1,841
Patents Filed	38	955	837	207	85
Patents Issued	8	653	919	708	122
Licensing					
Licenses, Total Active	5	575	4,640	1,933	503
Licenses, New Active	0	58	686	346	96
Invention Licenses, Total Active	5	470	822	1,472	529
New Inventions Licenses, Total Active	0	58	98	291	88
Income Bearing Licenses, Total Active	1	283	2,749	1,001	326
Income Bearing Exclusive Licenses	0	179	113	158	8
Income					
Total Income, All Active Licenses*	$38	$5,601	$21,085	$78,540	$2,613
Invention Licenses*	$38	$2,977	$18,220	$76,468	$2,530
Total Earned Royalty Income (ERI)*	$38	$7,279	$10,466	$79,000	$1,704
Collaboration					
CRADAs, Total Active	212	6,090	1,072	575	0
New CRADAs	60	936	287	93	0
Traditional CRADAs, Total Active	212	3,768	1,072	476	0
Other Collaborative R&D Relationships	n.a.	2,322	0	99	1,967

*** Thousands**

2. Transition Process Characteristics for Technology Transfer and Commercialization Across Government Agencies

Table D-3 summarizes key characteristics of each of these agencies' transition processes. The table is extensively referenced for source data on the characteristics cited.

[2] Federal Laboratory Technology Transfer Fiscal Year 2019, Summary Report to the President and the Congress, National Institute of Standards and Technology, U.S. Department of Commerce, August 2022, https://www.nist.gov/system/files/documents/2022/09/29/FY2019%20Federal%20Technology%20Transfer%20Report.pdf

Table D-3. Transition Process Characteristics for Technology Transfer and Commercialization Across Government Agencies

Transition Process Characteristic	DHS	DoD	DoE	NASA	NIH
Effectiveness of technology transfer[3]	Not included in Reference	Low	Medium	Medium	High
Transition metrics used	Market impact, invention disclosures/ patents, and licenses https://www.dhs.gov/sites/default/files/publications/Science%20and%20Technology%20%28S%20and%20T%29%20-%20Metrics%20Used%20to%20Make%20DHS%20Center%20of%20Excellence%20Awards.pdf	Patents, licenses, and Navy Transition Review Board (review board does not function as a quantitative metric) https://apps.dtic.mil/sti/pdfs/ADA582099.pdf	Market impact, patents, and licenses https://www.energy.gov/technologytransitions/resources/data-collection-and-analysis	Patents and licenses https://technology.nasa.gov/analytics	Patents, licenses, and milestones related to FDA approval processes https://www.techtransfer.nih.gov/tt-metrics
Transition office/mission	Technology Transfer and Commercialization program: The Department of Homeland Security (DHS) Science and Technology Directorate's (S&T)	Technology Transition Initiative (TTI): move technology from a science and Technology (S&T) program into DoD acquisition programs https://apps.dtic.mil/d	Office of Technology Transitions (OTT): works to ensure groundbreaking scientific discoveries achieve their maximum public return and impact, advancing the	NASA's Technology Transfer Program: ensures that innovations developed for exploration and discovery are broadly available to the public, maximizing the benefit	Office of Technology Transfer (OTT): mission is to improve public health through the management of inventions made by NIH and FDA scientists and the development of

[3] Vanessa Peña, et al., Early Stage Research and Technology at U.S. Federal Government Agencies, IDA Science & Technology Policy Institute, IDA Document D-8481, April 2017, https://www.ida.org/-/media/feature/publications/e/ea/early-stage-research-and-technology-at-us-federal-government-agencies/d-8481.ashx

Transition Process Characteristic	DHS	DoD	DoE	NASA	NIH
	Technology Transfer and Commercialization Program (T2C) serves as the centralized point to manage technology transfer activities throughout DHS and the DHS laboratory network. https://www.dhs.gov/science-and-technology/technology-transfer-program Transition to Practice (TTP) Program https://www.dhs.gov/sites/default/files/publications/csd-ttp-technology-guide-vol1.pdf	escriptivesum/Y2013/OSD/stamped/0603942D8Z_3_PB_2013.pdf	economic, energy, and national security interests of the United States https://www.energy.gov/technologytransitions/office-technology-transitions	to the Nation https://technology.nasa.gov/	intellectual property policies for NIH's intramural and extramural research programs https://www.techtransfer.nih.gov/nih-and-its-role-technology-transfer
Use of SBIR/STTR	Yes	Yes	Yes	Yes	Yes
Is technology transfer tracked?	Under development	No- Most programs stop tracking a project once the program is no longer funding it (besides the Navy): The Navy uses a Transition	Yes	Yes	Yes- Tech Transfer Path

Transition Process Characteristic	DHS	DoD	DoE	NASA	NIH
		Review Board to monitor completed projects and determine/report whether transitioned projects are utilized in systems that support Navy warfighters			
Current transition processes - challenges	Technology transition "Valley of Death" - Only a small portion of research performed in federal laboratories reaches the marketplace where it can have an impact (known as the Valley of Death). This challenge is often a result of lack of partnerships between the government and the private sector, nonexistent funding and other resources to mature the technology, and inefficient processes for transitioning technology out of the	Most DoD programs do not have metrics established to track completed projects. Many programs track whether a technology is delivered to an acquisition program of record, but often have limited or no insight into whether the technology resulted in enhanced performance or new capabilities, cost savings, or reduced times for testing and evaluation and system integration. DoD does not use a gated process with criteria	Recent reports have highlighted barriers and inconsistencies in technology transfer at DOE, including a 2015 commission report that found barriers related to the costs of collaboration and low maturity level of many DOE technologies. Other barriers include gaps in funding, legal and administrative barriers, and lack of alignment between DOE research and industry needs. "Valley of Death" is only partly addressed with its Technology Commercialization	Sometimes poor collaboration between Technology Transfer Office and other offices https://oig.nasa.gov/docs/IG-19-016.pdf NASA uses both informal and formal activities as part of its technology transfer and partnership efforts (informal - those that contribute to the transfer of knowledge, cooperative research partnerships, and use of facilities and equipment for non-NASA projects, and	No common set of success measures is used across NIH today for technology development. https://www.ida.org/-/media/feature/publications/e/ea/early-stage-research-and-technology-at-us-federal-government-agencies/d-8481.ashx Many scientists lack a basic understanding of tech transfer, what it was and why it is important; scientists that were aware found

Transition Process Characteristic	DHS	DoD	DoE	NASA	NIH
	laboratory environment. Successfully transitioning technological research to operational use has been identified as a critical area in the Federal Cybersecurity R&D Strategic Plan (2016). https://www.nitrd.gov/cybersecurity/ https://www.dhs.gov/science-and-technology/TTP#:~:text=This%20problem%2C%20known%20as%20%E2%80%9Cthe,out%20of%20the%20laboratory%20environment.	that allows lab and program managers to know when a technology is ready to transition. https://www.govinfo.gov/content/pkg/GAOREPORTS-GAO-06-883/html/GAOREPORTS-GAO-06-883.htm DoD's process for spanning the "Valley of Death" via POR is called the "Acquisition System" for risk reduction	Fund In addition, DOE's Energy I-Corps program trains researchers to commercialize new technologies and to identify industry needs and potential customers. However, DOE has not yet assessed how many and which types of researchers would benefit from such training. https://www.gao.gov/assets/gao-21-202.pdf	publishing of scientific data with practical application; formal - includes the strategic and coordinated process of identifying innovations and designing methods of providing for their application outside of their original intended mission use.) For the past few years, NASA has focused on informal technology transfer methods. The formal processes can be strengthened. https://www.nasa.gov/pdf/709314main_NASA_PLAN_FINAL.pdf Need to increase awareness of technology transfer processes and make sure NASA personnel are fully aware of their responsibility to report inventions and plan for	the invention disclosure form (a PDF that scientists are supposed to use to initiate the process) to be confusing

Transition Process Characteristic	DHS	DoD	DoE	NASA	NIH
				technology transfer	
Current transition processes - successes	Since its inception in 2012, the TTP program has successfully transitioned more than a dozen federally funded cybersecurity technologies and helped create several cybersecurity startups https://www.dhs.gov/science-and-technology/TTP#:~:text=This%20problem%2C%20known%20as%20%E2%80%9Cthe,out%20of%20the%20laboratory%20environment.	Examples - Army: New Miniature Laser Resonator for Rangefinders/Target Designators Navy: Detection Kit for Improvised Explosive Devices Airforce: Communication Systems Interference Minimizer and Clarity Enhance https://federallabs.org/news/latest-dau-magazine-cover-story-highlights-dod-tech-transfer-successes	See OTT's latest success stories: https://www.energy.gov/technologytransitions/downloads/technology-spotlights-and-success-stories	As of 2012, more than 1,600 technology transfer successes have been documented in NASA's *Spinoff Magazine*, which include commercial applications in health and medicine, transportation, public safety, consumer goods, agriculture, environmental resources, computer technology, manufacturing, and energy conversion and use. https://www.nasa.gov/open/technology-transfer.html	See OTT successful technology transfers and discoveries: https://www.techtransfer.nih.gov/reportsstats/stories-discovery

DoD Sources:

- https://apps.dtic.mil/sti/pdfs/ADA582099.pdf
- https://apps.dtic.mil/descriptivesum/Y2013/OSD/stamped/0603942D8Z_3_PB_2013.pdf
- https://www.govinfo.gov/content/pkg/GAOREPORTS-GAO-06-883/html/GAOREPORTS-GAO-06-883.htm
- https://federallabs.org/news/latest-dau-magazine-cover-story-highlights-dod-tech-transfer-successes

DoE Sources:

- https://www.energy.gov/technologytransitions/resources/data-collection-and-analysis
- https://www.energy.gov/technologytransitions/office-technology-transitions
- https://www.gao.gov/assets/gao-21-202.pdf
- https://www.energy.gov/technologytransitions/downloads/technology-spotlights-and-success-stories

DHS Sources:

- https://www.dhs.gov/sites/default/files/publications/Science%20and%20Technology%20%28S%20and%20T%29%20-%20Metrics%20Used%20to%20Make%20DHS%20Center%20of%20Excellence%20Awards.pdf
- https://www.dhs.gov/science-and-technology/technology-transfer-program
- https://www.dhs.gov/sites/default/files/publications/csd-ttp-technology-guide-vol1.pdf
- https://www.nitrd.gov/cybersecurity/
- https://www.dhs.gov/science-and-technology/TTP#:~:text=This%20problem%2C%20known%20as%20%E2%80%9Cthe,out%20of%20the%20laboratory%20environment
- https://www.dhs.gov/science-and-technology/TTP#:~:text=This%20problem%2C%20known%20as%20%E2%80%9Cthe,out%20of%20the%20laboratory%20environment

NASA Sources:

- https://technology.nasa.gov/analytics
- https://technology.nasa.gov/
- https://oig.nasa.gov/docs/IG-19-016.pdf
- https://www.nasa.gov/pdf/709314main_NASA_PLAN_FINAL.pdf
- https://www.nasa.gov/open/technology-transfer.html

NIH Sources:

- https://www.techtransfer.nih.gov/tt-metrics
- https://www.techtransfer.nih.gov/nih-and-its-role-technology-transfer
- https://www.ida.org/-/media/feature/publications/e/ea/early-stage-research-and-technology-at-us-federal-government-agencies/d-8481.ashx
- https://www.techtransfer.nih.gov/reportsstats/stories-discovery

3. Transition-Related Goals in GPRAMA Reporting Across Government Agencies

USC/CREATE conducted a review of current and recent annual performance plans and/or reports for five U.S. Government agencies that receive funding for research and development (R&D) or technology transfer. The goal of this review was to identify transition-related performance goals in their required reporting under the Government Performance and Results Modernization Act of 2010 (GPRAMA). The top five federally funded agencies included,

- Department of Defense (DoD)
- National Institutes of Health (NIH)
- Department of Energy (DOE)
- National Aeronautics and Space Administration (NASA)
- National Science Foundation (NSF)

The five agencies reported a broad range of performance measures.

3.1. Department of Defense Annual Performance Plans/Reports

Overview

The Department of Defense (DoD) provides a consolidated annual performance report for all of its components, including the Departments of the Army, Navy, and Air Force, and 20 defense agencies, including DARPA. DoD Performance Plans, Reports, and Budgets dated between FY 2012 and FY 2021 can be found at https://dam.defense.gov/Publications/Annual-Performance-Plan-and-Performance-Report/. From that webpage:

> "The DCMO is responsible for the development of the Defense Department's Annual Performance Plan (APP) and Annual Performance Report (APR), pursuant to the Government Performance and Results Act (GPRA) of 1993 and the GPRA Modernization Act (GPRAMA) of 2010. The Plan and Report are both submitted as part of DoD's annual Congressional Justification/President's Budget request. The Annual Performance Plan identifies a limited number of DoD-wide performance goal priorities and implementing strategies for the current and budget year, plus five years of actual performance trend data that are aligned by the Department's strategic goals and objectives. The Annual Performance Report identifies a limited number of DoD-wide performance results for the prior year, plus four years of actual performance trend data that are aligned by the Department's strategic goals and objectives. The report also identifies management corrective actions for prior year performance results not met."

On PDF page 12 of its FY 2020 Annual Performance Plan/FY 2018 Annual Performance Report (https://dam.defense.gov/Portals/47/Documents/Publications/Annual%20Performance%20Plan/FY%202020%20Annual%20Perf%20Plan%20and%20FY%202018%20Annual%20Perf%20Report.pdf?ver=2019-03-28-155655-073), the DoD notes an organizational reform, notable for the purposes of this review due to its impact on DARPA, as described below:

> Congress directed the Department to make two important organizational reforms: In accordance with the FY 2018 NDAA, in early 2018 the Department executed its most significant restructure in 30 years dividing the Under Secretary of Defense (USD) for Acquisition, Technology and Logistics into the USD for Acquisition and Sustainment (A&S) and USD for Research and Engineering (R&E).

- The USD(A&S) is focused on increasing lethality and readiness while enhancing global relationships and security cooperation. One example is the reform of key pieces of the Foreign Military Sales process and accelerating sales through pilot programs with Romania, Japan, Saudi Arabia, and Bahrain.
- The USD(R&E) is concentrated on the Department's investments in key priority areas to restore battlefront dominance by 2028 with the goal to bolster and maintain U.S. technological superiority. In support of those priorities, USD(R&E) created a new modernization "Road to Dominance" that is pushing advancements, and increased investment, in nine priority technology areas to include hypersonic, artificial intelligence and cyberspace.

PDF page 22 of the aforementioned report shows the sub-structure of the USD R&E, which includes the Defense Advanced Research Projects Agency (DARPA):

Current Performance Goals and Strategic Goals and Objectives

The most recent DoD annual performance plan is the "FY 2021 Annual Performance Plan & FY Annual Performance Report" dated January 29, 2020: https://dam.defense.gov/Portals/47/Documents/Publications/Annual%20Performance%20Plan/FY%202021%20Annual%20Perf%20Plan%20&%20FY%202019%20Annual%20Perf%20Report.pdf.

In this report, Performance Goal 1.6.1 (report pages 50-51; PDF pages 82-83) addresses technological advancement and investment by the USD R&E. Note that under "Published Performance/Progress Reports" it states, "The majority of this information is sensitive and will not undergo public presentation":

SO 1.6: Ensure the U.S. technological advantage	
SO Leader: OUSD (R&E)	
PG 1.6.1: Foster U.S. military technical advantage by advancing development and aligning investments	**PG Leader:** OUSD (R&E)
Performance Goal Overview: The OUSD(R&E) aims to focus the Department's investments in key priority areas to restore battlefront dominance by 2028 with the goal to bolster and maintain U.S. technological superiority. It aligns with the three NDS lines of effort in increasing lethality, building alliances by working with allied nations in common research and development areas, and fostering reform through delivery of capability at the speed of relevance; through increasing use of prototyping, demonstration, experimentation, and red teaming. Key barriers and challenges include: the acceleration of global technology development; globalization of technical expertise that challenge DoD technical innovation and product delivery processes; and the convergence of capabilities between the military and commercial sectors where, for example, access to processes, intellectual property, and technology is an issue. NDAA FY 2017, Section 901, Established the Under Secretary of Defense for Research and Engineering, such that the Under Secretary would serve as the chief technology officer of the DoD with the mission of advancing technology and innovation for the joint force and the Department.	
Partners (Component Internal and External): Internal: The Department's Research and Engineering (R&E) community, which includes the military departments and their laboratories, Federally Funded Research and Development Centers (FFRDCs), University Affiliated Research Centers (UARCs), all other DoD laboratories and product centers, and the defense agencies, is focused on delivering new and innovative capabilities to the warfighter. The R&E community must work together to ensure that technology development is aligned with the Road to Dominance (RTD) strategies in hypersonics, directed energy, fully networked command, control, and communications, space, cyber, artificial intelligence and machine learning, microelectronics, quantum science, autonomy, biotechnology, and 5G. External: DoD scientists, engineers, and researchers at FFRDCs and UARCs engage and collaborate with U.S. and allied universities, our allied and partner government laboratories, small to large businesses, and non-traditional performers within the U.S. industrial base. The Department will encourage and rely on this community to support the technology development efforts.	

