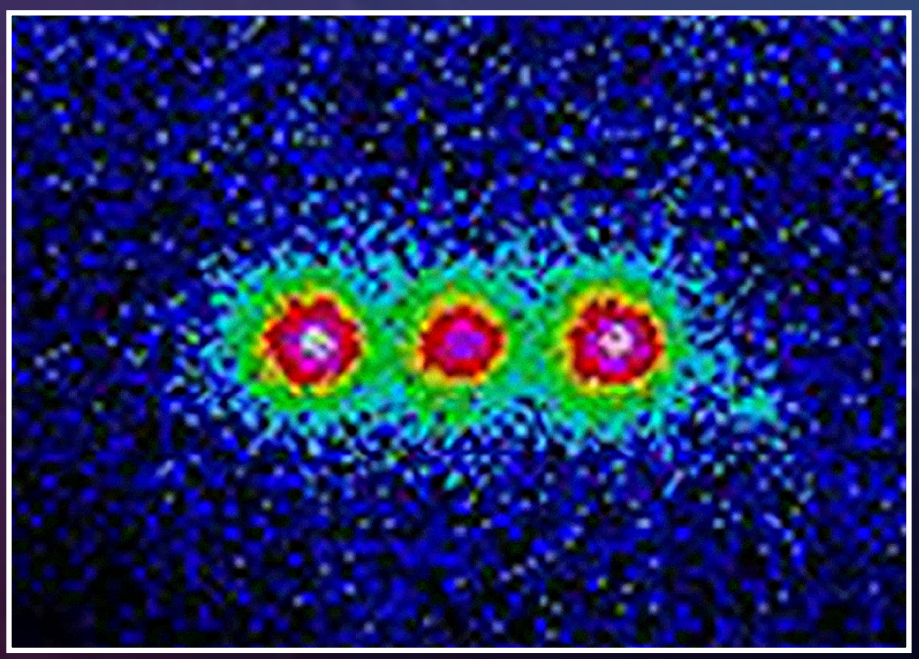
Federal Laboratory Technology Transfer

Fiscal Year 2011

Summary Report to the President and the Congress



Prepared by:
National Institute of
Standards and Technology
U.S. Department of Commerce

September 2013

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Cover photo credit:

Title: Quantum Physics; Quantum Computing; Fourier Transform/Beryllium Ions

This colorized image shows the fluorescence from three trapped beryllium ions illuminated with an ultraviolet laser beam. Black and blue areas indicate lower intensity, and red and white higher intensity.

NIST physicists used three beryllium ions to demonstrate a crucial step in a procedure that could enable future quantum computers to break today's most commonly used encryption codes. Methods for ion-trapping and for quantum control of ions led to David Wineland's (NIST) 2012 Nobel Prize in Physics.

Courtesy National Institute of Standards and Technology

FOREWORD

The Department of Commerce is pleased to submit this Fiscal Year 2011 Technology Transfer Summary Report to the President and the Congress. This report illustrates the continuing efforts of Federal laboratories to ensure that the Nation's investment in innovative research is transferred from our laboratories to the American people.

Federal laboratories, through their basic and mission-oriented research and development investments, have historically been at the forefront of scientific discovery, invention and technological innovation. Technology transfer facilitates the adoption of Federal research results directly through the transfer of laboratory results and by providing non-Federal entities opportunities to partner with Federal laboratories on innovative research of mutual interest. Over the years, new products, services and the formation of new companies have occurred through technology transfer initiatives.

The Administration recognizes the importance of invention and technological innovation as drivers of economic growth and has challenged Federal laboratories to accelerate technology transfer operations over the next five years. This challenge was issued formally by the President on October 28, 2011, in the Memorandum for the Heads of Executive Departments and Agencies, entitled "Accelerating Technology Transfer and Commercialization of Federal Research in Support of High-Growth Businesses." This Presidential Memorandum reiterated the important role of innovation in accelerating the development of new industries, products, and services that lead to economic growth and job creation. In addition to directing agencies to accelerate technology transfer activities, it directed the Secretary of Commerce to improve and expand, where appropriate, the collection of metrics regarding the effectiveness of Federal technology transfer activities. The present report will help serve as a baseline to measure continued progress toward achieving this ambitious challenge, while achieving excellence in performing mission-focused research.

This report fulfills the requirement of Title 15 of the United States Code, Section 3710(g)(2), for an annual report summarizing the use of technology transfer authorities by Federal agencies. It highlights the achievements of Federal technology transfer and includes data on the use of specific transfer authorities. We will use future editions of this report to continue to keep the President and the Congress informed of the on-going efforts of Federal laboratories to expand our technology transfer efforts in partnership with U.S. industry, academic institutions, non-profit foundations, and state, local and tribal governments. These efforts will continue to play a vital role in building the Nation's economic strength.

Patrick D. Gallagher
Under Secretary of Commerce for Standards and Technology

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CHAPTER 1

Overview of Federal Technology Transfer

As part of their missions, many Federal laboratories conduct research and development activities in their laboratories. These activities often result in the creation of new intellectual property, new information and new technologies. To make effective use of their resources, Federal laboratories leverage their research activities by partnering with other federal agencies and laboratories as well as many non-federal organizations in industry, academia, the non-profit sector, and state, local and tribal governments. Through these partnerships, Federal agencies are better able to effectively develop and transform the results of their research from the laboratory to the market. The transfer of federally-developed information and technology to industry promotes economic growth and benefits society.

Federal agencies have a variety of legal authorities which are used to evaluate, protect, license, transfer, and monitor the utilization and commercialization of technologies developed in whole or in part by Federal laboratories. By making these technologies available to private, academic and other government entities, Federal research and development (R&D) activities provide the United States a competitive edge in today's global market and improve the quality of life for all Americans.

This annual report summarizes the technology transfer and R&D activities of each of the eleven Federal agencies that have significant R&D programs. The data contained in this report were obtained directly from each of the Federal agencies. The Department of Commerce's National Institute of Standards and Technology (NIST) prepared and organized this report. An electronic version of this report is available at: http://www.nist.gov/tpo/publications/index.cfm.

Scope

This report summarizes the technology transfer achievements of the eleven Federal agencies that have significant Federal laboratory operations:

- 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 Veterans Affairs (VA)
- Environmental Protection Agency (EPA)
- National Aeronautics and Space Administration (NASA)

Each of these agencies has established programs for promoting the transfer and commercialization of intellectual property developed in their R&D laboratories.

Technology Transfer Principles and Approach

Promoting U.S. economic growth and creating jobs through the transfer and commercialization of federally developed technologies is a high priority for Federal laboratories. Collaborations between Federal laboratories and non-federal organizations provide leverage which promotes more efficient and timely development of new technologies and facilitates the creation of new information and knowledge. These collaborations create better access to the results of Federal agency research and play an important role in the efficient and timely development of innovative technologies and new products. Efficient technology transfer activities of Federal agencies ensure that taxpayer investments in research and development significantly benefit the domestic economy. Transferring research results, know-how and rights to develop, refine, use and market new technologies developed by Federal R&D laboratories reaps many benefits for the economy and for the health, safety and welfare of the public. Since Federal research activities are often driven by agency-specific missions, technologies that are developed for a particular agency's use might otherwise be overlooked or go unused outside the agency without the dedicated efforts of Federal technology transfer offices, which promote the dissemination and utilization of these technologies. Effective technology transfer promotes real economic growth through the development of new products, processes, medical treatments, services and other benefits that serve a market need. The economic growth spurred by the transfer of Federal R&D results to industry creates a stronger job market, resulting from the manufacture and marketing of new products and services. In addition to strengthening domestic and regional economies, successful partnerships with non-federal entities provide other benefits, including:

- Stimulating the flow of ideas between the government and other research sectors
- Creating new businesses, especially small businesses
- Attracting and retaining talented scientific personnel within the Federal laboratories
- Providing support to the mission of each agency
- Accelerating the development and reducing the costs of products and services to reach the marketplace
- Supporting further research by generating licensing revenue
- Rewarding innovative accomplishments of Federal employee inventors through royalty sharing
- Creating a wide variety of new and efficient products in health care, defense, domestic security and many other sectors of the economy.