Major Management Priorities and Challenges: Once the RTD strategies are complete, the Department will work as a whole to see what investments can be made within the DoD Topline.

Major challenges would be a failure to act on those duties of the OUSD(R&E) within 10 USC 133a: (2)

Establishing policies on, and supervising, all defense research and engineering, technology development, technology transition, prototyping, experimentation, and developmental testing activities and programs, including the allocation of resources for defense research and engineering, and unifying defense research and engineering promotion and protection efforts across the Department.

Primary Governance Organizations: The OUSD(R&E) works regularly in collaboration with the Services, Agencies, and OSD components. Recurring forums, with previously identified subjects, would be the DMAG or DWR.

Published Performance / Progress Reports: The majority of this information is sensitive and will not undergo public presentation.

Performance Goal Contributing Programs: The DOD Components, particularly the Services, Agencies, and OSD must work together to maintain technological superiority.

Performance Measures		Q1 2020	Q2 2020	Q3 2020	Q4 2020	FY 2021	FY 2022	Prior Year Result
PM 1.6.1.1: Recruit a Director of Defense Research and Engineering for Modernization to serve as the Department's steward and advocate for advancing the Department's National Defense Strategy's modernization priorities	Target	X				N/A	N/A	N/A
PM 1.6.1.2: Deliver Department-Wide Road to Dominance Strategies to Deliver Game-Changing Effects for the Warfighter	Target				X	N/A	N/A	N/A
PM 1.6.1.3: Leverage strategic partnerships to ensure the Department's investments are appropriately focused on the modernization priorities and address issues during the FY 2022 Program and Budget Review, as needed, to address remaining investment gaps	Target				X	N/A	N/A	Met

Discontinued Performance Goals and Strategic Goals and Objectives

On PDF page 37 of its FY 2017 Annual Performance Report (https://dam.defense.gov/Portals/47/Documents/Publications/Annual%20Performance%20Plan/FY%202017%20DoD%20Annual%20Performance%20Report.pdf?ver=2018-02-12-095634-557), the DoD's Performance Goal 3.1.1 addressed transition programs, and included a target goal for FY 2017 (40%), as well as actual results from prior years (ranging from 72% to 82%):

Department of Defense — FY 2017 Annual Performance Report

STRATEGIC GOAL 3 Achieve Dominant Capabilities Through Innovation, Technical Excellence and Defense Institutional Reform						
SO 3.1: Incentivize Productivity and Innovation in Industry and Government.						
SO Leader: USD(AT&L), OSD						
PG 3.1.1: Maintain a strong technical foundation within the Department's Science and Technology (S&T) program by transitioning completed demonstration programs.		**PG Leader:** Assistant Secretary of Defense for Research and Engineering (R&E), OUSD (AT&L), OSD				
Performance Measure		**Q1 2017**	**Q2 2017**	**Q3 2017**	**Q4 2017**	**Prior Year Results**
3.1.1.1: Percent of completing demonstration programs transitioning each year.	Target	Measured Annually			40%	FY13: 77% FY14: 82% FY15: 82% FY16: 72% (Target: 40%)
	Actual				N/A	

However, beginning with FY 2020 Annual Performance Plan/FY 2018 Annual Performance Report (https://dam.defense.gov/Portals/47/Documents/Publications/Annual%20Performance%20Plan/FY%202020%20Annual%20Perf%20Plan%20and%20FY%202018%20Annual%20Perf%20Report.pdf?ver=2019-03-28-155655-073), Strategic Goal 3 became (PDF pg. 98):

STRATEGIC GOAL 3 Reform the Department's Business Practices for Greater Performance and Affordability	
SO 3.1: Improve and strengthen business operations through a move to DoD-enterprise or shared services; reduce administrative and regulatory burden	
SO Leaders: CMO	
PG 3.1.1: Create a long-lasting culture of innovation, empowerment and improvement to reduce the cost of doing business throughout the Department	**PG Leader:** CMO

Performance Goal Overview:

Business reform goes beyond efficiencies and reductions: it includes improving business processes, systems, or policies that increase effectiveness, efficiency, and reliability; improving innovation or processes for weapon system acquisition; and better alignment of resources to support the National Defense Strategy. Reforming business operations to improve the lethality of the Department is one of the three pillars of the National Defense Strategy: 1) Build a More Lethal Force; 2) Strengthen alliances and Attract New Partners; and 3) Reform the Department for Greater Performance and Affordability. Current defense enterprise business reform efforts in the Department are being led by the Office of the Chief Management Officer (OCMO).

The OCMO is charged with establishing policies for, and directing, all enterprise business operations of the Department, including planning and processes, business transformation, performance measurement and management, and business information technology management and improvement. The Transformation directorate is leading reform efforts to improve enterprise business operations across the Department, establishing a culture of continuous improvement focused on results and accountability. The Transformation directorate serves as the Executive Secretariat for the Reform Management Group (RMG) and maintains the rigor and oversight of reform initiatives and decisions impacting the Department's business operations.

The RMG is a deliberative body with the seniority and authority to make decisions affecting the business of the Department, directly supporting the Secretary of Defense's third line of effort. The RMG is comprised of representatives from the Offices of the Principal Staff Assistants, under the Secretary of Defense, and the Military Departments. This governance body guides the reform business processes of the Department and promotes responsible use of federal resources by allowing organizations to reallocate savings to increase lethality and improve readiness.

Performance Measure		Q1 201	Q2 2019	Q3 2019	Q4 2019	FY 2020	FY 2021	Prior Year Results
PM 3.1.1.1: Achieve DoD-wide reform savings to meet OMB annual reform savings targets with validation from Comptroller. Savings targets for FY 2019 – FY 2023 meet or exceed $46.6B. The $4.7B 2017/2018 achievements are in addition to the OMB target of $46.6B.	Target				FY 2019 $6B	FY 2020 $7B	FY 2021 $9B	FY 2017/2018: $4.7B

Review of Relevant Literature Regarding DARPA

It appears that DARPA (https://www.darpa.mil/) is not required to submit a strategic plan to Congress. These passages were found in a report by the Congressional Research Service dated August 19, 2021 (https://crsreports.congress.gov/product/pdf/R/R45088/15):

PDF pg. 12:

"In 2015, as part of the National Defense Authorization Act for Fiscal Year 2016 (P.L. 114-92), Congress repealed a provision requiring DARPA to prepare and submit a biennial strategic plan to Congress describing the agency's long-term strategic goals; the research programs developed in support of those goals; the agency's technology transition strategy; the policies governing the agency's management, organization, and personnel; and the connection between DARPA's activities and the missions of the military services."

PDF pg. 20:

"As noted by GAO and others, technology transfer is not a primary emphasis of DARPA. GAO has found that inconsistencies in the reporting and collection of technology transfer information by the agency make it difficult to reliably report on the overall success of DARPA's transition efforts. GAO first stated its concern regarding the lack of documentation for DARPA's technology transfer activities in 1974. More recently, GAO has concluded that DARPA leadership "foregoes opportunities to assess, and thus potentially improve, technology transition strategies" and that technology transition responsibilities fall to individual program managers that GAO believes are not sufficiently trained to achieve successful outcomes. Congress may examine the effectiveness of DARPA's Adaptive Execution Office which is responsible for reviewing and implementing the agency's technology transition strategies, including assisting individual program managers."

DARPA's accomplishments and plans for are detailed in the DoD's Budget Justification to Congress for the upcoming fiscal year. The reports related to DARPA can be found on a dedicated webpage: https://www.darpa.mil/about-us/budget. The most recent budget justification document is for FY 23 and is dated April 2022: https://www.darpa.mil/attachments/U_RDTE_MJB_DARPA_PB_2023_APR_2022_FINAL.pdf.

3.2. Analysis of the National Institutes of Health (NIH) Annual Performance Goals/Reports

Overview

The Department of Health and Human Services (HHS) provides a consolidated annual performance report for all pf its components, including the Centers for Disease Control and Prevention (CDC), Food and Drug Administration (FDA), and the National Institutes of Health (NIH)

Current Performance Goals and Strategic Goals and Objectives

In its FY 2023 Annual Performance Plan (https://www.hhs.gov/sites/default/files/fy2023-performance-plan.pdf), Strategic Goal 4 is to "Restore Trust and Accelerate Advancements in Science and Research for All" (PDF page 69). Objective 4.2 states that it will "Invest in the research enterprise and the scientific workforce to maintain leadership in the development of innovations that broaden our understanding of disease, healthcare, public health, and human services resulting in more effective interventions, treatments, and programs" (PDF page 72). However, none of its related performance measures are associated with transition:

By 2025, develop or evaluate the efficacy or effectiveness of new or adapted prevention interventions for substance use disorders (SUD). (Lead Agency - NIH; Measure ID - SRO-5.2)

Provide research training for predoctoral trainees and fellows that promotes greater retention and long-term success in research careers. (Lead Agency - NIH; Measure ID - CBRR-1.1)

Increase the total number of mentored research career development experiences for trainees from diverse backgrounds, including groups underrepresented in biomedical research, to promote individual development and to prepare them for a range of research-related careers. (Lead Agency - NIH; Measure ID - CBRR-25)

Maintain the yearly number of undergraduate students with mentored research experiences through the IDeA (Institutional Development Award) Networks of Biomedical Research Excellence (INBRE) program in order to sustain a pipeline of undergraduate students who will pursue health research careers. (Lead Agency - NIH; Measure ID - CBRR-26)

Percentage of scientists retained at FDA after completing Fellowship or Traineeship programs. (Lead Agency - FDA; Measure ID - 291101)

Conduct and disseminate policy relevant research reports on rural health issues. (Lead Agency - HRSA; Measure ID - 6010.01)

It does address a future NIH goal related to commercialization (PDF page 36):

By 2026, establish a formalized funding pathway for the development, validation, and regulatory review of diagnostic technologies to enhance surveillance and pandemic preparedness. (Lead Agency – NIH; Measure ID – SRO-5.19)

	FY 2016	FY 2017	FY 2018	FY 2019	FY 2020	FY 2021	FY 2022	FY 2023
Target	N/A	N/A	N/A	N/A	N/A	N/A	Receive FDA authorization for marketability for 3 home, point-of-care, or lab-based diagnostics.	Receive FDA authorization for marketability for 2 home, point-of-care, or lab-based diagnostics.
Result	N/A	N/A	N/A	N/A	N/A	N/A	Dec. 2022	Dec. 2023
Status	Not Collected	Not Collected	Not Collected	Not Collected	Not Collected	Not Collected	In progress	In progress

NIH is aiming to accelerate the innovation of new technologies using a design, build, test and deploy approach to improve future pandemic preparedness and surveillance. In response to the COVID-19 pandemic, NIH launched the Rapid Acceleration of Diagnostics (RADx®) initiative to speed up innovation in the development and deployment of COVID-19 testing approaches and strategies. RADx Tech, a component of RADx, focuses on speeding up the development, validation, and commercialization of innovative diagnostic tests, including home, point-of-care, and laboratory-based tests. NIH is building on the research mechanisms used and lessons learned through the RADx® Tech program to help guide and inform approaches and specific capabilities needed for surveillance and preparedness over the next five years and to move innovative and needed technologies to market. RADx Tech's success was achieved by facilitating partnerships across the federal government, industry, and academia and drawing on expertise from technology innovators, clinical testing, regulatory affairs, entrepreneurs, and business leaders. This approach resulted in many new home-based and point-of-care tests available for purchase under FDA's Emergency Use Authorization within eight months, an unprecedented speed. In FY 2022, NIH is working to receive FDA authorization for marketability for three home, point-of-care, or laboratory-based diagnostics. In FY 2023, NIH aims to receive this FDA authorization for two diagnostics.

3.3. Analysis of Department of Energy Annual Performance Plans/Reports

Overview

The Department of Energy (DOE) provides a consolidated annual performance report for all of its components, including the Office of Technology Transitions (https://www.energy.gov/technologytransitions/office-technology-transitions), the Advanced Research Projects Agency – Energy (ARPA-E) (https://arpa-e.energy.gov/), and the National Nuclear Security Administration (NNSA) (https://www.energy.gov/nnsa/national-nuclear-security-administration).

The DOE organization chart is available at https://www.energy.gov/organization-chart.

Current Performance Goals and Strategic Goals and Objectives

Annual Performance Reports for the DOE are listed on a dedicated webpage: https://www.energy.gov/cfo/listings/annual-performance-reports. Their most recent report is the FY 2018 Annual Performance Report/FY 2020 Annual Performance Plan, dated January 25, 2021:

https://www.energy.gov/sites/default/files/2021/01/f82/fy-2018-doe-annual-performance-report-fy-2020-annual-performance-plan.pdf.

Tables 1-5 below display the transition-related Performance Goals attributed to the NNSA's Office of Defense Nuclear Nonproliferation Research and Development program. Note that by FY 2017, all target goals are 80% or above.

Table 1. Early Proliferation Detection Goal for the NNSA Office of Defense Nuclear Nonproliferation Research and Development Program

Program	Defense Nuclear Nonproliferation Research and Development										
Performance Goal (Measure)	**Early Proliferation Detection** - Demonstrate advancements in material production and weaponization detection by achieving the baseline Technology Readiness Level (TRL) targets at project completion, as set in those projects' Life Cycle Plans.										
Fiscal Year	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024
Target	N/A	N/A	N/A	N/A	N/A	80 % of completed projects	80 % of completed projects	80 % of completed projects	80 % of completed projects	80 % of completed projects	80 % of completed projects
Result	N/A	N/A	N/A	N/A	N/A	TBD	TBD	TBD	TBD	TBD	TBD
Endpoint Target	Annually, achieve baseline TRL targets on 80% of completed projects.										
Commentary on 2018 Results (Action Plan if Not Met)											
Documentation, Limitations, Methodology, Validation, and Verification											

Table 2. Nuclear Detonation Detection Goal for the NNSA Office of Defense Nuclear Nonproliferation Research and Development Program

Program	Defense Nuclear Nonproliferation Research and Development										
Performance Goal (Measure)	**Nuclear Detonation Detection** - Annual index that summarizes the status of all NNSA nuclear detonation detection R&D deliveries that improve the nation's ability to detect nuclear detonations.										
Fiscal Year	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024
Target	90% index	90% index	90% index	90% index	90% index	90% index	90% index	90% index	90% index	90% index	90% index
Result	**Met** - 90	**Met** - 90	**Met** - 90	**Met** - 90	**Met** - 90	TBD	TBD	TBD	TBD	TBD	TBD
Endpoint Target	Annually achieve timely delivery of NNSA nuclear detonation detection products. (90% target reflects good on-time delivery. Index considers factors beyond NNSA's control and impact on customer schedules.)										
Commentary on 2018 Results (Action Plan if Not Met)	Achieved the FY 2018 delivery of nuclear detonation detection sensor payloads in accordance with current US Air Force published schedule for satellite production. Payload delivery for FY 2018 tracks with planned milestones; in particular, one Global Burst Detector (GBD) payload was delivered to the USAF in 1Q FY 2018. This result is important because it maintains the U.S. national capability to monitor the Earth for nuclear detonations.										
Documentation, Limitations, Methodology, Validation, and Verification	Quarterly reports; Consent-to-Ship memo documenting the readiness of each delivery to user agencies; final delivery and receipt is documented in a DD 1149 Shipping and Receiving Form.										