Federal technology transfer offices typically rely on the following principal mechanisms to facilitate the transfer of federally developed technologies from the Federal government to the private sector:

Cooperative Research and Development

Cooperative research and development relationships between Federal laboratories and non-federal collaborators are widely viewed as an effective and economical means of transferring technology and promoting joint research. These cooperative relationships create a mutually advantageous leveraging of Federal agency and collaborator resources and technical capabilities, as well as provide avenues for both the collaborator and the Federal laboratory to gain new competencies and develop new skills.

One frequently used mechanism for establishing joint research relationships is the Cooperative Research and Development Agreement (CRADA). CRADAs are agreements between a Federal laboratory and one or more collaborators to work jointly on an R&D project with a defined scope of work. CRADAs allow Federal laboratories to create R&D partnerships to develop and advance promising new technologies towards commercialization. Many agencies have other specific authorities which also facilitate cooperative R&D relationships.

Intellectual Property Management

Invention Disclosure and Patenting

The protection of intellectual property can be vital to attracting the additional investment and product development resources necessary for early stage research products to be brought to their full commercial potential. Federal laboratory achievements in the areas of invention disclosures and patents obtained are often cited as metrics of the active management of intellectual assets and technical know-how by Federal agencies.

Licensing

Licensing of federally developed technologies is one of the primary mechanisms used to create incentives for industry to invest the resources necessary to develop and commercialize nascent leading-edge technologies. Successful development and commercialization creates benefits to the economy and contributes to competitiveness and domestic economic growth. The ability to grant licenses to the non-federal sector to develop and commercialize government-owned technologies helps protect federally developed innovations, which would otherwise not be further developed into commercial products or services. The terms and conditions under which Federal intellectual property is licensed vary based upon many factors, including the extent of development of the technology, the financial resources needed to further develop the technology for consumer use, fields of use, projected market impact and other factors.

Other Technology Transfer Mechanisms

In addition to licensing, there is a wide variety of other technology transfer mechanisms used by Federal agencies. Different mechanisms are used when licensing may not be necessary to efficiently or effectively transfer a technology to the non-federal sector. Some of the mechanisms used by Federal laboratories are tailored to support the specific focus, needs and mission of a particular Federal laboratory and/or a particular technology. Some of these other technology transfer mechanisms include:

- Material transfer agreements
- Technical publications and reports
- Collaborative research agreements (e.g., Memoranda of Understanding (MOU), Clinical Trial Agreements)
- Presentations at conferences, workshops, poster sessions and responding to inquiries
- Creation and utilization of user-facilities
- Outreach to trade and technical media

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CHAPTER 2

Performance in Fiscal Year 2011

Strengthening Performance Metrics

Every Federal agency that operates or directs one or more Federal laboratories or that conducts research and development is required to prepare and submit an annual report of its technology transfer activities as described in 15 U.S.C. § 3710(f). These reports contain details on each agency's technology transfer program and include agency plans to use technology transfer to advance the agency's mission and to promote U.S. competitiveness. Additionally, specific data are provided in order to measure the level of basic technology transfer. These data include:

- Number of patent applications filed
- Number of patents granted
- Number of licenses granted and details regarding the licenses
- Earned royalty income and other statistical information regarding royalty income
- Disposition of royalty income
- Number of licenses terminated for cause
- Discussion of other relevant parameters unique to the agency

The tables and charts below present a brief, cross-agency summary of the utilization of these technology transfer tools. Although the standard metrics required by statute continue to demonstrate robust use of these technology transfer tools, the metrics only address a part of the full picture of the successfulness of Federal technology transfer. While it is not difficult to compile statistics on technology transfer activities, it is far more difficult to actually identify and quantify the downstream benefits and the effectiveness of the technology transfers, simply because of the many variables and factors involved in successfully utilizing and commercializing nascent technologies. For example, knowledge gained from initial research may not make an immediate impact on the state of science or on the economy in general, but it may open new avenues for discoveries that lead to further innovation and to future products, medical treatments, and services which will advance science and benefit the economy. Additionally, new mechanisms of technology transfer have appeared and Federal laboratories have embraced these new approaches. As examples of new approaches, open source software from Federal research is available and material properties databases have been made available on the Internet. Both of these technology transfer mechanisms have had significant impact on U.S. businesses. Likewise, Federal laboratories are engaged in transferring technical knowledge to the next generation of scientists and engineers through postdoctoral appointments and partnering with universities. Contributions like these are not captured in the statistics presented here.

In a continuing effort to develop better metrics and to improve the effectiveness of Federal technology transfer, the Federal Interagency Working Group on Technology Transfer (IWGTT) meets regularly. This group and comprises agency representatives and technology transfer experts from across the Federal government. The IWGTT serves as a broad forum to identify and discuss best practices, better metrics, emerging concerns and trends through dialogue, interagency comparisons and experience sharing. Through the IWGTT, Federal agencies cooperatively discuss and review new and better means to improve both quantitative and qualitative measurements of technology transfer activities and other means to improve dissemination of federally developed technologies.

On October 28, 2011, the President issued the Presidential Memorandum -- *Accelerating Technology Transfer and Commercialization of Federal Research in Support of High-Growth Businesses.*[1] Section 2 of the Presidential Memorandum (PM) called for the establishment of performance goals, metrics, and evaluation methods, as well as implementing and tracking progress relative to those goals. In Fiscal Year 2012, Federal agencies prepared plans for improving their technology transfer operations. These plans were submitted to the Office of Management and Budget and to the Office of Science and Technology Policy for clearance.

The PM directed that the Secretary of Commerce, "in consultation with other agencies, including the National Center for Science and Engineering Statistics, shall improve and expand, where appropriate, its collection of metrics in the Department of Commerce's annual technology transfer summary report, submitted pursuant to 15 U.S.C. § 3710(g)(2)." In accordance with the PM, in Fiscal Year 2012, the IWGTT reviewed previous years' methods and types of technology transfer metrics. The IWGTT is now in the process of revising and improving the types of metrics collected and reported. Beginning in Fiscal Year 2013, these improved metrics will be reflected in the annual technology transfer report. The expanded metrics will provide better and more information to help improve future policy decisions. These metrics will, among other things, present a broader multi-agency perspective of technology transfer and will contain more information on interactions with small businesses and other collaborative efforts that have the potential to spur scientific advances, discoveries and innovations.

Anecdotal evidence and success stories demonstrate the broad range of successful outcomes of Federal agency technology transfer, such as life-saving treatments, increased security, enhanced awareness about dangers and hazards, and new business start-ups. Chapter 3 of this report highlights a small sampling of the numerous positive impacts and outcomes of Federal technology transfer activities.

The following tables summarize Federal agency technology transfer activities for a five-year period from Fiscal Year 2007 through Fiscal Year 2011. The tables are compiled from each agency's reports over those years. The total figures from the eleven agencies indicate that licenses and new licenses both trended upward slightly. Income from licenses, and earned royalty income were generally steady over this period. Invention disclosures, patent

[1] http://www.whitehouse.gov/the-press-office/2011/10/28/presidential-memorandum-accelerating-technology-transfer-and-commerciali

applications filed, and patents issued remained steady over the period from Fiscal Year 2007 through Fiscal Year 2010, followed by significant increases in Fiscal Year 2011. The number of active CRADAs declined slightly in Fiscal Year 2008, but rebounded to new heights in Fiscal Year 2009. Overall, these total figures and trends from the technology transfer activities of the Federal government represent steady, mature programs, as shown by the consistently high and relatively stable volume of CRADAs, licenses, patents, and earned royalty income activities.

In Table 1, "Traditional CRADAs" refers to collaborative research and development agreements between a Federal laboratory and non-federal partners. "Total CRADAs" includes agreements in addition to traditional CRADAs. These additional agreements may include material transfer agreements, non-disclosure agreements, and others. In Table 3, "All licenses" includes, in addition to invention licenses, other licenses for copyrighted software, open channel-web and noncommercial software, biological materials, and other forms of intellectual property.

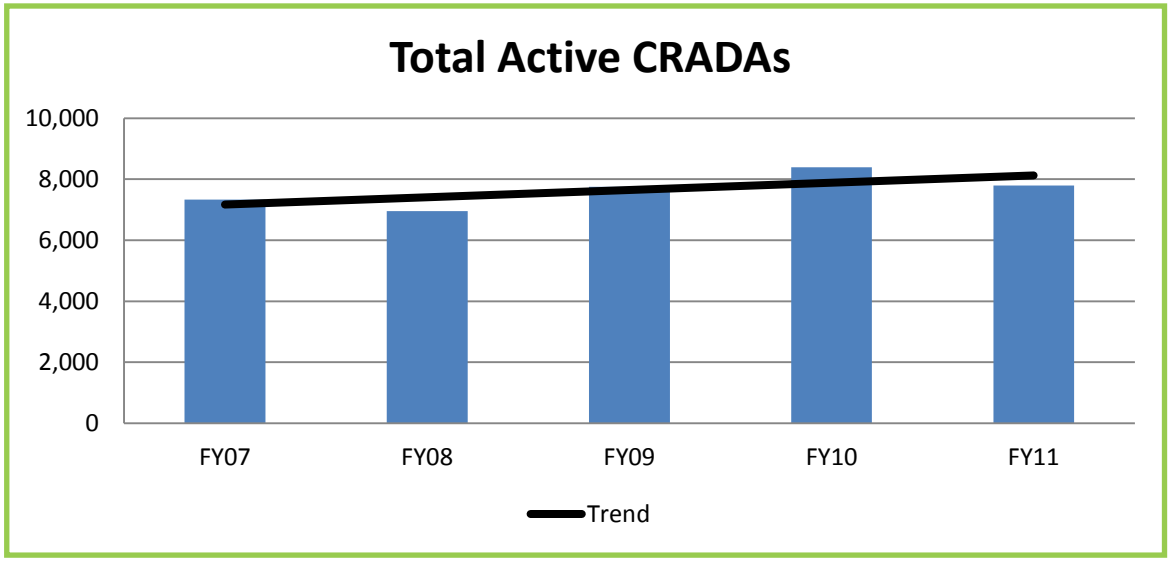
Table 1: Collaborative Relationships for Research and Development

		FY 2007	FY 2008	FY 2009	FY 2010	FY 2011
DHS	• **CRADAs**, total active in the FY	-	23	23	36	62
	- New, executed in the FY	-	8	6	14	31
	• Traditional CRADAs, total active in the FY	-	21	22	32	55
	• Other collaborative R&D relationships	-	3	5	3	11
DOC	• **CRADAs**, total active in the FY	2,778	2,390	2,397*	2,254*	2,280
	- New, executed in the FY	1,865	1,583	1,501	1,408	1,402
	• Traditional CRADAs, total active in the FY	154	131	101*	101*	133
	• Other collaborative R&D relationships[1]	2,672*	2,816	2,828	2,897	2,899
DOD	• **CRADAs**, total active in the FY	2,971	2,596	2,870	3,248	2,554
	- New, executed in the FY	641	745	659	720	762
	• Traditional CRADAs, total active in the FY	2,383	1,993	2,247	2,516	1,685
	• Other collaborative R&D relationships	0	3	1	287	988
DOE	• **CRADAs**, total active in the FY	697	711	744	697	720
	- New, executed in the FY	182	178	176	176	208
	• Traditional CRADAs, total active in the FY	697	711	744	697	720
	• Other collaborative R&D relationships	0	0	0	0	0
	•					
DOI	• **CRADAs**, total active in the FY	170	170	248	436	351
	- New, executed in the FY	112	98	74	82	295
	• Traditional CRADAs, total active in the FY	20	33	36	29	22
	• Other collaborative R&D relationships	0	0	0	0	209

Table 1: Collaborative Relationships for Research and Development *(continued)*

		FY 2007	FY 2008	FY 2009	FY 2010	FY 2011
DOT	• **CRADAs**, total active in the FY	36	23	22	22	25
	- New, executed in the FY	7	6	7	0	8
	• Traditional CRADAs, total active in the FY	36	23	0	0	0
	• Other collaborative R&D relationships	0	0	2	2	5
EPA	• **CRADAs**, total active in the FY	84	112	112	67	84
	- New, executed in the FY	18	49	83	33	26
	• Traditional CRADAs, total active in the FY	67	74	51	50	54
	• Other collaborative R&D relationships	0	0	0	0	0
HHS	• **CRADAs**, total active in the FY	284	453	457	447	430
	- New, executed in the FY	68	83	105	83	81
	• Traditional CRADAs, total active in the FY	206	295	284	300	284
	• Other collaborative R&D relationships	NR	NR	NR	NR	4861
NASA	• **CRADAs**, total active in the FY	1	1	1	0	0
	- New, executed in the FY	0	0	1	0	0
	• Traditional CRADAs, total active in the FY	1	1	1	0	0
	• Other collaborative R&D relationships**	3,812	4,076	4,507	4,379*	3,480
USDA	• **CRADAs**, total active in the FY	230	252	259	287	298
	- New, executed in the FY	69	76	79	99	88
	• Traditional CRADAs, total active in the FY	207*	224*	217	233	213
	• Other collaborative R&D relationships	4,084	5,466	9,960	11,214	13,007
VA	• **CRADAs**, total active in the FY	82	221	623	897*	994
	- New, executed in the FY	52	155	438	493*	446
	• Traditional CRADAs, total active in the FY	74	207	581	835*	n/r
	• Other collaborative R&D relationships	0	0	0	0	0
TOTALS	• **CRADAs**, total active in the FY	7,333	6,952	7,756	8,391	7,798
	- New, executed in the FY	3,014	2,981	3,129	3,108	3,347
	• Traditional CRADAs, total active in the FY	3,845	3,713	4,284	4,793	3,166
	• Other collaborative R&D relationships	10,568	12,364	17,303	18,800	25,460

-DHS began compiling and reporting data in 2008.
n/r – Data not reported.
* Updated to correct earlier data.
** Limited use of CRADA authority; NASA often employs Space Act Agreements instead.
1 Includes domestic and foreign guest researchers and other researchers working at NIST under various agreements.