Table 3. Nuclear Security Goal for the NNSA Office of Defense Nuclear Nonproliferation Research and Development Program

Program	Defense Nuclear Nonproliferation Research and Development										
Performance Goal (Measure)	**Nuclear Security** - Demonstrate advancements in nuclear weapons and material security by achieving the baseline Technology Readiness Level (TRL) targets at project completion, as set in those projects' Life Cycle Plans.										
Fiscal Year	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024
Target	N/A	N/A	N/A	N/A	N/A	80% of completed projects	80% of completed projects	80% of completed projects	80% of completed projects	80% of completed projects	80% of completed projects
Result	N/A	N/A	N/A	N/A	N/A	TBD	TBD	TBD	TBD	TBD	TBD
Endpoint Target	Annually, achieve baseline TRL targets on 80% of completed projects.										
Commentary on 2018 Results (Action Plan if Not Met)											
Documentation, Limitations, Methodology, Validation, and Verification											

Table 4. Nuclear Weaponization and Material Production Detection Goal for the NNSA Office of Defense Nuclear Nonproliferation Research and Development Program

Program	Defense Nuclear Nonproliferation Research and Development										
Performance Goal (Measure)	**Nuclear Weaponization and Material Production Detection** - Cumulative percentage of progress toward demonstrating improvements in detection and characterization capabilities of nuclear weapons production activities.										
Fiscal Year	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**	**2023**	**2024**
Target	20% progress	50% of progress	70% of progress	90% of progress	100% of progress	N/A	N/A	N/A	N/A	N/A	N/A
Result	**Met** - 20	**Met** - 50	**Met** - 70	**Met** - 90	**Met** - 100	N/A	N/A	N/A	N/A	N/A	N/A
Endpoint Target	By the end of FY 2018, achieve 100% cumulative progress toward demonstrating new capabilities detecting uranium and plutonium production and nuclear weaponization processes.										
Commentary on 2018 Results (Action Plan if Not Met)	Achieved the cumulative target of 100% progress. This percentage correlates to meeting the targeted technology readiness level (TRL) goal as specified in the Nuclear Weapons and Material Security Roadmap's investment strategy for each of 18 separate requirements. This result is important because it advances U.S. technical capabilities in support of nuclear counter terrorism and incident response and to detect, characterize, and monitor the foreign development of nuclear weapons.										
Documentation, Limitations, Methodology, Validation, and Verification	Program Plan/Roadmap document; Annual report (unclassified)										

Table 5. Nuclear Weapons and Material Security Goal for the NNSA Office of Defense Nuclear Nonproliferation Research and Development Program

Program	Defense Nuclear Nonproliferation Research and Development										
Performance Goal (Measure)	**Nuclear Weapons and Material Security** - The cumulative percentage of progress towards demonstrating improvements in Special Nuclear Material detection, warhead monitoring, chain-of-custody monitoring, safeguards, and characterization capabilities.										
Fiscal Year	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**	**2023**	**2024**
Target	20% progress	50% progress	70% of progress	90% of progress	100% of progress	N/A	N/A	N/A	N/A	N/A	N/A
Result	**Met** - 20	**Met** - 50	**Met** - 70	**Met** - 90	**Met** - 100	N/A	N/A	N/A	N/A	N/A	N/A
Endpoint Target	By the end of FY 2018, achieve 100% cumulative progress toward demonstrating new capabilities for warhead monitoring, warhead chain-of-custody, Special Nuclear Material movement detection, and nuclear safeguards.										
Commentary on 2018 Results (Action Plan if Not Met)	Achieved the cumulative target of 100% progress. This percentage correlates to meeting the targeted TRL goals as specified in the Nuclear Material Production Detection Roadmap's investment strategy for each of 12 separate requirements. This result is important because it advances U.S. technical capabilities to detect, characterize, and monitor the foreign production of special nuclear materials.										
Documentation, Limitations, Methodology, Validation, and Verification	Program Plan/Roadmap document; Annual report (classified)										

While unable to locate any other performance goals in the FY 2018 Annual Performance Report related to technology transition or commercialization, the DOE did define a Strategic Goal related to commercialization for the Office of Science, the Office of Technology Transitions, and the NNSA, and it also identified Key Accomplishments from the Office of Technology Transitions related to its Strategic Objective 10: Enable Commercialization of National Laboratory Innovation:

- **Strategic Goal 2: Advance Science Discovery and National Laboratory Innovation (report page 2/PDF page 6)**

  DOE will advance American pre-eminence in scientific discovery through cutting-edge research, primacy in high-performance computing, and operation of world-class scientific facilities. The Department will take steps to improve access to its national laboratory portfolio of innovation and enable greater opportunities for commercialization of Lab-developed intellectual property.

  Contributing Programs: Science, Technology Transitions, National Nuclear Security Administration

- **Strategic Objective 10: Enable Commercialization of National Laboratory Innovation (report page 213/PDF page 217)**

  Key Accomplishments:

  Technology Transitions

- On October 31, 2017, DOE removed barriers for business to engage the National Labs through a flexible mechanism, known as Agreements for Commercializing Technology, and extended it to projects that receive federal funding.
- Launched the Lab Partnering Service (LPS) in July 2018. The LPS is a web tool for providing streamlined access to the expertise and intellectual property developed at the National Labs. It was developed in consultation with the investor and business communities.
- The Technology Commercialization Fund supported 54 projects across 12 National Laboratories involving more than 30 private-sector partners.
- An inventory of the Department's existing commercialization programs, initiatives, and activities led by the DOE Programs and Laboratories was assembled. The inventory, together with a recently completed survey of relevant statutory authorities as well as best practices, will inform future activities and policies.

Agency Priority Goals

The DOE identified a FY 2018-2019 Agency Priority Goal related to commercialization (report pages 4-5; PDF pages 8-9):

> Stand up a new public-private partnership pilot program at DOE for national laboratory innovation. DOE will:
>
> - By September 30, 2018, develop an inventory of the Department's existing commercialization programs and relevant statutory authorities, and document best practices, common challenges and resource requirements.
> - By September 30, 2019, design a pilot commercialization program template in conjunction with the National Laboratories

As of September 30, 2018, the DOE noted that it had:

- Completed an inventory of relevant statutes, resources, and best practices and annotated individual authorities.
- Launched the Lab Partnering Service

Discontinued Performance Goals and Strategic Goals and Objectives

In FY 2018, the Office of Energy Efficiency and Renewable Energy (EERE) discontinued a Performance Goal defined as "R&D Consortia - Number of Manufacturing Research and Development Consortia selected for negotiation to demonstrate advanced material and process technologies, leading to commercialization" due to a shift in focus towards early stage R&D (report page 224; PDF page 228). The FY 2017 target goal was 2, which was met.

Patents, Licenses and Royalties

While unable to locate any Performance Goals or metrics related to technology transition or commercialization patents, licenses, or royalties, the DOE does maintain separate websites that track patents:

- 2020 Patent and Patent Application Analysis for the US DOE Hydrogen and Fuel Cell Technologies Office: https://www.energy.gov/sites/default/files/2021-10/hfto-2020-patent-analysis.pdf
- DOE Office of Scientific and Technical Information (OSTI) Patent Search site: https://www.osti.gov/doepatents/

Other Literature Related to DOE Annual Performance Reports

In its 21-202 Report, "Department of Energy: Improved Performance Planning Could Strengthen Technology Transfer" (Feb. 2021, https://www.gao.gov/assets/gao-21-202.pdf), the GAO identified deficiencies in the Office of Technology Transition (OTT)'s performance plan. The following excerpt is found on report pages 27-28/PDF pages 31-32:

> OTT Does Not Have Objective and Measurable Performance Goals
>
> OTT's execution plan describes key activities for each strategic objective, but does not identify specific performance goals to understand agency progress. For example, DOE's strategic objective to define and elevate the department's technology transfer mission across the laboratories does not have objective and measurable performance goals associated with it. Ideally, agencies should define performance goals that are generally free of bias, do not require subjective judgments to dominate their measurement, and allow for assessment of progress towards agency objectives. Instead, the execution plan describes key activities under this objective, such as issuing a Secretarial Policy Statement on technology transfer, setting technology-transfer-related goals for national laboratories as part of DOE's annual laboratory planning process, and pursuing regular, ongoing engagement between DOE leadership and laboratory leadership and staff. While these activities may help achieve DOE's objective, they do not provide measurable performance goals that gauge the department's progress toward meeting this objective. For example, the key activities listed do not define measures that are potentially subjective, such as "regular, ongoing engagement," and they lack time frames for completion. Similarly, the execution plan does not identify a performance goal for DOE's objective of encouraging researchers to pursue technology transfer activities, such as a target goal for researcher participation. Instead, the execution plan describes key activities, including establishing an awards and recognition program and assessing laboratory conflict-of-interest policies that govern researchers' outside employment.

3.4. Analysis of National Aeronautics and Space Association (NASA) Annual Performance Goals/Reports

Overview

The National Aeronautics and Space Administration (NASA) provides links to its Budget Documents, Strategic Plans, and Performance Reports on a dedicated webpage: https://www.nasa.gov/news/budget/index.html. NASA's Small Business Innovation Research (SBIR), Small Business Technology Transfer (STTR), and I-Corps programs "encourage domestic small business to engage in Federal Research/Research and Development that has the potential for commercialization (https://sbir.nasa.gov/content/frequently-asked-questions).

Current Performance Goals and Strategic Goals and Objectives

NASA's most recent report, "FY2023 Volume of Integrated Performance," can be found at https://www.nasa.gov/sites/default/files/atoms/files/nasa_fy_2023_volume_of_integrated_performance.pdf. In it, the focus of Strategic Goal 3 is innovation.

- Strategic Goal 3: Catalyze economic growth and drive innovation to address national challenges
- Strategic Objective 3.1: Innovate and advance transformational space technologies

- Performance Goal 3.1.1: Foster a diverse U.S. engineering and technology talent base, expand commercial opportunities in the space industry, and advance technology solutions.
  PG 3.1.1 includes in its development milestones for FY 2022 & 23:
  - Achieve at least 1 knowledge transition for a minimum of 75% of research grants
  - Achieve 60 innovative Small Business Technologies that receive external funding to further advance technologies
  - Achieve 3,600 licenses and software usage agreements

3.1.1: Foster a diverse U.S engineering and technology talent base, expand commercial opportunities in the space industry, and advance innovative technology solutions.

NASA's **Space Technology Mission Directorate** nurtures innovative and high-risk/high-pay-off technologies and concepts, including early stage ideas, that could transform future NASA missions, as well as the aerospace industry.

Critical activities completed for Early Stage Innovation and Partnerships (ESIP) program supporting the Performance Goal.

Fiscal Year	2020	2021	2022	2023	2024	2025
Target	N/A	N/A	At least 4 completed			
Achieved	N/A	N/A				
Rating	N/A	N/A				

2015	2016	2017	2018	2019
Green	Green	Green	Green	Green

List of development milestones for FY 2022

1. Achieve at least 1 knowledge transition for a minimum of 75 percent of research grants.
2. Offer 45 new opportunities to broaden NASA's innovation community through prizes, challenges, and crowdsourcing.
3. Achieve 60 innovative Small Business Technologies that receive external funding to further advance technologies.
4. Achieve 3,600 licenses and software usage agreements.
5. Complete benchmarking of diversity, equity, and inclusion data for ESIP portfolio.

List of development milestones for FY 2023

1. Achieve at least 1 knowledge transition for a minimum of 75 percent of research grants.
2. Offer 45 new opportunities to broaden NASA's innovation community through prizes, challenges, and crowdsourcing.
3. Achieve 60 innovative Small Business Technologies that receive external funding to further advance technologies.
4. Achieve 3,600 licenses and software usage agreements.
5. Conduct 10 strategic engagement opportunities to underserved and underrepresented communities.

Source:
https://www.nasa.gov/sites/default/files/atoms/files/nasa_fy_2023_volume_of_integrated_performance.pdf, PDF page 84

- Performance Goal 3.1.2: Mature technology projects that offer significant improvement to existing solutions or enable new capabilities

  NASA has set a target of 60% for the percentage of key performance parameters (KPPs) completed for Technology Maturation projects. It surpassed its goal in FY 2020 (64%) but fell just short in FY 2021 (59%)

3.1.2: Mature technology projects that offer significant improvement to existing solutions or enable new capabilities.

Percentage of key performance parameters completed for Technology Maturation projects.

Fiscal Year	2020	2021	2022	2023	2024	2025
Target	60%	60%	60%	60%		
Achieved	64%	59%				
Rating	Green	Yellow				

2015	2016	2017	2018	2019
Green	Green	Green	Yellow	Green

This Performance Goal aligns to 3.1.2 under the 2018 Strategic Plan.

NASA's Game Changing Development program, part of the Space Technology Mission Directorate, guides innovative, high-impact technologies and capabilities from proof of concept through component or breadboard testing in a relevant environment.

MEDLI2 was one of the crucial technologies on the rover's protective aeroshell that helped document the entry, descent, and landing of the spacecraft. Its role in collecting critical data about the harsh environment during Perseverance's entry through the planet's atmosphere gave NASA a bird's eye view of what was happening to the aeroshell as it flew through the Martian skies. The data provided was essential to understanding how much margin remained on the Perseverance entry, along with data that will be used to improve prediction models and tools for future missions.

MEDA has continued to operate successfully, providing daily and seasonal reports on atmospheric pressure, humidity, ultraviolet radiation at the Martian surface, air temperature, and ground temperature around the rover. The data will support predictions for future science and exploration missions: dust lifting and transport; how storms evolve into large ones encircling Mars; how dust particles interact with light; and temperature, heat, and dust cycles.

FY 2021 Performance Progress

NASA missed achieving this performance goal target (i.e., 60 percent of planned key performance parameter (KPP) events) by a single percentage point. The KPPs' thresholds that NASA met or exceeded during FY 2021 each represent technology advancement that may lead to entirely new mission approaches and provide solutions to national needs. COVID-19 effects, along with project-specific technology development challenges, impacted NASA's ability to meet the desired performance thresholds for some KPPs.

NASA met KPPs in projects such as Autonomous Pop-Up Flat Folding Explorer Robot (A-PUFFER), Automated Reconfigurable Mission Adaptive Digital Assembly Systems (ARMADAS), and Rapid Analysis and Manufacturing Propulsion Technology (RAMPT). A-PUFFER demonstrated multiple small rovers that cooperated to explore an unmapped environment without a human in-the-loop. We successfully transitioned A-PUFFER to the Cooperative Autonomous Distributed Robotic Exploration (CADRE) lunar technology demonstration project, which will deliver a system of multi-agent autonomous robotic rovers for launch by a Commercial Lunar Payload Services (CLPS) provider in 2024.

Additionally, Mars Entry, Descent, and Landing Instrumentation (MEDLI) 2 and the Mars Environmental Dynamics Analyzer (MEDA), which launched on the 2020 Mars Perseverance rover, operated successfully in their respective demonstrations.

Source:
https://www.nasa.gov/sites/default/files/atoms/files/nasa_fy_2023_volume_of_integrated_performance.pdf, PDF page 86

Agency Priority Goals

One of the four new Agency Priority Goals for FY 2022-23 is applicable to SBIR/STTR (https://www.nasa.gov/sites/default/files/atoms/files/nasa_fy_2023_volume_of_integrated_performance.pdf, PDF page 10):

3.1.5: Ensure American global leadership in space technology innovations through increased partnering with industry and demonstrating key lunar surface and deep space technologies. *By September 30, 2023: NASA will demonstrate leadership in space technology by:*

- *Enhancing partnerships with industry through delivery or completion of milestones for at least 4 Tipping Point opportunities, and at least 3 critical small business technology transitions to develop capabilities that support NASA and commercial needs;*
- *Delivering at least 3 new technologies that will be demonstrated on the lunar surface or in lunar orbit; and*
- *Completing at least 2 major milestones for projects that increase the Nation's capabilities in deep space.*

Early Stage Innovation and Partnerships, Technology Demonstrations, Technology Maturation, and SBIR and STTR, Space Technology Mission Directorate (STMD)

- Agency Priority Goal 3.1.5: Ensure American Global leadership in space technology innovations through increased partnering with industry, broadening the base of innovation, and demonstrating key lunar surface and deep

3.1.5: Ensure American global leadership in space technology innovations through increased partnering with industry, broadening the base of innovation, and demonstrating key lunar surface and deep space technologies. (Agency Priority Goal)

Critical milestones achieved for two programs supporting the performance goal.