Total Active CRADAs
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6,000
4,000
2,000
0
FY07
FY08
FY09
FY10
FY11
Trend

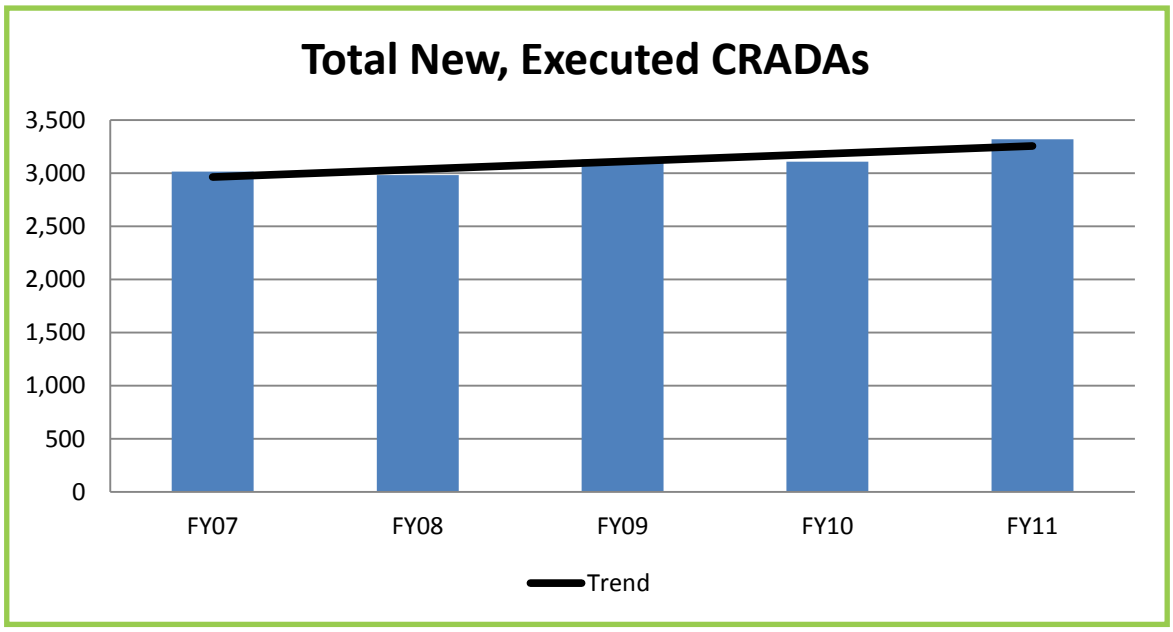

Total New, Executed CRADAs
3,500
3,000
2,500
2,000
1,500
1,000
500
0
FY07
FY08
FY09
FY10
FY11
Trend

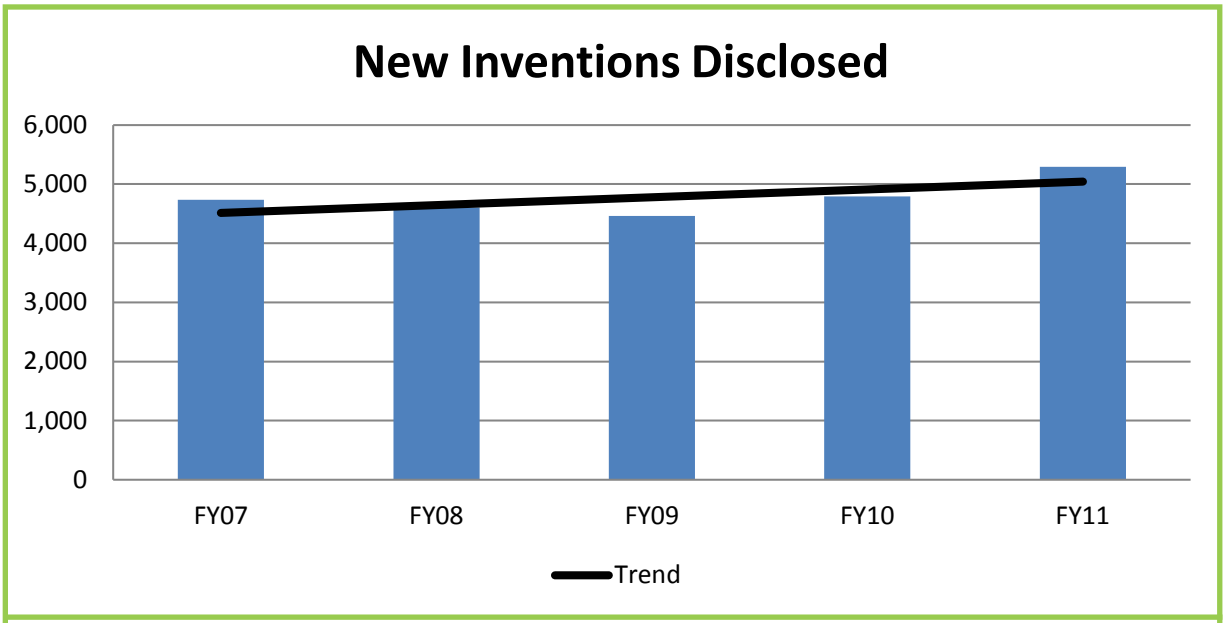
Table 2: Invention Disclosure and Patenting

		FY 2007	FY 2008	FY 2009	FY 2010	FY 2011
DHS	• New inventions disclosed in the FY	-	10	32	7	38
	• Patent applications filed in the FY	-	0	2	2	12
	• Patents issued in the FY	-	1	2	1	0
	•					
DOC	• New inventions disclosed in the FY	32	40	41	34	26
	• Patent applications filed in the FY	8	21	20	19	15
	• Patents issued in the FY	3	3*	7	11	14
DOD	• New inventions disclosed in the FY	838	1,018	831	698	929
	• Patent applications filed in the FY	597	590	690	436	844
	• Patents issued in the FY	425	462	404	304	523
DOE	• New inventions disclosed in the FY	1,575	1,460	1,439	1,616	1,820
	• Patent applications filed in the FY	693	904	775*	965*	868
	• Patents issued in the FY	441	370	363*	480	460
DOI	• New inventions disclosed in the FY	7	7	4	5	5
	• Patent applications filed in the FY	5	7	8	7	2
	• Patents issued in the FY	6	1	4	5	1
DOT	• New inventions disclosed in the FY	2	3	3	1	2
	• Patent applications filed in the FY	2	0	1	1	1
	• Patents issued in the FY	3	2	1	1	0
EPA	• New inventions disclosed in the FY	16	9	8	5	8
	• Patent applications filed in the FY	15	6	3	3	8
	• Patents issued in the FY	10	4	9	9	12
HHS	• New inventions disclosed in the FY	447	437	389	363	402
	• Patent applications filed in the FY	261	164	156	113	266
	• Patents issued in the FY	379	278	397	153	320

Table 2: Invention Disclosure and Patenting *(continued)*

		FY 2007	FY 2008	FY 2009	FY 2010	FY 2011
NASA	• New inventions disclosed in the FY	1,514	1,324	1,412	1,735*	1,721
	• Patent applications filed in the FY	127	122	141*	150*	130
	• Patents issued in the FY	68	90	93	130*	156
USDA	• New inventions disclosed in the FY	126	133	154	164	152
	• Patent applications filed in the FY	114	123	123	112	142
	• Patents issued in the FY	37	30	24	44	57
VA	• New inventions disclosed in the FY	175	164	150	168	191
	• Patent applications filed in the FY	25	13	37	31	93
	• Patents issued in the FY	8	10	15	10	32
TOTALS	• New inventions disclosed in the FY	4,732	4,605	4,463	4,796	5,294
	• Patent applications filed in the FY	1,847	1,950	1,956	1,839	2,381
	• Patents issued in the FY	1,380	1,251	1,319	1,148	1,575

-DHS began compiling and reporting data in 2008.
n/r – Data not reported.
* Updated to correct earlier data.


New Inventions Disclosed
6,000
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4,000
3,000
2,000
1,000
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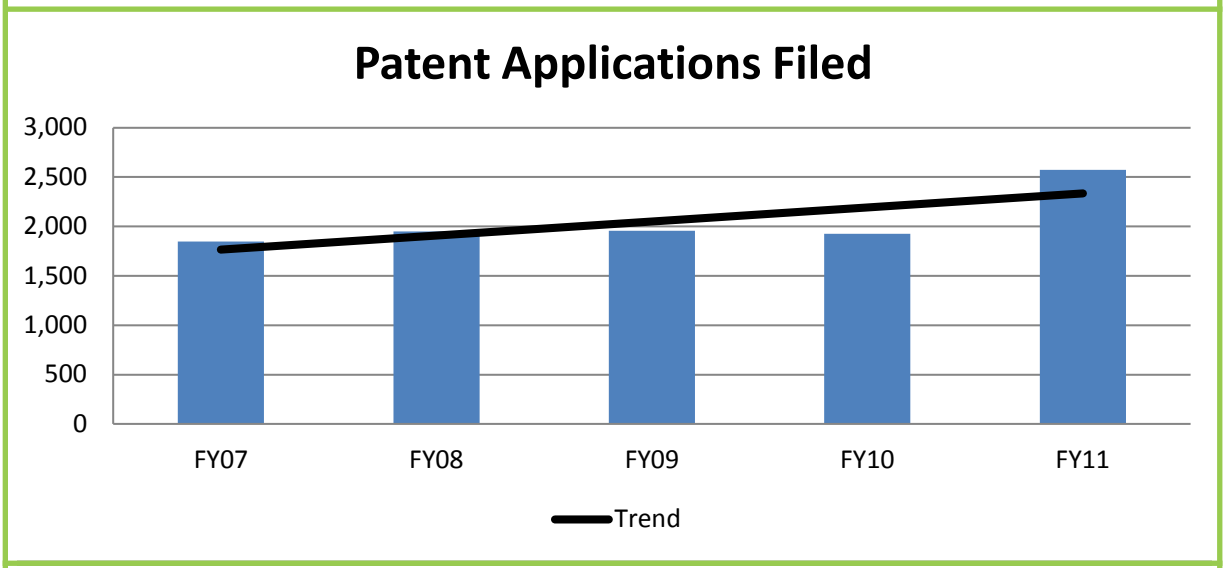
FY07
FY08
FY09
FY10
FY11
Trend


Patent Applications Filed
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2,500
2,000
1,500
1,000
500
0
FY07
FY08
FY09
FY10
FY11
Trend