Fiscal Year	2020	2021	2022	2023	2024	2025
Target	N/A	N/A	4	4		
Achieved	N/A	N/A				
Rating	N/A	N/A				

Critical activities for FY 2022

1. Final assembly of the Cislunar Autonomous Positioning System Technology Operations and Navigation Experiment (CAPSTONE) spacecraft in preparation for pre-shipment testing.
2. Complete Solar Electric Propulsion (SEP) Critical Design Review (CDR).
3. Deliver the Polar Resources Ice Mining Experiment (PRIME)-1 to Intuitive Machines for integration with their Commercial Lunar Payload Services (CLPS) lander, in preparation for their mission.
4. Complete 3 early design milestones for Cryogenic Fluid Management (CFM) Tipping Point projects.

Critical activities for FY 2023

1. Transition 3 SBIR/STTR sequentials planned to be completed in CY 2022 to stakeholder programs for planned follow-on use/development and integration into future systems and demonstrations.
2. Deliver the LTE Proximity Communications Tipping Point with Nokia to Intuitive Machines for integration to their CLPS Lander.
3. Complete Environmental Testing for the Cooperative Autonomous Distributed Robotic Explorers (CADRE).
4. Initiate primary mission operations of the Deep Space Optical Communications (DSOC).

NASA's Space Technology Mission Directorate (STMD) offers prizes for meeting key technology challenges, while reaching out to non-traditional NASA partners. STMD also provides an opportunity for small businesses and research institutions to participate in government-sponsored research and development efforts in key technology areas.

Source: PDF page 91

Discontinued Performance Goals and Strategic Goals and Objectives

Performance Goal 3.1.4: PDF page 90

3.1.4 [Completed at the end of FY 2021]: Spur technology development through engagement with the commercial sector and the general public.

Critical milestones achieved for two programs supporting the performance goal.

Fiscal Year	2020	2021	2022	2023	2024	2025
Target	3	3				
Achieved	3	3				
Rating	Green	Green				

2015	2016	2017	2018	2019
Green	Green	Green	Green	Green

Critical milestones for FY 2021

1. Conduct 42 NASA challenges, prize competitions, and crowdsourcing activities.
2. Advance 45 Small Business Innovative Research/ Small Business Technology Transfer (SBIR/STTR) technologies beyond Phase II.
3. Manifest 16 payloads on commercial suborbital flights for testing.

NASA's Space Technology Mission Directorate (STMD) offers prizes for meeting key technology challenges, while reaching out to non-traditional NASA partners. STMD also provides an opportunity for small businesses and research institutions to participate in government-sponsored research and development efforts in key technology areas.

FY 2021 Performance Progress

NASA achieved the FY 2021 target for this Performance Goal by exceeding the targets for all three supporting critical activities.

NASA started 52 new Prize, Challenge, and Crowdsourcing (PCC) activities and continued 13 activities that started prior to FY 2021. Of the new challenges started, 28 were through the NASA@ WORK platform, which provides NASA employees an unconventional and inventive way to share knowledge and advance projects. Exciting public challenges that started in FY 2021 included the Break the Ice Lunar Challenge designed to help NASA excavate ice on the Moon; the Deep Space Food Challenge in partnership with the Canadian Space Agency to help bring innovative food production technologies to space and here on Earth; and the NASA TechRise Student Challenge in partnership with the Flight Opportunities Program.

NASA provided opportunities for small, highly innovative companies and research institutions through the SBIR/STTR program. We created 110 post-Phase II opportunities, compared to the targeted 45 opportunities, including 35 Phase II-E awards, six Civilian Commercialization Readiness Pilot Program opportunities, five Lunar Sequential Phase II awards, and 64 Phase III awards. Our investments continue to demonstrate examples of infusion into NASA missions and other applications. For example, the Roll-Out Solar Array (ROSA) was awarded several funding opportunities, including numerous SBIRs that allowed a small company to go from an innovative idea to designing successful ground and flight demonstrations on the International Space Station (ISS). Since then, ROSA has been deployed on the ISS to supplement the legacy arrays, will be the main power source for Power and Propulsion Element/Gateway, and has been infused into the Double Asteroid Redirection Test (DART) mission.

NASA also competitively selected 36 payloads from industry and academia for flight on commercial flight vehicles to achieve Agency priorities through its Flight Opportunities program, exceeding the target of 16. One example of these payloads was a that flew to suborbital space on Virgin Galactic's first fully crewed spaceflight.

3.5. Analysis of National Science Foundation (NSF) Annual Performance Plans/Reports

Overview

The Department of Energy (DOE) provides links to its Annual Performance and Agency Financial Reports on a dedicated webpage: https://www.nsf.gov/about/performance/annual.jsp. Their most recent Annual Performance Report (for FY 2021) can be found at: https://www.nsf.gov/about/budget/fy2023/pdf/92_fy2023.pdf. Their FY 2022-2023 Annual Performance Plan can be found at https://www.nsf.gov/about/budget/fy2023/pdf/fy2023budget.pdf (PDF pages 505-531) within their FY 2023 Budget Request to Congress.

Current Performance Goals and Strategic Goals and Objectives

The National Science Foundation has not included technology transition or commercialization as Strategic or Performance Goals in recent Performance Reports (FY 2017-2021). They also do not include metrics on patents, licenses or royalty income.

Table 1 below identifies NSF's Strategic Goals and Objectives between FY 2018 to FY 2022, Table 2 lists their planned Strategic Goals and Objectives for FY 2022-2026, and Table 3 displays its FY 2021 Performance Goals.

Table 1. NSF Strategic Goals and Objectives: FY 2018 to 2022

1. Expand knowledge in science, engineering, and learning.	**1.1 Knowledge:** Advance knowledge through investments in ideas, people, and infrastructure.
	1.2 Practice: Advance the practice of research.
2. Advance the capability of the Nation to meet current and future challenges.	**2.1 Societal Impacts:** Support research and promote partnerships to accelerate innovation and to provide new capabilities to meet pressing societal needs.
	2.2 STEM Workforce: Foster the growth of a more capable and diverse research workforce and advance the scientific and innovation skills of the Nation.
3. Enhance NSF's performance of its mission.	**3.1 Human Capital:** Attract, retain, and empower a talented and diverse workforce.
	3.2 Processes and Operations: Continually improve agency operations.

Source: NSF FY 2021 Annual Performance Report (PDF pg.2): https://www.nsf.gov/about/budget/fy2023/pdf/92_fy2023.pdf

Table 2. NSF FY 2022-2026 Strategic Framework, Strategic Goals, and Objectives

Strategic Goal	Strategic Objective
1. Empower: Empower STEM talent to fully participate in science and engineering	**1.1 Ensure accessibility and inclusivity –** Increase the involvement of communities underrepresented in STEM and enhance capacity throughout the nation.
	1.2 Unleash STEM talent for America – Grow a diverse STEM workforce to advance the progress of science and technology.
2. Discover: Create new knowledge about our universe, our world, and ourselves	**2.1 Advance the frontiers of research –** Accelerate discovery through strategic investments in ideas, people, and infrastructure
	2.2 Enhance research capacity – Advance the state of the art in research practice
3. Impact Benefit society by translating knowledge into solutions	**3.1 Deliver benefits from research –** Advance research and accelerate innovation that addresses societal challenges
	3.2 Lead globally – Cultivate a global science and engineering community based on shared values and strategic cooperation
4. Excel: Excel at NSF operations and management	**4.1 Strengthen at speed and scale –** Pursue innovative strategies to strengthen and expand the agency's capacity and capabilities
	4.2 Invest in people – Attract, empower, and retain a talented and diverse NSF workforce

Source: FY 2023 NSF Budget Request to Congress (PDF page 505):
https://www.nsf.gov/about/budget/fy2023/pdf/fy2023budget.pdf

Table 3. NSF FY 2021 Performance Goals

FY 2021 PERFORMANCE GOAL	RESULT
1. Agency Priority Goal: Developing an Agency-Wide Partnerships Strategy. (Partnerships)	Achieved
2. Ensure that key NSF-wide program investments are implemented and on track. (Key Program Investments)	Achieved
3. Ensure program integrity and responsible stewardship of major research facilities and infrastructure. (Infrastructure)	Partially Achieved
4. Divisions and Offices will make timely proposal decisions. (Dwell Time)	Not Achieved
5. Improve the quality of written reviews of NSF proposals. (Improve Review Quality)	Achieved
6. Foster a culture of inclusion through change management efforts resulting in change leadership and accountability. (Inclusion)	Achieved
7. Ensure that employee job requirements are aligned with competencies and skills needed for the future. (HR)	Achieved
8. Streamline and simplify user interactions with IT systems and functions that support the merit review process, reducing non-value-added steps and reducing the time spent managing the proposal and award lifecycle. (IT)	Partially Achieved

Source: NSF FY 2021 Annual Performance Report (PDF pg.3):
https://www.nsf.gov/about/budget/fy2023/pdf/92_fy2023.pdf

The NSF Innovation Corps (or I-Corps) program appears to be dedicated to technology transition and commercialization; in the NSF FY 2023 Budget Request to Congress, it defines the program as "connect[ing] NSF-funded science and engineering research with the technological, entrepreneurial, and business communities, fostering a national innovation ecosystem that links scientific discovery with technology development, societal needs, and economic opportunities. The goal of the I-Corps™ program, created by NSF in 2011, is to reduce the time and risk associated with translating promising ideas and technologies from the laboratory to the marketplace. The program is designed to support the commercialization of deep technologies, or those revolving around fundamental discoveries in science and engineering. The I-Corps™ program addresses the skill and knowledge gap associated with the transformation of fundamental research into deep technology ventures. Its curriculum consists of experiential learning for customer and industry discovery, coupled with first-hand investigation of industrial processes, allowing teams to quickly assess the translational potential of inventions" (https://www.nsf.gov/about/budget/fy2023/pdf/fy2023budget.pdf, PDF page 297).

However, the Strategic Objective assigned to I-Corps relates to data collected on the number and diversity of individuals trained in the program, not to the number of transitions or commercialized products (https://www.nsf.gov/about/budget/fy2023/pdf/fy2023budget.pdf, PDF pg. 522):

Strategic Objective 3.1 – Deliver benefits from research. Advance research and accelerate innovation that addresses societal challenges.

Contextual Indicator: Number and diversity of entrepreneurs participating in I-Corps™

Metric Definition: This metric tracks the number of unique individuals trained through NSF's Innovation Corps (I-Corps™) program, and the percentage of those trained who identified as being members of under-represented groups.[22]

Results/Historical Actuals

Indicator	Prior Year Results (Actuals) FY 2017-2018	FY 2019-2020
Total trained	1,628	1,928
Number (percentage) who identified as female	338 (21%)	411 (21%)
Number (percentage) who identified as a member of an underrepresented group	437 (27%)	568 (30%)

NSF I-Corps™ connects NSF-funded science and engineering research with the technological, entrepreneurial, and business communities, fostering a national innovation ecosystem that links scientific discovery with technology development, societal needs, and economic opportunities. Through I-Corps training, academic researchers can reduce the time needed to translate a promising idea from the laboratory to the marketplace or other relevant societal setting.

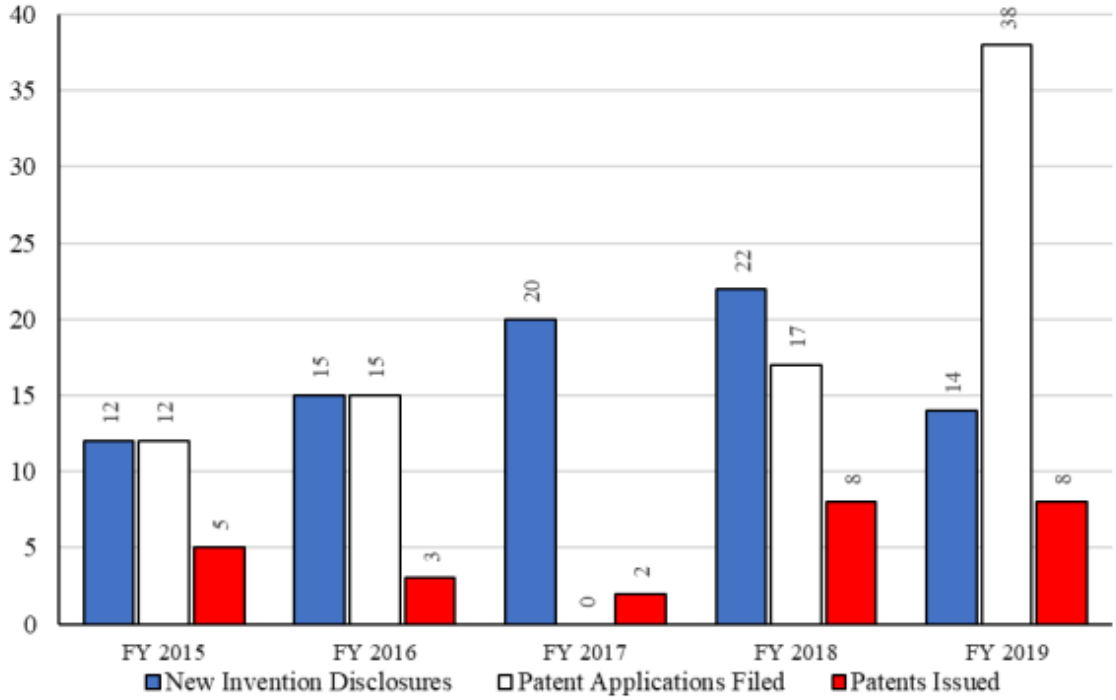
Rationale for Contextual Indicator: The I-Corps program is migrating to a new operational model based on expanded consortia, known as "Hubs," to develop and nurture a National Innovation Network. This new model will help NSF continue to expand the ability to teach researchers customer discovery skills and facilitate technology applications for solutions that benefit the Nation. NSF awarded the first round of I-Corps Hubs awards in FY 2020, and we anticipate that following conclusion of those first awards, more data will be available to inform meaningful targets for participation.

Appendix D-1. Source Data for Indicators of Success (IoS) for Technology Transfer Aspects of Transition Across Government Agencies

D-1.1. Department of Homeland Security (DHS) Technology Transfer Reporting for FY 2015-2019: Inventions, Patents, Licensing, CRADAs

DHS Invention Disclosures and Patenting

In FY 2019, DHS reported 14 new inventions disclosures. From FY 2015 to FY 2019, DHS reported a 217% increase in patent applications filed, with 12 in FY 2015 and 38 in FY 2019. Patents issued increased by 60%, with 5 in FY 2015 and 8 in FY 2019.



	FY 2015	FY 2016	FY 2017	FY 2018	FY 2019
New Invention Disclosures	12	15	20	22	14
Patent Applications Filed	12	15	0	17	38
Patents Issued	5	3	2	8	8

Figure 26: DHS Invention Disclosures and Patenting (FY 2015-2019)*

Patents issued to DHS in FY 2019 covered multiple technology areas, including Measurement (25%), Control (14%), Biotechnology (17%), Pharmaceuticals (17%), Audio-visual Technology (12%), and Analysis of Biological Materials (5%).[4]

[4] Source: Prepared by Science-Metrix using USPTO data indexed in PatentsView in January 2022. Used with permission.