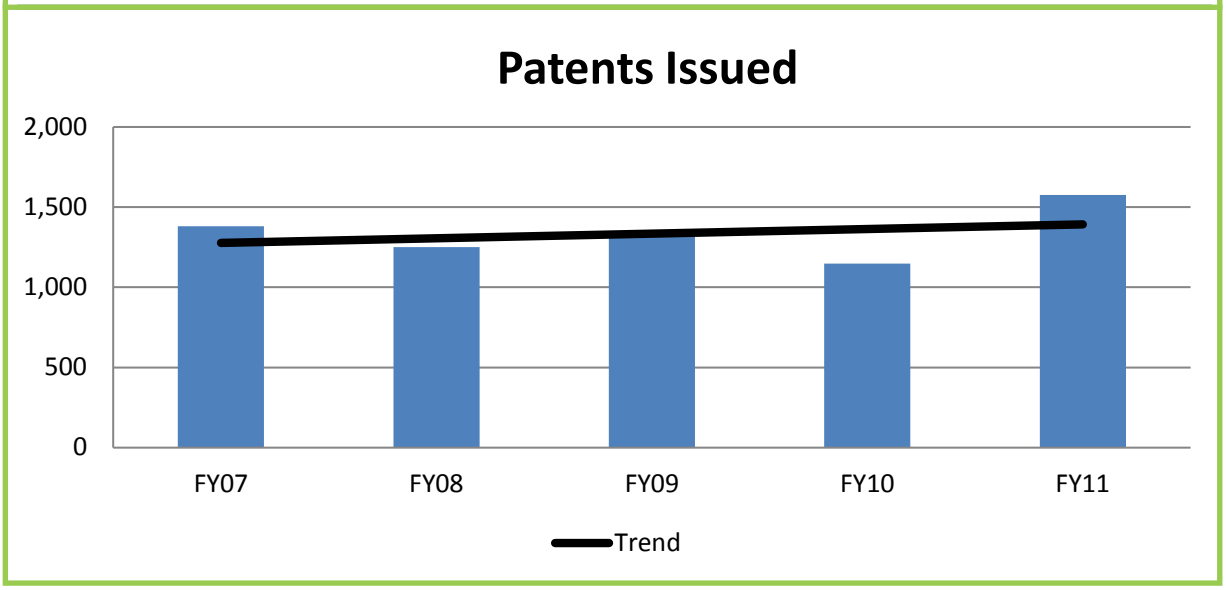

Patents Issued
2,000
1,500
1,000
500
0
FY07
FY08
FY09
FY10
FY11
Trend

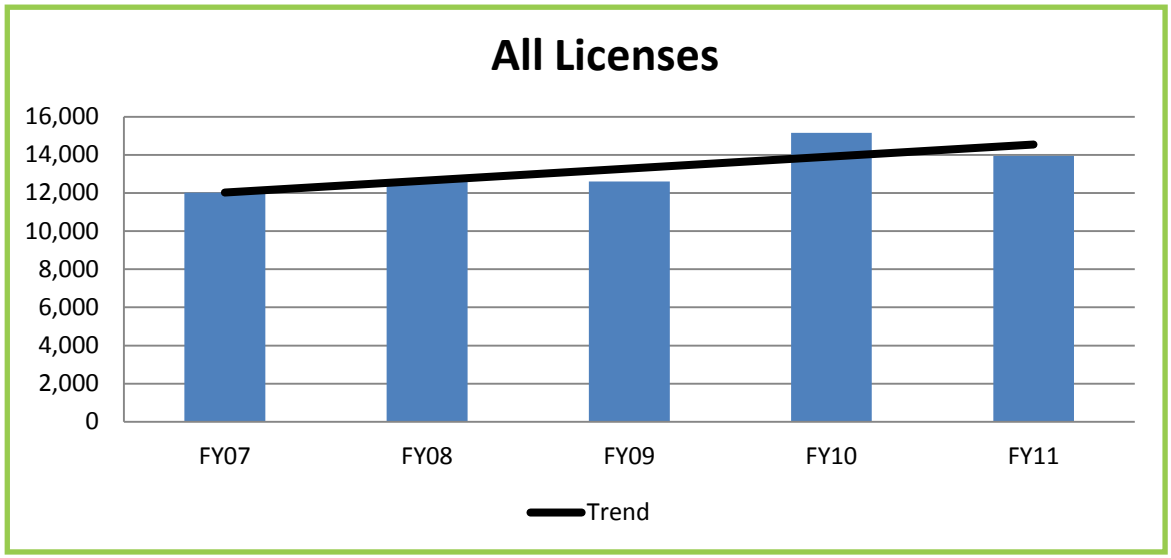
Table 3: Profile of Active Licenses

		FY 2007	FY 2008	FY 2009	FY 2010	FY 2011
DHS	• **All licenses**, number total active in the FY	-	18	63	458	495
	• New, executed in the FY	-	0	45	458	418
	• **Invention licenses**, total active in the FY	-	0	0	0	0
	• New, executed in the FY	-	0	0	0	0
DOC	• **All licenses**, number total active in the FY	222	29	40	46	40
	• New, executed in the FY	187	2	12	7	5
	• **Invention licenses**, total active in the FY	222	29	40	46	40
	• New, executed in the FY	187	2	12	7	5
DOD	• **All licenses**, number total active in the FY	495	365	432	397	633
	• New, executed in the FY	67	52	57	50	63
	• **Invention licenses**, total active in the FY	460	351	386	341	431
	• New, executed in the FY	67	52	57	50	63
DOE	• **All licenses**, number total active in the FY	5,842	6,146*	5,742*	6,228*	5,310
	• New, executed in the FY	606	685	755*	826*	665
	• **Invention licenses**, total active in the FY	1,354	1,448*	1,452	1,453	1,432
	• New, executed in the FY	164	177	139	166	169
DOI	• **All licenses**, number total active in the FY	15	19	21	28	25
	• New, executed in the FY	1	1	4	4	2
	• **Invention licenses**, total active in the FY	15	18	18	23	23
	• New, executed in the FY	0	1	3	3	2
DOT	• **All licenses**, number total active in the FY	5	5	2	3	3
	• New, executed in the FY	0	0	0	0	1
	• **Invention licenses**, total active in the FY	1	5	3	3	3
	• New, executed in the FY	0	0	0	0	0
EPA	• **All licenses**, number total active in the FY	38	37	40	37*	45
	• New, executed in the FY	5	2	3	2	6
	• **Invention licenses**, total active in the FY	38	37	40	37*	45
	• New, executed in the FY	5	2	3	2	6

Table 3: Profile of Active Licenses *(continued)*

		FY 2007	FY 2008	FY 2009	FY 2010	FY 2011
HHS	• **All licenses**, number total active in the FY	1,418	1,675	1,584	1,941	1,613
	• New, executed in the FY	293	277	221	269	264
	• **Invention licenses**, total active in the FY	915	1,376	1,304	1240	414
	• New, executed in the FY	234	233	198	217	106
NASA	• **All licenses**, number total active in the FY	3,520	3,912	4,181	5,515*	5,227
	• New, executed in the FY	721	633	803	498	581
	• **Invention licenses**, total active in the FY	316	330	146	456*	461
	• New, executed in the FY	45	34	49	36	34
USDA	• **All licenses**, number total active in the FY	339	328	329	343	357
	• New, executed in the FY	25	28	25	22	35
	• **Invention licenses**, total active in the FY	339	328	329	343	357
	• New, executed in the FY	25	28	25	22	35
VA	• **All licenses**, number total active in the FY	130	153	163	169	192
	• New, executed in the FY	18	23	10	6	11
	• **Invention licenses**, total active in the FY	130	153	163	169	192
	• New, executed in the FY	18	23	10	6	11
TOTALS	• **All licenses**, number total active in the FY	12,024	12,687	12,597	15,165	13,940
	• New, executed in the FY	1,923	1,703	1,935	2,142	2,051
	• **Invention licenses**, total active in the FY	3,790	4,075	3,881	4,111	3,398
	• New, executed in the FY	745	552	496	509	431

-DHS began compiling and reporting data in 2008.
* Updated to correct earlier data.


All Licenses
16,000
14,000
12,000
10,000
8,000
6,000
4,000
2,000
0
FY07
FY08
FY09
FY10
FY11
Trend

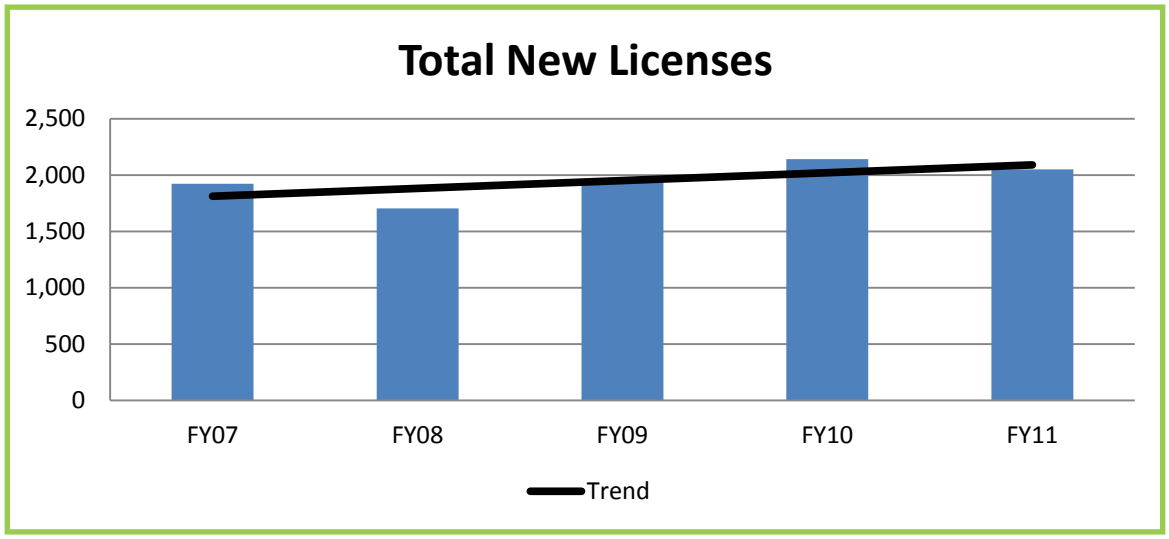

Total New Licenses
2,500
2,000
1,500
1,000
500
0
FY07
FY08
FY09
FY10
FY11
Trend

Table 4: Characteristics of Licensing Bearing Income

		FY 2007	FY 2008	FY 2009	FY 2010	FY 2011
DHS	• **All income bearing licenses**, number	-	0	0	0	0
	• Exclusive	-	0	0	0	0
DOC	• **All income bearing licenses**, number	35	25	27	28	25
	• Exclusive	16	14	15	17	15
DOD	• All income bearing licenses, number	194	210	227	134	214
	• Exclusive	84	70	78	67	51
DOE	• All income bearing licenses, number	3,291	4,397	3,339	3,493*	3,510
	• Exclusive	352	372	411	462	315
DOI	• All income bearing licenses, number	14	16	18	19	22
	• Exclusive	4	5	4	5	3
DOT	• All income bearing licenses, number	4	4	3	3	3
	• Exclusive	2	1	3	3	2
EPA	• All income bearing licenses, number	38	37	40	37	42
	• Exclusive	6	7	8	7	8
HHS	• All income bearing licenses, number	901	1,057	899	838	1,023
	• Exclusive	144	149	111	113	131
NASA	• All income bearing licenses, number	254	271	276	271	292
	• Exclusive	110	119	122	122	119
USDA	• All income bearing licenses, number	337	313	314	321	335
	• Exclusive	241	223	222	230	239
VA	• All income bearing licenses, number	115	138	144	150	170
	• Exclusive	44	61	64	69	77
TOTALS	• All income bearing licenses, number	5,183	6,468	5,287	5,292	5,635
	• Exclusive	1,003	1,021	1,038	1,093	959

- DHS began compiling and reporting data in 2008.
* Updated to reflect corrected data.
n/r – Data not reported

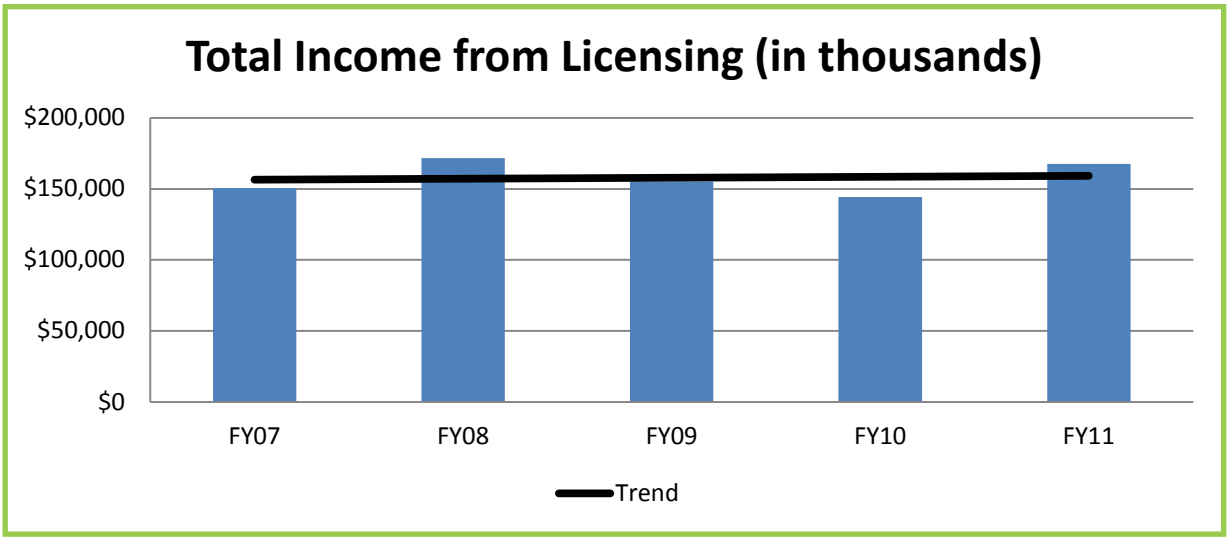
Table 5: Income from Licensing (Dollars reported in thousands)

		FY 2007	FY 2008	FY 2009	FY 2010	FY 2011
DHS	• **Total income**, all licenses active in FY	-	$0	$0	$0	$0
	• **Invention licenses**	-	$0	$0	$0	$0
	• **Total Earned Royalty Income**, (ERI)	-	$0	$0	$0	$0
DOC	• **Total income**, all licenses active in FY	$225	$293	$336	$237	$277
	• **Invention licenses**	$225	$293	$336	$237*	$277
	• **Total Earned Royalty Income**, (ERI)	$217	$293	$336	$237	$277
DOD	• **Total income**, all licenses active in FY	$14,246	$16,057	$16,439	$13,424	$15,682
	• **Invention licenses**	$14,240	$16,048	$16,165	$13,026	$15,364
	• **Total Earned Royalty Income**, (ERI)	n/a	n/a	n/a	n/a	n/a
DOE	• **Total income**, all licenses active in FY	$39,165	$49,318	$43,496	$40,642	$44,728
	• **Invention licenses**	$34,933	$43,108	$40,238	$37,066	$40,600
	• **Total Earned Royalty Income**, (ERI)	$18,759	$31,718	$28,901	$25,220	$27,107
DOI	• **Total income**, all licenses active in FY	$57	$79	$89	$80	$93
	• **Invention licenses**	$57	$79	$89	$80	$93
	• **Total Earned Royalty Income**, (ERI)	$57	$79	$89	n/a	$82
DOT	• **Total income**, all licenses active in FY	$34	$18	$44	$17	$15
	• **Invention licenses**	$34	$18	$44	$17	$15
	• **Total Earned Royalty Income**, (ERI)	$34	$9	$34	$3	$5
EPA	• **Total income**, all licenses active in FY	$544	$1,038	$849	$536	$383
	• **Invention licenses**	$544	$1,038	$849	$536	$383
	• **Total Earned Royalty Income**, (ERI)	$107	$296*	$255	$197*	$135
HHS	• **Total income**, all licenses active in FY	$88,799	$97,609	$85,059	$80,923	$98,453
	• **Invention licenses**	$67,108	$94,712	$83,041	$79,805	$82,842
	• **Total Earned Royalty Income**, (ERI)	$70,743	$80,805	$77,251	$76,665	$84,807
NASA	• **Total income**, all licenses active in FY	$3,651	$2,802	$3,144	$4,517*	$3,506
	• **Invention licenses**	$3,462	$2,725	$2,288	$4,229*	$3,369
	• **Total Earned Royalty Income**, (ERI)	$1,520	$1,711	$732	$2,280*	$1,504
USDA	• **Total income**, all licenses active in FY	$3,634	$3,978	$5,383	$3,647*	$4,005
	• **Invention licenses**	$3,634*	$3,978	$5,383	$3,647*	$4,005
	• **Total Earned Royalty Income**, (ERI)	$2,682*	$3,010*	$4,422*	$3,075*	$3,137

Table 5: Income from Licensing (Dollars reported in thousands) *(continued)*

		FY 2007	FY 2008	FY 2009	FY 2010	FY 2011
VA	• **Total income**, all licenses active in FY	$358	$141	$202	$167	$401
	• **Invention licenses**	$358	$141	$202	$167	$401
	• **Total Earned Royalty Income**, (ERI)	n/a	n/a	n/a	n/a	n/r
TOTAL	• **Total income**, all licenses active in FY	$150,713	$171,333	$155,041	$144,190	$167,543
	• **Invention licenses**	$124,595	$162,140	$148,635	$138,810	$147,349
	• **Total Earned Royalty Income**, (ERI)	$94,119	$117,921	$112,020	$107,677	$117,054

- DHS began compiling and reporting data in 2008.
* Updated to reflect corrected data.
n/a – Data not available from agency.
n/r – Data not reported.



CHAPTER 3
Outcomes and Impact of Technology Transfer Activities

Reports of the successful transfer and use of federally developed technologies cut across industrial sectors and demonstrate the broad impact of Federal agency technology transfer activities. The case studies provided below are examples of some of the downstream outcomes arising from technology transfer activities.