*Figure numbering is per the original reference report, Federal Laboratory Technology Transfer Fiscal Year 2019, Summary Report to the President and the Congress, National Institute of Standards and Technology, U.S. Department of Commerce, August 2022,

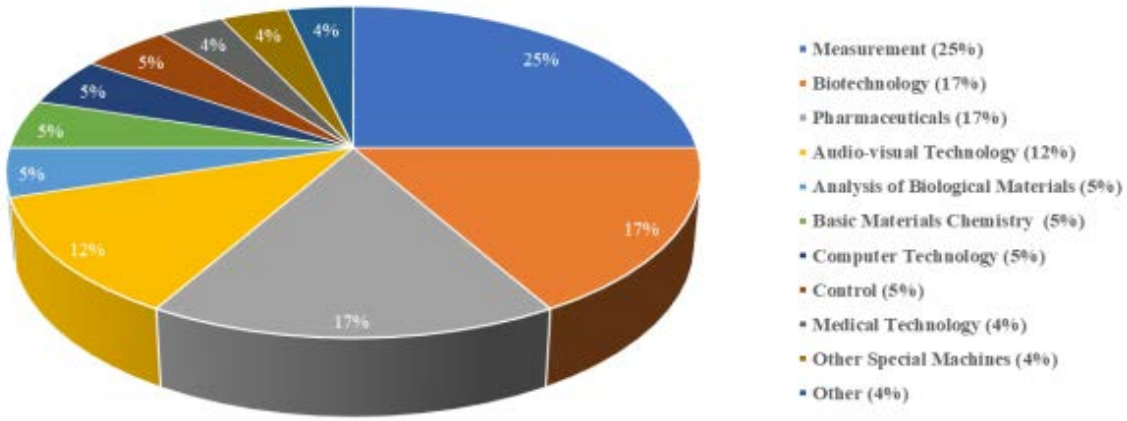
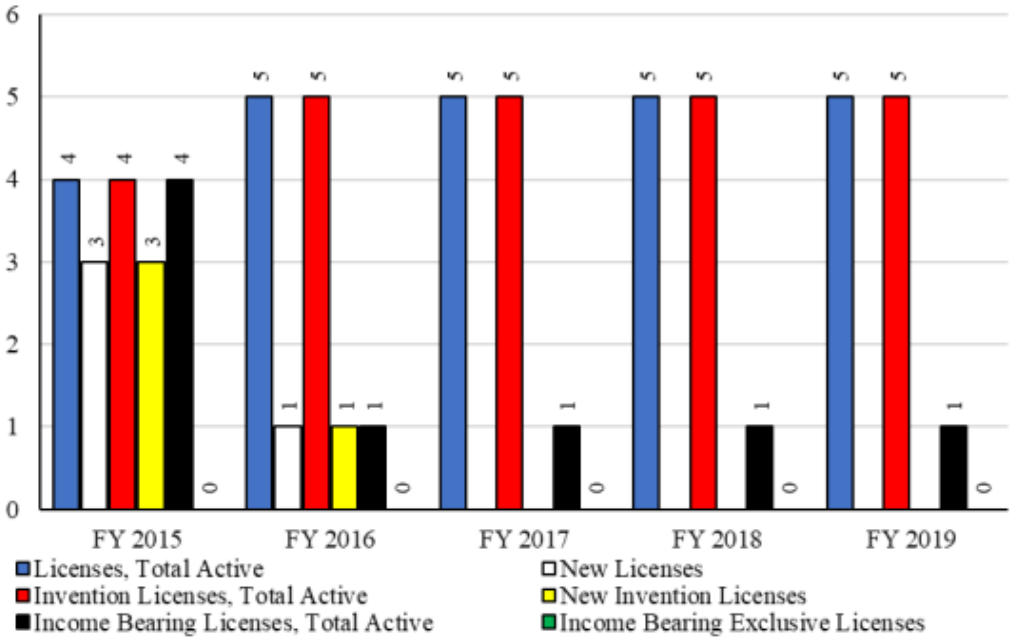


Figure 27: USPTO Patents Assigned to DHS by Technology Area (FY 2019)

DHS Licenses

In FY 2019, DHS managed five active license agreements. Out of the five active agreements, two were income bearing.

https://www.nist.gov/system/files/documents/2022/09/29/FY2019%20Federal%20Technology%20Transfer%20Report.pdf

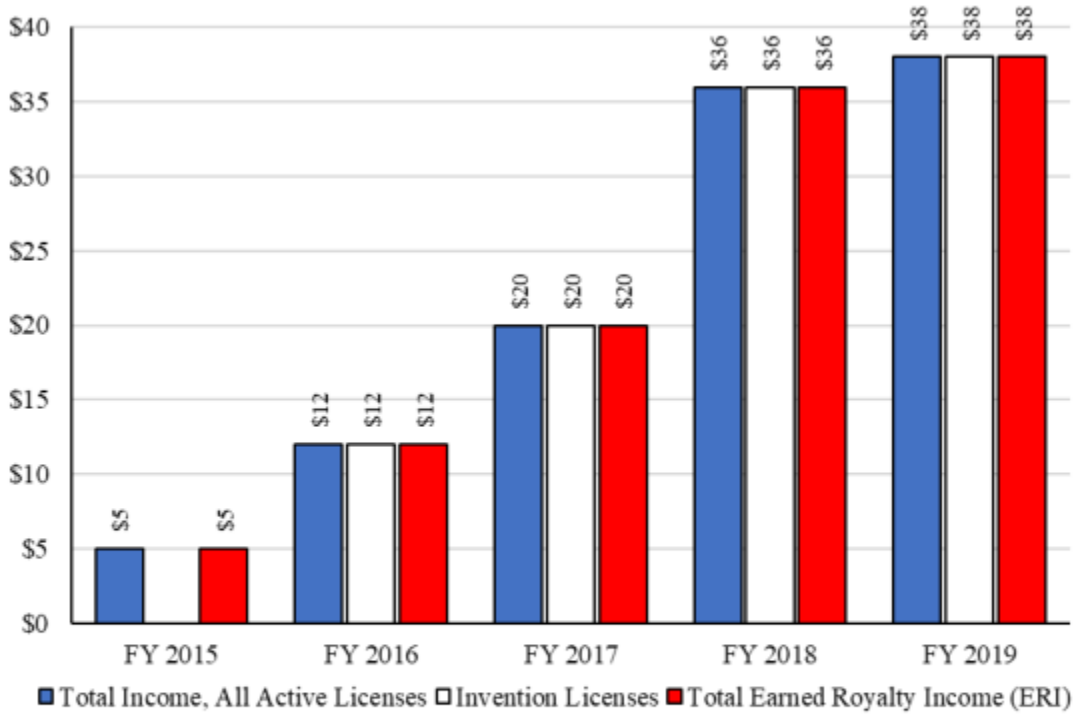


	FY 2015	FY 2016	FY 2017	FY 2018	FY 2019
Licenses, Total Active	4	5	5	5	5
New Licenses	3	1	0	0	0
Invention Licenses, Total Active	4	5	5	5	5
New Invention Licenses	3	1	0	0	0
Income Bearing Licenses, Total Active	4	1	1	1	1
Income Bearing Exclusive Licenses	0	0	0	0	0

Figure 28: DHS Licenses (FY 2015-2019)

DHS Income from Licensing

From FY 2015 to FY 2019, DHS reported a 660% increase in Total Earned Royalty Income, from $5,000 in FY 2015 to $38,000 in FY 2019.



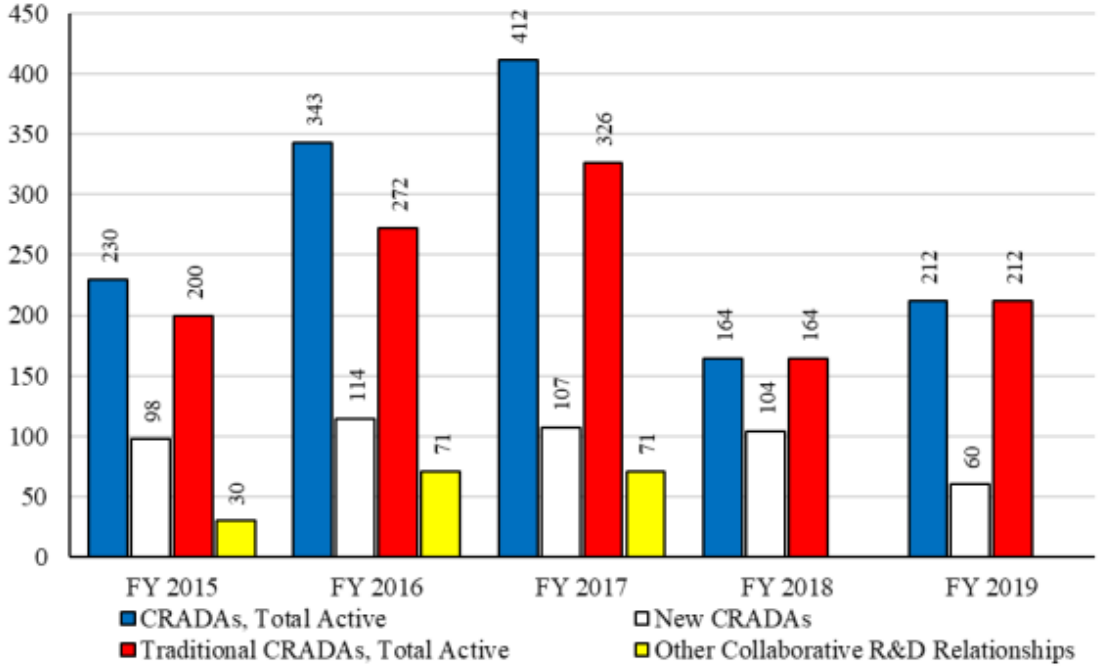
	FY 2015	FY 2016	FY 2017	FY 2018	FY 2019
Total Income, All Active Licenses	$5	$12	$20	$36	$38
Invention Licenses	$0	$12	$20	$36	$38
Total Earned Royalty Income, (ERI)	$5	$12	$20	$36	$38

Figure 29: DHS Income from Licensing ($000s) (FY 2015-2019)

DHS Collaborative R&D Relationships[5]

Total active CRADAs decreased by 8%, from 230 in FY 2015 to 212 in FY 2019. New CRADAs decreased by 39%, from 98 in FY 2015 to 60 in FY 2019. Traditional CRADAs increased by 6%, from 200 in FY 2015 to 212 in FY 2019.

[5] DHS was unable to report values for other collaborative R&D relationships for FY 2018 and FY 2019.



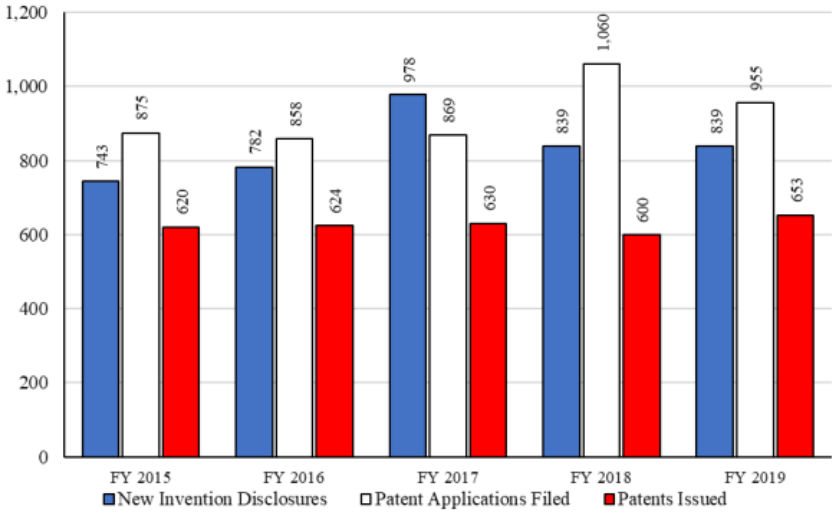
	FY 2015	FY 2016	FY 2017	FY 2018	FY 2019
CRADAs, Total Active	230	343	412	164	212
New CRADAs	98	114	107	104	60
Traditional CRADAs, Total Active	200	272	326	164	212
Other Collaborative R&D Relationships	30	71	71	n.a.	n.a.

Figure 30: DHS Collaborative R&D Relationships (FY 2015-2019)

D-1.2. Department of Defense (DoD) Technology Transfer Reporting for FY 2015-2019: Inventions, Patents, Licensing, CRADAs

DoD Invention Disclosures and Patenting

Between FY 2015 and FY 2019, new inventions disclosed increased by 13%, from 743 disclosures in FY 2015 to 839 disclosures in FY 2019. Patent applications filed increased by 9%, from 875 in FY 2015 to 955 in FY 2019. Patents issued increased by 5%, from 620 patents in FY 2015 to 653 patents in FY 2019.



	FY 2015	FY 2016	FY 2017	FY 2018	FY 2019
New Invention Disclosures	743	782	978	839	839
Patent Applications Filed	875	858	869	1,060	955
Patents Issued	620	624	630	600	653

Figure 11: DoD Invention Disclosures and Patenting (FY 2015-2019)

Patents issued to DoD in FY 2019 covered many technology areas, including the top categories of Measurement (13%), Other Special Machines (11%), Computer Technology (9%), Telecommunications (8%), and Electrical Machinery, Apparatus, Energy (6%). (Source: Prepared by Science-Metrix using USPTO data indexed in PatentsView in January 2022. Used with permission.)

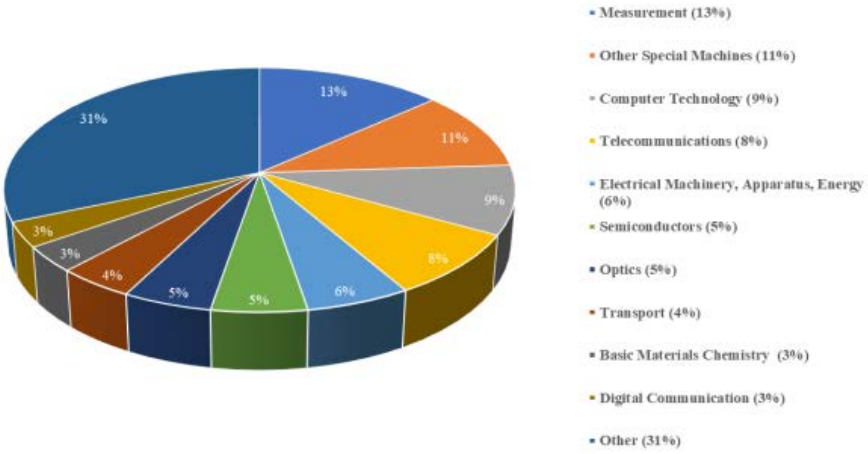
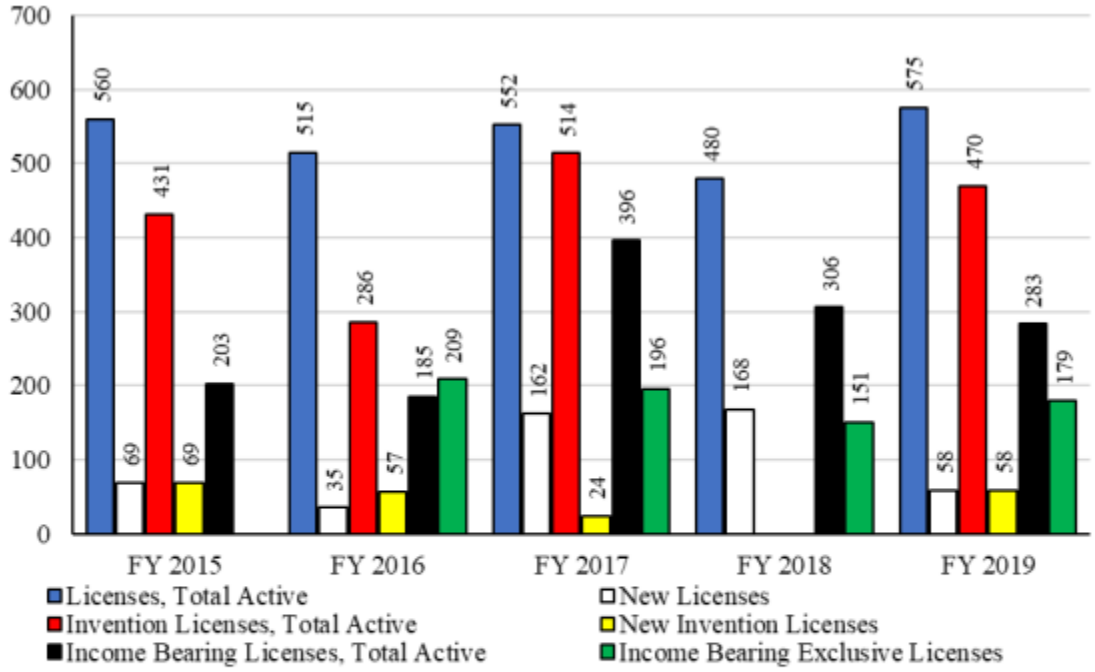


Figure 12: USPTO Patents Assigned to DoD by Technology Area (FY 2019)

DoD Licenses[6]

Total active licenses increased by 3%, from 560 licenses in FY 2015 to 575 licenses in FY 2019, while new licenses decreased by 16%, from 69 in FY 2015 to 58 in FY 2019. From FY 2015 to FY 2019, total active invention licenses increased by 9% to 470, and new invention licenses decreased by 16% to 58. From FY 2015 to FY 2019, total active income-bearing licenses increased by 39% to 179.

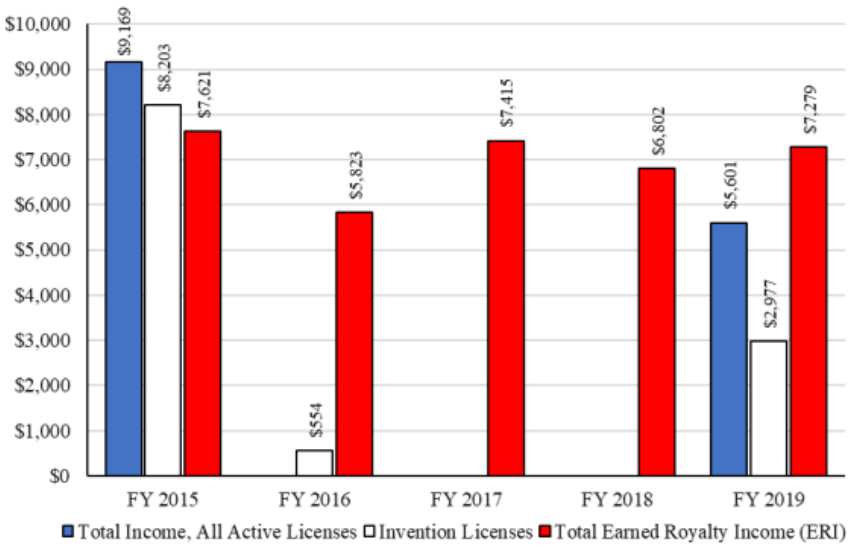


	FY 2015	FY 2016	FY 2017	FY 2018	FY 2019
Licenses, Total Active	560	515	552	480	575
New Licenses	69	35	162	168	58
Invention Licenses, Total Active	431	286	514	n.a.	470
New Invention Licenses	69	57	24	n.a.	58
Income Bearing Licenses, Total Active	203	185	396	306	283
Income Bearing Exclusive Licenses	n.a.	209	196	151	179

DoD Income from Licensing[7]

From FY 2015 to FY 2019, total earned royalty income decreased by 39% to $5.6 million. Income from Invention Licenses decreased by 64%, from $8.2 million in FY 2015 to $3.0 million in FY 2019. Total Earned Royalty Income decreased by 4%, from $7.6 million in FY 2015 to $7.3 million in FY 2019.

[6] DoD was unable to report data for Income Bearing Exclusive Licenses for FY 2015, Invention Licenses, Total Active for FY 2018, and for New Invention Licenses for FY 2018.
[7] DoD was unable to report data for Total Income, All Active Licenses for FY 2016 through FY 2018 or Invention License Income for FY 2017 and FY 2018.

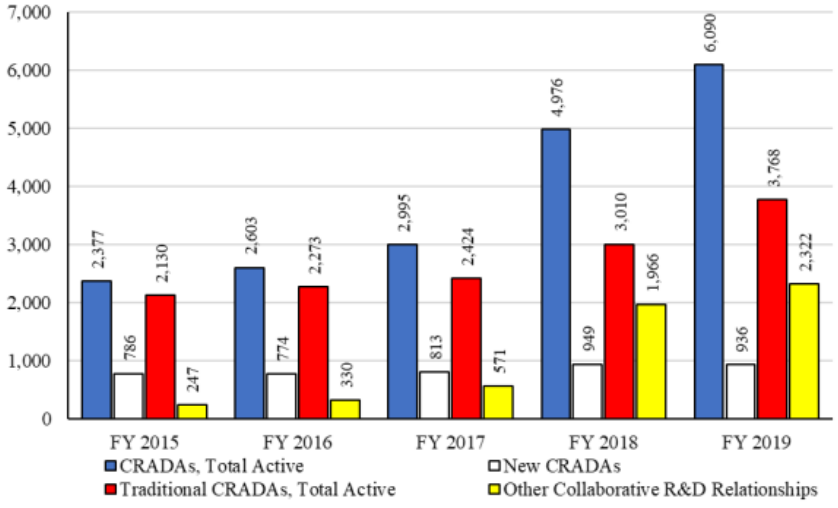


	FY 2015	FY 2016	FY 2017	FY 2018	FY 2019
Total Income, All Active Licenses	$9,169	n.a.	n.a.	n.a.	$5,601
Invention Licenses	$8,203	$554	n.a.	n.a.	$2,977
Total Earned Royalty Income, (ERI)	$7,621	$5,823	$7,415	$6,802	$7,279

Figure 14: DoD Income from Licensing ($000s) (FY 2015-2019)

DoD Collaborative R&D Relationships

Between FY 2015 and FY 2019, total active CRADAs increased by 156%, from 2,377 in FY 2015 to 6,090 in FY 2019, while new CRADAs increased by 19%, from 786 in FY 2015 to 939 in FY 2019. Traditional CRADAs increased by 77%, from 2,130 in FY 2015 to 3,768 in FY 2019. Other collaborative relationships increased by 840%, from 247 in FY 2015 to 2,322 in FY 2019.



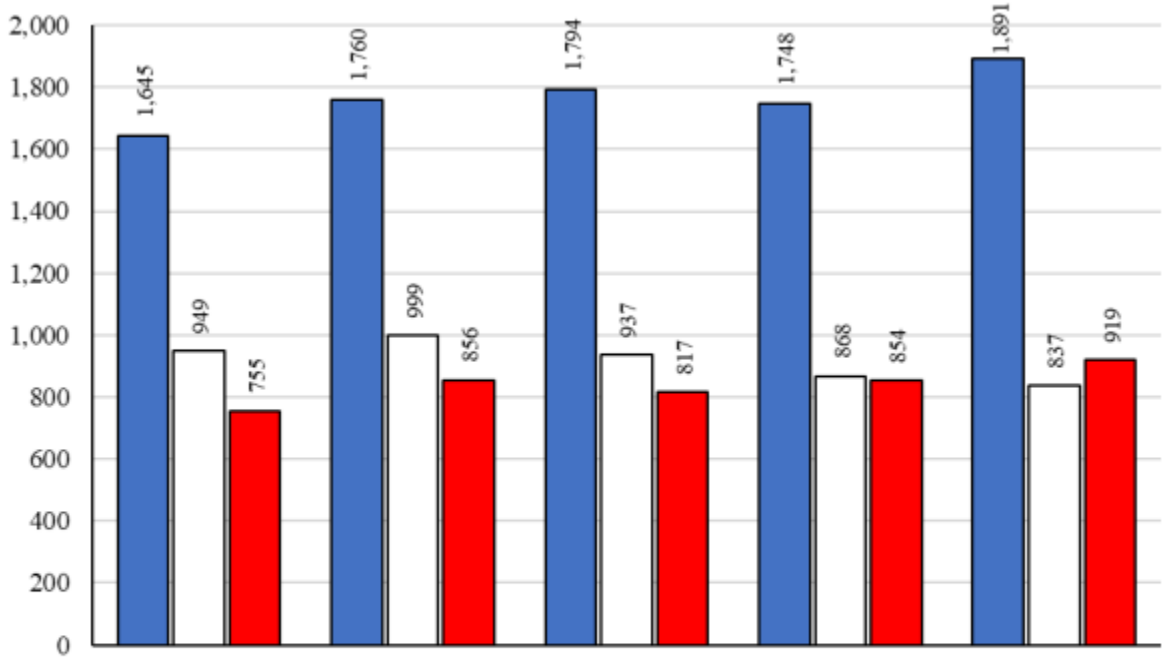
	FY 2015	FY 2016	FY 2017	FY 2018	FY 2019
CRADAs, Total Active	2,377	2,603	2,995	4,976	6,090
New CRADAs	786	774	813	949	936
Traditional CRADAs, Total Active	2,130	2,273	2,424	3,010	3,768
Other Collaborative R&D Relationships	247	330	571	1,966	2,322

Figure 15: DoD Collaborative R&D Relationships (FY 2015-2019)

D-1.3. Department of Energy (DOE) Technology Transfer Reporting for FY 2015-2019: Inventions, Patents, Licensing, CRADAs

DOE Invention Disclosures and Patenting

Between FY 2015 and FY 2019, new inventions disclosed increased by 15%, from 1,645 in FY 2015 to 1,891 disclosures in FY 2019. Patent applications filed declined by 12%, from 949 in FY 2015 to 837 in FY 2019, while patents issued increased by 22%, from 755 in FY 2015 to 919 patents in FY 2019.



	FY 2015	FY 2016	FY 2017	FY 2018	FY 2019
New Invention Disclosures	1,645	1,760	1,794	1,748	1,891
Patent Applications Filed	949	999	937	868	837
Patents Issued	755	856	817	854	919

Figure 16: DOE Invention Disclosures and Patenting (FY 2015-2019)

Patents issued to DOE in FY 2019 covered many technology areas, including Electrical Machinery, Apparatus, Energy (13%), Measurement (12%), Chemical Engineering (6%), Materials, Metallurgy (6%), and Computer Technology (6%).[8]

[8] Source: Prepared by Science-Metrix using USPTO data indexed in PatentsView in January 2022. Used with permission.

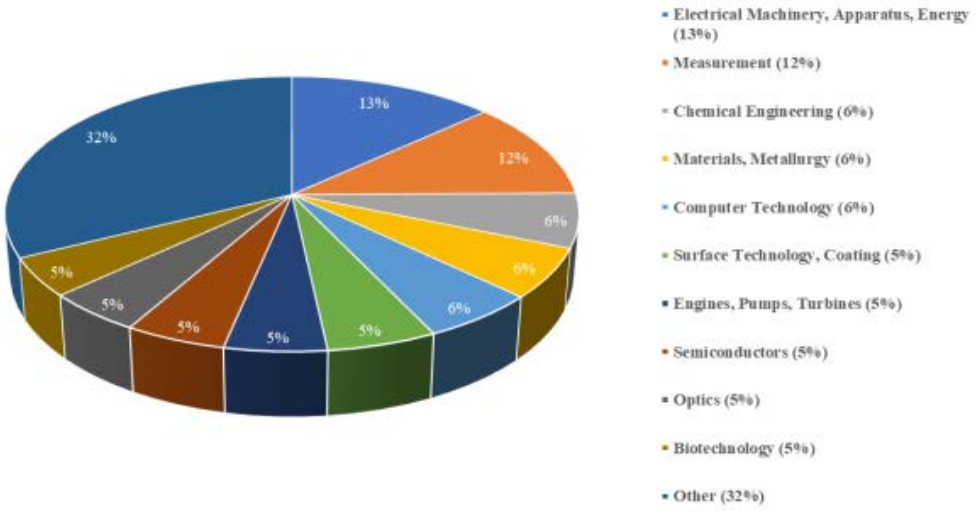
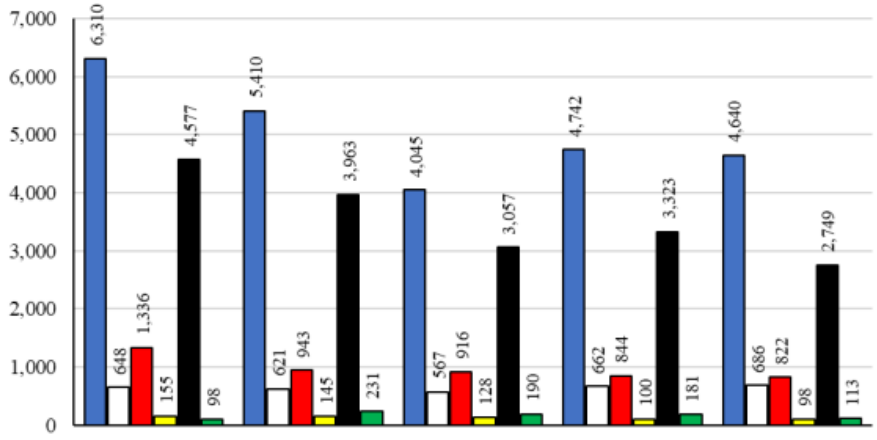


Figure 17: USPTO Patents Assigned to DOE by Technology Area (FY 2019)

DOE Licenses

Between FY 2015 and FY 2019, total active licenses decreased by 26%, from 6,310 in FY 2015 to 4,640 in FY 2019. New licenses increased by 6%, from 648 in FY 2015 to 686 in FY 2019. Invention licenses decreased by 38%, from 1,336 in FY 2015 to 822 in FY 2019. New invention licenses decreased by 37%, from 155 in FY 2015 to 98 in FY 2019. Income-bearing licenses decreased by 40%, from 4,577 in FY 2015 to 2,749 in FY 2019, and income-bearing exclusive licenses increased by 15%, from 98 in FY 2015 to 113 in FY 2019.

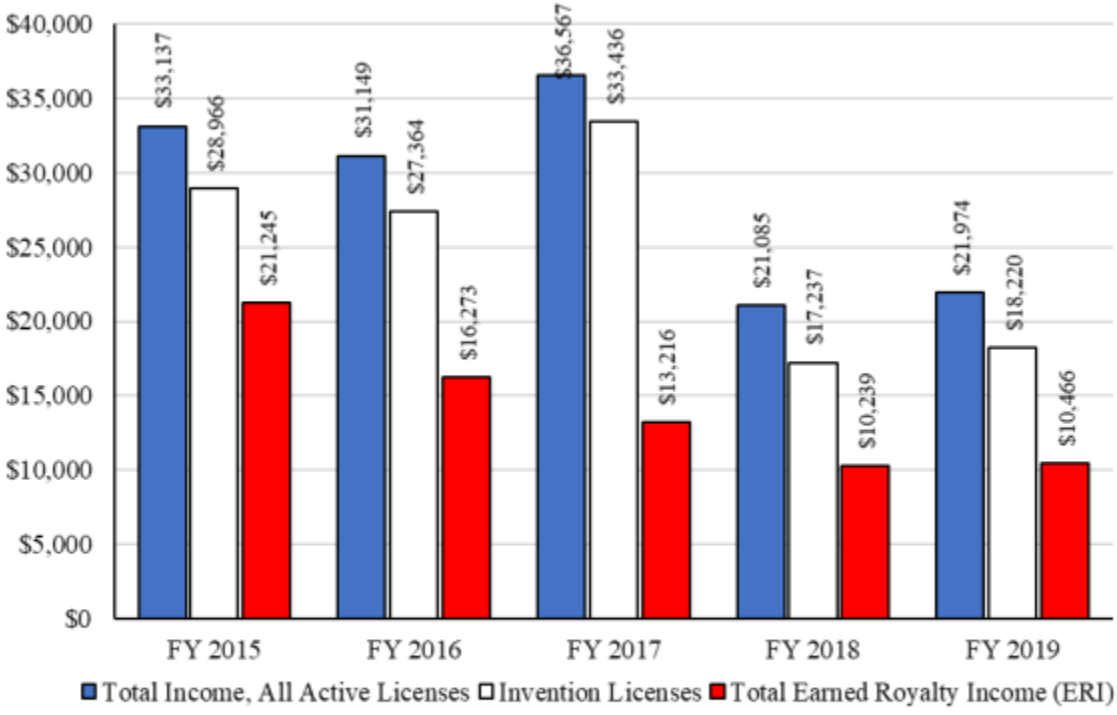


	FY 2015	FY 2016	FY 2017	FY 2018	FY 2019
Licenses, Total Active	6,310	5,410	4,045	4,742	4,640
New Licenses	648	621	567	662	686
Invention Licenses, Total Active	1,336	943	916	844	822
New Invention Licenses	155	145	128	100	98
Income Bearing Licenses, Total Active	4,577	3,963	3,057	3,323	2,749
Income Bearing Exclusive Licenses	98	231	190	181	113

Figure 18: DOE Licenses (FY 2015-2019)

DOE Income from Licensing

Between FY 2015 and FY 2019, DOE reported that total income from all active licenses decreased by 34%, from $33.1 million in FY 2015 to $22.0 million in FY 2019. Income from invention licenses decreased by 37%, from $29.0 million in FY 2015 to $18.2 million in FY 2019. Total earned royalty income decreased 51%, from $21.2 million in FY 2015 to $10.5 million in FY 2019.

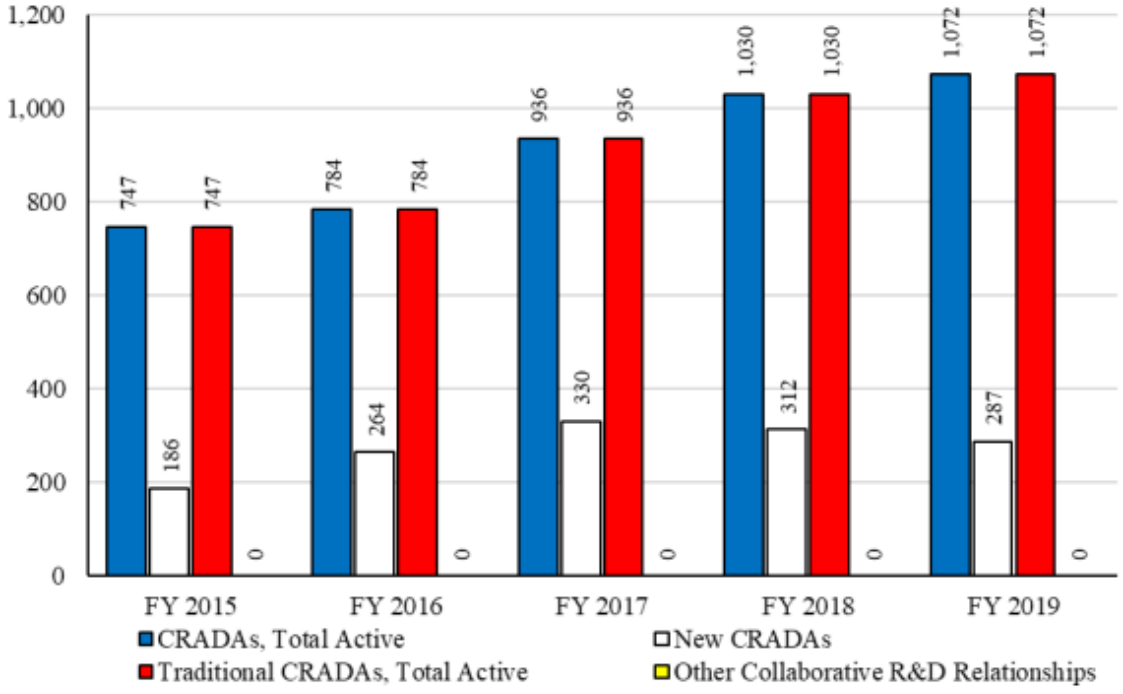


	FY 2015	FY 2016	FY 2017	FY 2018	FY 2019
Total Income, All Active Licenses	$33,137	$31,149	$36,567	$21,085	$21,974
Invention Licenses	$28,966	$27,364	$33,436	$17,237	$18,220
Total Earned Royalty Income, (ERI)	$21,245	$16,273	$13,216	$10,239	$10,466

Figure 19: DOE Income from Licenses ($000s) (FY 2015-2019)

DOE Collaborative R&D Relationships

Between FY 2015 and FY 2019, total active CRADAs increased by 43%, from 747 in FY 2015 to 1,072 in FY 2019. New CRADAs increased by 54%, from 186 in FY 2015 to 287 in FY 2019. Traditional CRADAs increased by 43%, from 747 in FY 2015 to 1,072 in FY 2019.



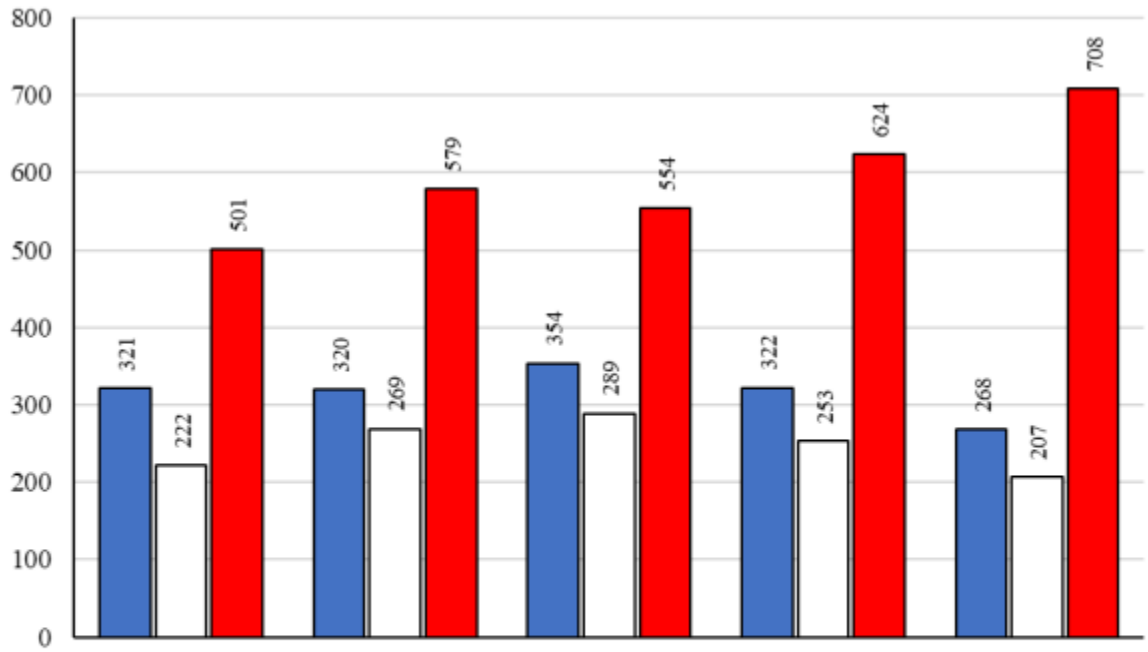
	FY 2015	FY 2016	FY 2017	FY 2018	FY 2019
CRADAs, Total Active	747	784	936	1,030	1,072
New CRADAs	186	264	330	312	287
Traditional CRADAs, Total Active	747	784	936	1,030	1,072
Other Collaborative R&D Relationships	0	0	0	0	0

Figure 20: DOE Collaborative R&D Relationships (FY 2015-2019)

D-1.4. Department of Health and Human Services (HHS) Technology Transfer Reporting for FY 2015-2019: Inventions, Patents, Licensing, CRADAs

HHS Invention Disclosures and Patenting

Between FY 2015 and FY 2019, new invention disclosures decreased by 17%, from 321 in FY 2015 to 268 disclosures in FY 2019. Patent applications filed decreased by 7%, from 222 in FY 2015 to 207 in FY 2019, while patents issued increased by 41%, from 501 in FY 2015 to 708 patents in FY 2019.



	FY 2015	FY 2016	FY 2017	FY 2018	FY 2019
New Invention Disclosures	321	320	354	322	268
Patent Applications Filed	222	269	289	253	207
Patents Issued	501	579	554	624	708

Figure 21: HHS Invention Disclosures and Patenting (FY 2015-2019)

Patents issued to HHS in FY 2019 covered many technology areas, including Pharmaceuticals (41%), Biotechnology (28%), Organic Fine Chemistry (8%), Analysis of Biological Materials (7%), and Measurement (4%).[9]

[9] Source: Prepared by Science-Metrix using USPTO data indexed in PatentsView in January 2022. Used with permission.

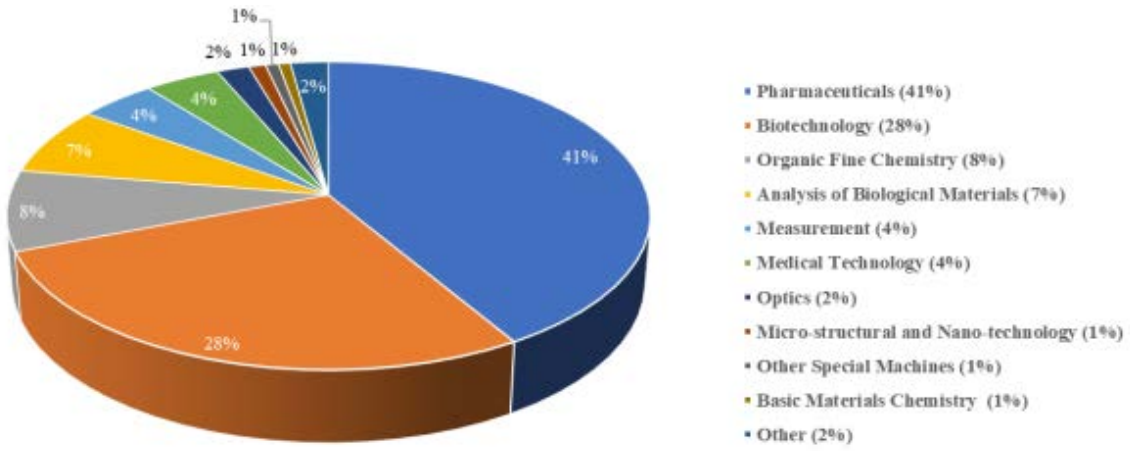
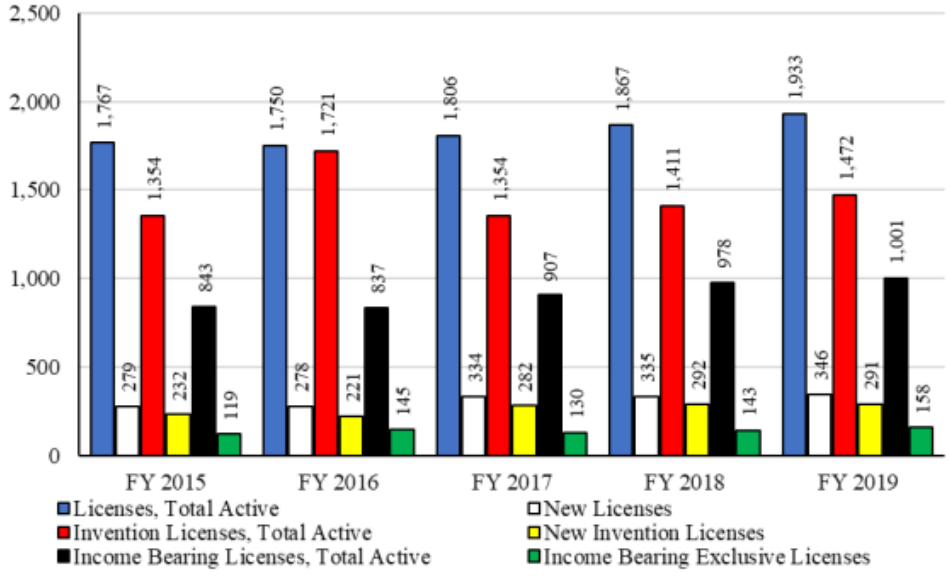


Figure 22: USPTO Patents Assigned to HHS by Technology Area (FY 2019)

HHS Licenses

Between FY 2015 and FY 2019, total active licenses increased by 9%, from 1,767 in FY 2015 to 1,933 licenses in FY 2019. New licenses increased by 24%, from 279 in FY 2015 to 346 in FY 2019. Total active invention licenses increased by 9%, from 1,354 in FY 2015 to 1,472 licenses in FY 2019. New invention licenses increased by 25%, from 232 in FY 2015 to 291 in FY 2019. Total active income-bearing licenses increased by 19%, from 843 in FY 2015 to 1,001 in FY 2019. Income-bearing exclusive licenses increased by 33%, from 119 in FY 2015 to 158 licenses in FY 2019.

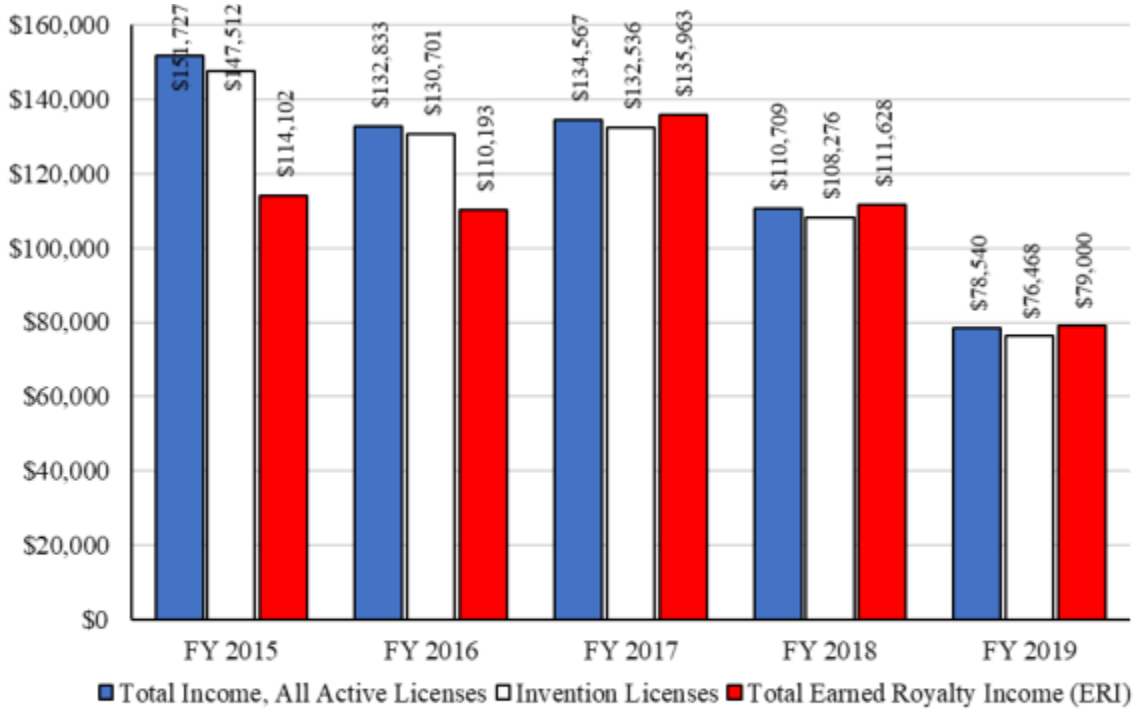


	FY 2015	FY 2016	FY 2017	FY 2018	FY 2019
Licenses, Total Active	1,767	1,750	1,806	1,867	1,933
New Licenses	279	278	334	335	346
Invention Licenses, Total Active	1,354	1,721	1,354	1,411	1,472
New Invention Licenses	232	221	282	292	291
Income Bearing Licenses, Total Active	843	837	907	978	1,001
Income Bearing Exclusive Licenses	119	145	130	143	158

Figure 23: HHS Licenses (FY 2015-2019)

HHS Income from Licensing

Between FY 2015 and FY 2019, total income from all active licenses decreased by 48%, from $151.7 million in FY 2015 to $78.5 million in FY 2019. The income from invention licenses decreased by 48%, from $147.5 million in FY 2015 to $76.5 million in FY 2019. Total earned royalty income decreased by 31%, from $114.1 million in FY 2015 to $79.0 million in FY 2019.

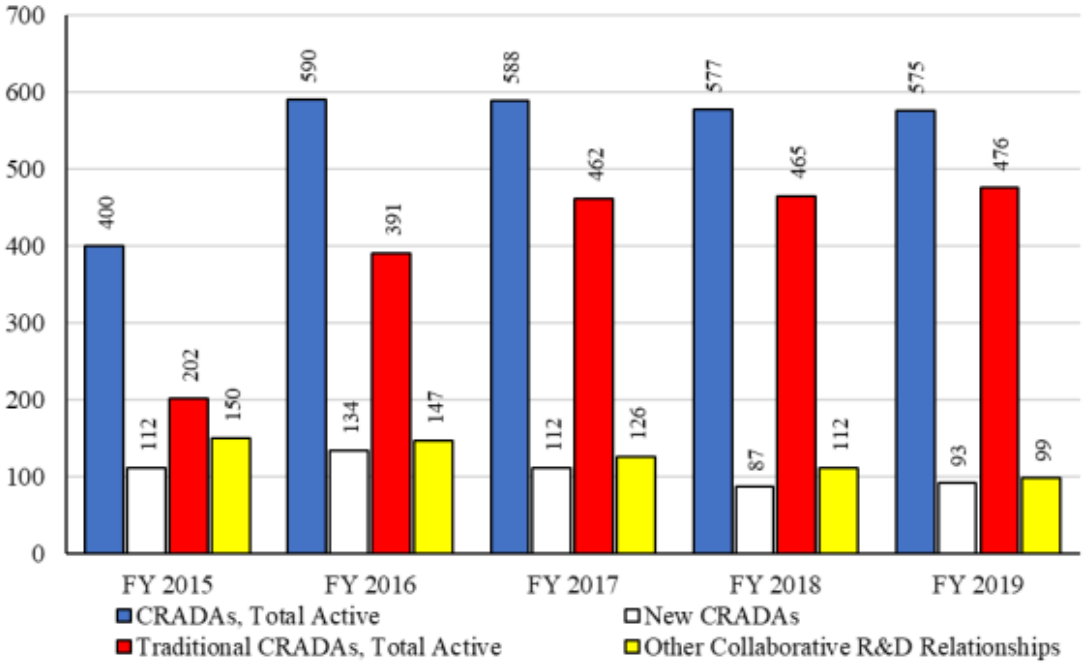


	FY 2015	FY 2016	FY 2017	FY 2018	FY 2019
Total Income, All Active Licenses	$151,727	$132,833	$134,567	$110,709	$78,540
Invention Licenses	$147,512	$130,701	$132,536	$108,276	$76,468
Total Earned Royalty Income, (ERI)	$114,102	$110,193	$135,963	$111,628	$79,000

Figure 24: HHS Income from Licensing ($000s) (FY 2015-2019)

HHS Collaborative R&D Relationships

Between FY 2015 and FY 2019, total active CRADAs increased by 44%, from 400 in FY 2015 to 575 in FY 2019. New CRADA agreements decreased by 17%, from 112 in FY 2015 to 93 in FY 2019. Traditional CRADAs increased by 136%, from 202 in FY 2015 to 476 in FY 2019. Other collaborative R&D relationships decreased by 34%, from 150 in FY 2015 to 99 in FY 2019.



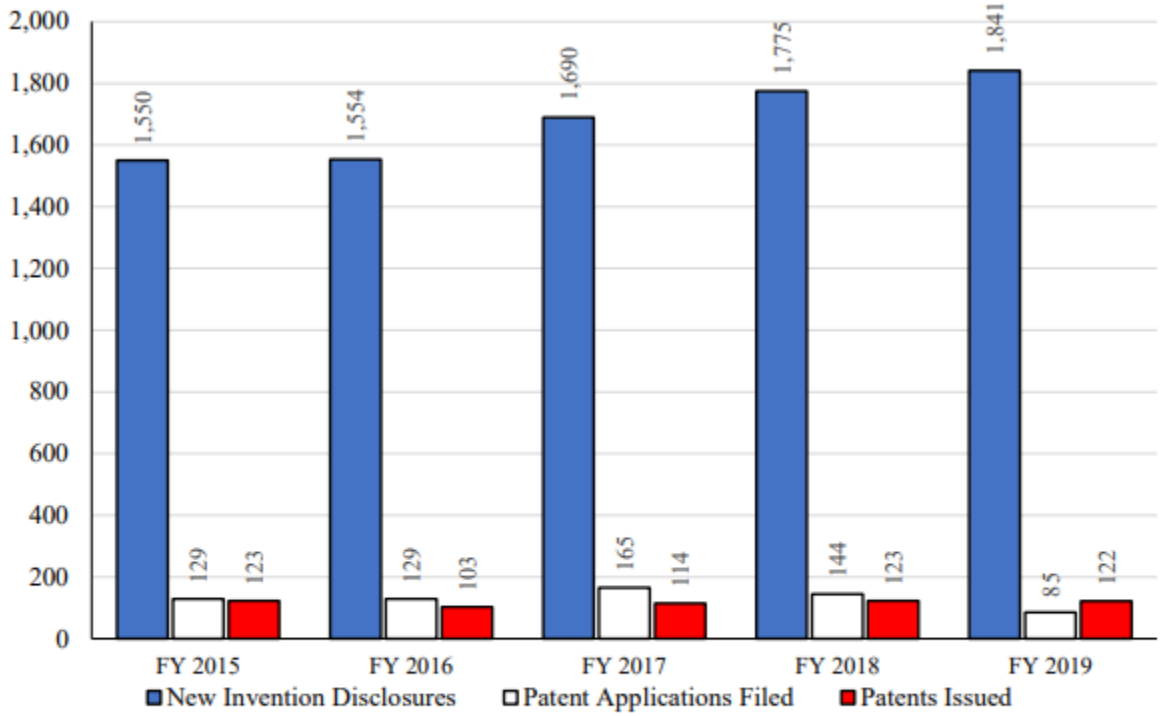
	FY 2015	FY 2016	FY 2017	FY 2018	FY 2019
CRADAs, Total Active	400	590	588	577	575
New CRADAs	112	134	112	87	93
Traditional CRADAs, Total Active	202	391	462	465	476
Other Collaborative R&D Relationships	150	147	126	112	99

Figure 25: HHS Collaborative R&D Relationships (FY 2015-2019)

D-1.5. National Aeronautics and Space Administration (NASA) Technology Transfer Reporting for FY 2015-2019: Inventions, Patents, Licensing, CRADAs

NASA Invention Disclosures and Patenting

Between FY 2015 and FY 2019, new inventions disclosed increased by 19%, from 1,550 in FY 2015 to 1,841 disclosures in FY 2019. Patent applications filed decreased by 34%, from 129 in FY 2015 to 85 in FY 2019. Patents issued decreased by 1%, from 123 in FY 2015 to 122 patents in FY 2019.



	FY 2015	FY 2016	FY 2017	FY 2018	FY 2019
New Invention Disclosures	1,550	1,554	1,690	1,775	1,841
Patent Applications Filed	129	129	165	144	85
Patents Issued	123	103	114	123	122

Figure 49: NASA Invention Disclosures and Patenting (FY 2015-2019)

Patents issued to NASA in FY 2019 covered many technology areas, including Measurement (16%), Transport (13%), Telecommunications (6%), Electrical Machinery, Apparatus, Energy (6%), and Computer Technology (6%).[10]

[10] 6 Source: Prepared by Science-Metrix using USPTO data indexed in PatentsView in January 2022. Used with permission.

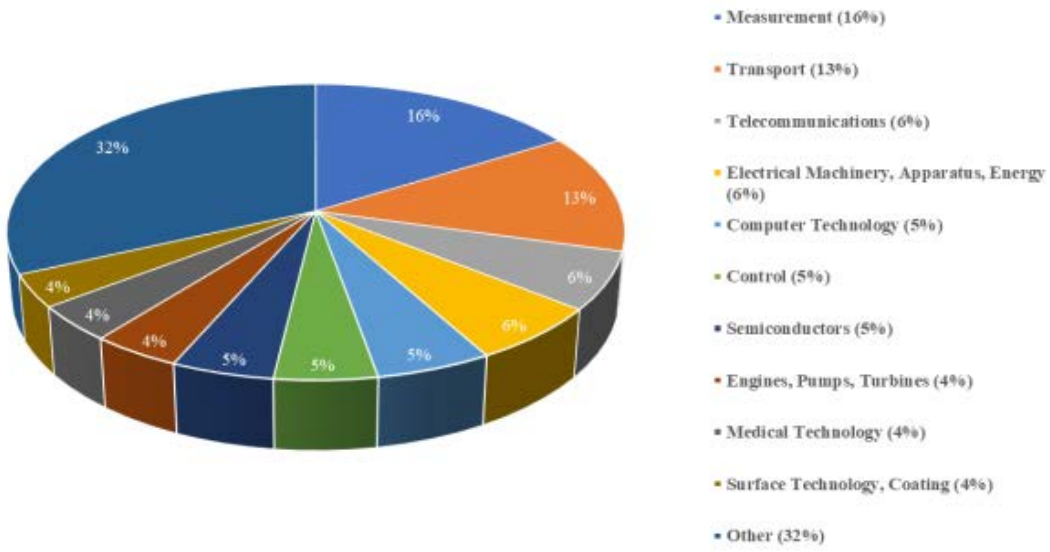
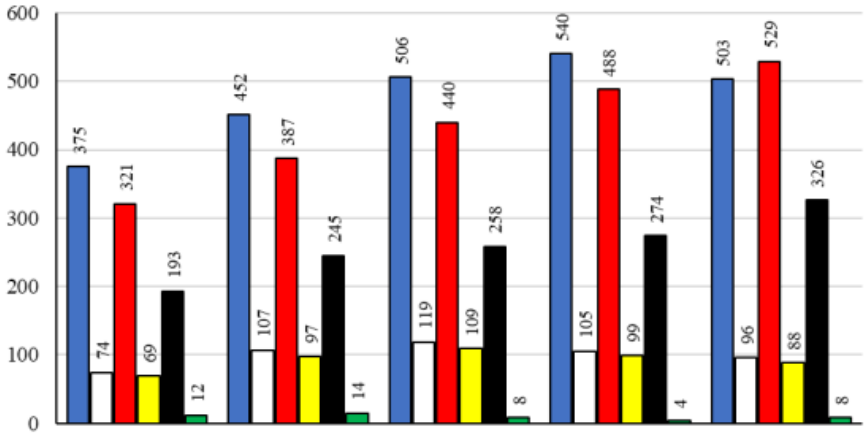


Figure 50: USPTO Patents Assigned to NASA by Technology Area (FY 2019)

NASA Licenses

Between FY 2015 and FY 2019, total active licenses increased by 34%, from 375 in FY 2015 to 503 licenses in FY 2019. New licenses increased by 30%, from 74 in FY 2015 to 96 in FY 2019. Total active invention licenses increased by 65%, from 321 in FY 2015 to 529 in FY 2019. New invention licenses increased by 28%, from 69 in FY 2015 to 88 in FY 2019. Total active income-bearing licenses increased by 69% to 326, while income-bearing exclusive licenses decreased by 33%, from 12 to 8.

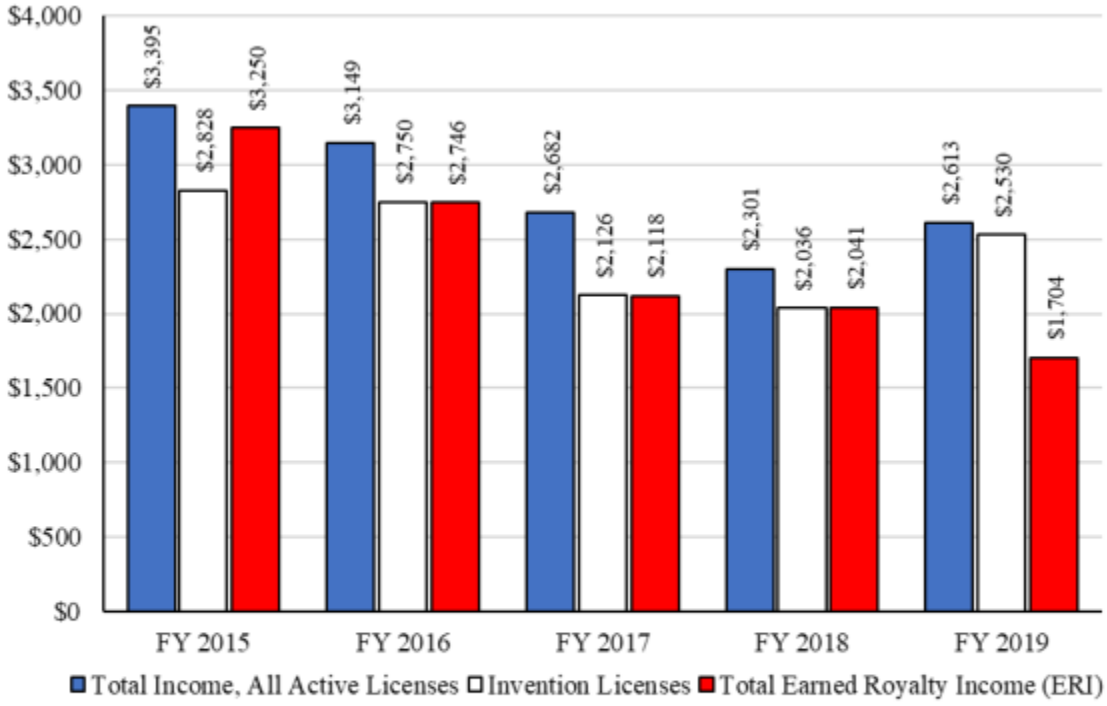


	FY 2015	FY 2016	FY 2017	FY 2018	FY 2019
Licenses, Total Active	375	452	506	540	503
New Licenses	74	107	119	105	96
Invention Licenses, Total Active	321	387	440	488	529
New Invention Licenses	69	97	109	99	88
Income Bearing Licenses, Total Active	193	245	258	274	326
Income Bearing Exclusive Licenses	12	14	8	4	8

Figure 51: NASA Licenses (FY 2015-2019)

NASA Income from Licensing

Between FY 2015 and FY 2019, NASA reported that the total income from all active licenses decreased by 23%, from $3.4 million in FY 2015 to $2.6 million in FY 2019. The income from invention licenses decreased by 11%, from $2.8 million in FY 2015 to $2.5 million in FY 2019. Total earned royalty income decreased by 48%, from $3.3 million to $1.7 million in FY 2019.



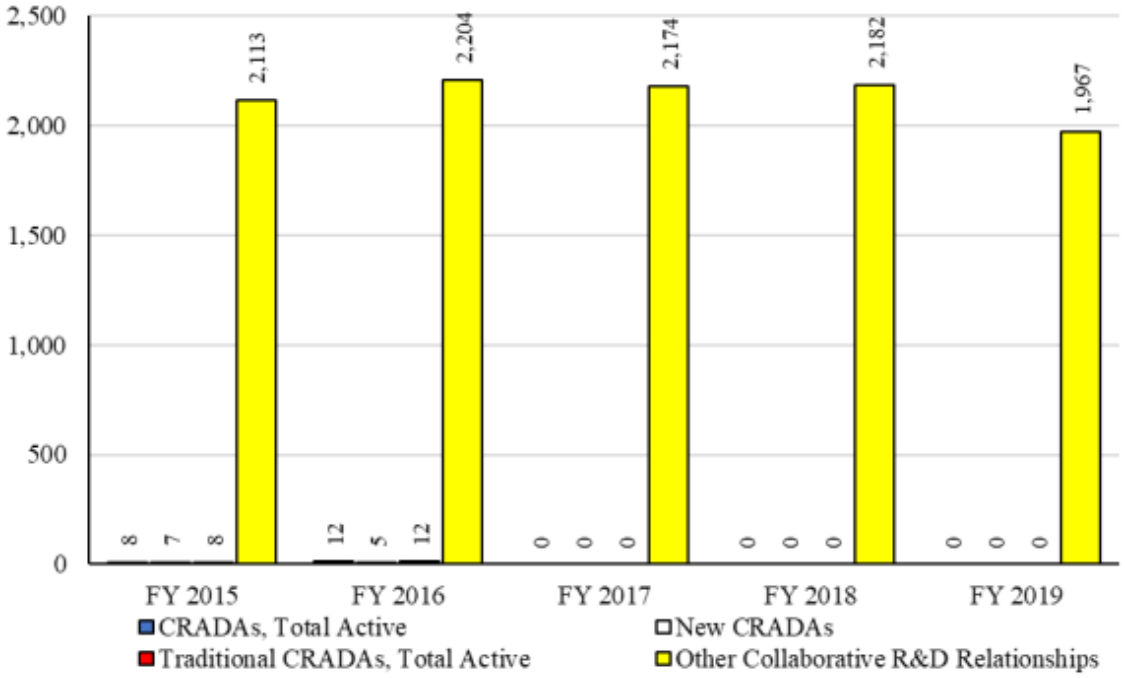
	FY 2015	FY 2016	FY 2017	FY 2018	FY 2019
Total Income, All Active Licenses	$3,395	$3,149	$2,682	$2,301	$2,613
Invention Licenses	$2,828	$2,750	$2,126	$2,036	$2,530
Total Earned Royalty Income, (ERI)	$3,250	$2,746	$2,118	$2,041	$1,704

Figure 52: NASA Income from Licensing ($000s) (FY 2015-2019)

NASA Collaborative R&D Relationships

The National Aeronautics and Space Act (Space Act), 51 U.S.C. §§ 20101-20164, provides NASA with the unique authority to enter into a wide range of "other transactions," frequently in the form of Space Act Agreements. The NASA uses Space Act Agreements to engage in collaborative research projects with various partners to advance NASA's mission and program objectives, including international cooperative space activities. Space Act Agreements differ from traditional CRADAs, and therefore in this report, Space Act Agreements are included under the category "Other Collaborative R&D Relationships."

Between FY 2015 and FY 2019, Space Act Agreements decreased 7%, from 2,113 agreements in FY 2015 to 1,967 in FY 2019.



	FY 2015	FY 2016	FY 2017	FY 2018	FY 2019
CRADAs, Total Active	8	12	0	0	0
New CRADAs	7	5	0	0	0
Traditional CRADAs, Total Active	8	12	0	0	0
Other Collaborative R&D Relationships	2,113	2,204	2,174	2,182	1,967

Figure 53: NASA Collaborative R&D Relationships (FY 2015-2019)