Department of Agriculture (USDA)

USDA broadly defines technology transfer as the adoption of research outcomes (i.e., solutions) for public benefit. These science-based innovations from USDA intramural research create new or improved technologies, processes, products and services that benefit the Nation by increasing productivity, increasing efficiency (keeping costs low) and enhancing global competitiveness for the U.S. agriculture sector. Thus, technology transfer functions are critical to accelerating utility of public R&D investments, creating economic activity, and promoting job creation and sustainable economic development.

Agricultural Research Service (ARS) ARS is USDA's principal intramural scientific research agency. Agency goals are to find solutions to agricultural problems that affect Americans every day, from field to table, such as (a) protecting crops and livestock from pests and diseases, (b) improving the quality and safety of agricultural products, (c) determining the best nutrition for people from infancy to old age, (d) sustaining our soil and other natural resources, (e) ensuring profitability for farmers and processors, and (f) keeping costs down for consumers.

Animal and Plant Health Inspection Service (APHIS) – Wildlife Services (WS) APHIS-WS provides Federal leadership and expertise to resolve wildlife conflicts and creates a balance that allows people and wildlife to coexist peacefully. Current program activities include threatened and endangered species conservation, the protection of public health and safety, wildlife disease surveillance and monitoring, a nationally coordinated research effort, and other activities and programs.

Forest Service (FS) The mission of FS is to sustain the health, diversity, and productivity of the Nation's forests and grasslands to meet the needs of present and future generations. Established in 1905, FS directly manages 193 million acres of public land in national forests and grasslands, and works with state forestry agencies and other partners to assist in managing 491 million acres of state and private forest lands.

More information about USDA technology transfer:
Agricultural Research Service: http://www.ars.usda.gov/partnering
Animal and Plant Health Inspection Service: http://www.aphis.usda.gov/wildlife_damage/nwrc/
Forest Service: http://www.fs.fed.us.

Highlights from Some of the Agency's Technology Transfer Activities

Flash Pasteurization, Food Safety, and Intervention Technologies

Flash Pasteurization uses bursts of steam to inactivate microorganisms on the surfaces of raw and processed meat products immediately prior to packaging. Flash Pasteurization is derived from the Vacuum-Steam-Vacuum process invented at the ARS's Eastern Regional Research Center. The Flash Pasteurization technology was developed as part of a CRADA between ARS and an industry partner. Flash Pasteurization, used in combination with "generally recognized as safe" antimicrobials, has now been commercialized for the decontamination of frankfurters and over $1 billion of product has been treated by the process in North and South America. For this work, the engineers and scientists involved won the ARS Outstanding Technology Transfer Award for 2008 (top honor) as well as the 2011 Federal Laboratory Consortium Excellence in Technology Transfer Award.

Testing and Screening for Veterinary Drug Residues

ARS researchers developed, extensively validated, and transferred to the Food Safety and Inspection Service (FSIS) a pair of advanced methods with fast sample throughput and much better performance to screen and identify 67 priority veterinary drug residues in meat samples. The new approach uses rapid extraction, followed by ultrahigh performance liquid chromatography – tandem mass spectrometry, to cover the existing drugs monitored below regulatory tolerance levels, and also expands the range to include many priority drug residues previously missed. FSIS is in the process of implementing the new approach, which is the central innovation leading FSIS officials to devise a more efficient and effective overall National Residue Program for residue monitoring and regulatory actions. This development is a major improvement over the FSIS's currently used combination of three (comparatively inefficient) screening tests, which are capable only of determining classes of drugs responsible for positive drug residue results. Use of the advanced ARS methods will ensure that every food animal is properly screened in thousands of slaughter establishments across the United States. This screening will protect the public from exposure to potentially harmful residues.

Xylose Fermenting Yeast

In the United States, there is considerable interest in developing alternative energy sources to reduce dependence on foreign oil and nonrenewable energy. The use of ethanol as a fuel has become increasingly prevalent in recent years. Biomass can be used to produce ethanol, but the high concentrations of xylose in biomass make metabolization into ethanol inefficient and not economically feasible. New yeast strains developed by USDA Forest Products Laboratory (FPL) and the methods to use them are needed to develop a more efficient means of bioethanol production. A clean technology company serving the global biofuels industry has licensed a yeast technology that was co-developed by researchers from the USDA Forest Service and the University of Wisconsin – Madison. This technology is associated with the fermentation of C5 sugars, such as xylose, to ethanol. The license marks the culmination of several CRADAs.

Boll Weevil Migrant Detection and Tracking

A multidisciplinary USDA-ARS team developed a highly effective technology package (boll weevil migrant detection and tracking technology) that facilitates cost-effective protection of boll weevil eradication zones from re-infestation. Real-world application of the package has improved detection of weevil populations and their source regions by identifying weevil genetics and pollen taxa associated with captured weevils, enhancing the use and interpretation of pheromone traps, and simulating weevil migratory flight pathways. In response to critical pest management issues raised by Boll Weevil Eradication Program leaders, APHIS, the National Cotton Council, Cotton Incorporated, and other major cotton stakeholders, the team developed, reported and transferred the technologies for operational implementation in the Eradication Program. With financial support from the Cotton Foundation and after training by ARS team members, APHIS is now capable of performing the genetics work necessary to conduct weevil population assignment analyses. Adoption and effective application of this boll weevil migrant detection and tracking technology package have, over the past several years, resulted in direct savings to the cotton industry in excess of $1M annually and have greatly enhanced the capability of the Eradication Program to efficiently protect against and mitigate post-eradication re-infestations. This technology was transferred through public release.

Department of Commerce (DOC)

At the Department Commerce, R&D is conducted at the National Institute of Standards and Technology (NIST), the National Oceanic and Atmospheric Administration (NOAA), and the Institute for Telecommunication Sciences (ITS) within the National Telecommunications and Information Administration (NTIA). More information about DOC technology transfer is available on the following websites:

- NIST: http://www.nist.gov/tpo/
- NOAA: http://www.noaa.gov
- ITS: http://www.its.bldrdoc.gov/media/1558/technology_transfer.pdf

National Institute of Standards and Technology (NIST) NIST's mission is to promote U.S. innovation and industrial competitiveness by advancing measurement science, standards, and technology in ways that enhance economic security and improve quality of life. NIST laboratories develop and disseminate measurement techniques, reference data, test methods, standards, and other technologies that support U.S. industry, academia, scientific research, and the activities of many federal agencies. In carrying out its mission, NIST partners directly with industry, academia, associations, and other government agencies.

National Oceanic and Atmospheric Administration (NOAA) NOAA's mission is: to understand and predict changes in climate, weather, oceans, and coasts; to share that knowledge and information with others; and to conserve and manage coastal and marine

ecosystems and resources. NOAA's mission will become ever more critical in the 21st century as national issues related to climate change, limited freshwater supply, ecosystem management, and homeland security intensify.

The Institute for Telecommunication Sciences (ITS) ITS is the chief research and engineering arm of the NTIA. ITS supports NTIA telecommunications objectives of promoting advanced telecommunications and information infrastructure development in the United States, enhancing domestic competitiveness, improving foreign trade opportunities for U.S. telecommunications firms, and facilitating more efficient and effective use of the radio spectrum. ITS also serves as a principal Federal resource for solving telecommunications concerns of other Federal agencies, state and local governments, private corporations and associations, and international organizations.

Highlights from Some of the Agency's Technology Transfer Activities

NIST Reference Data for Machining Helps Industry to Improve Models and Simulations
NIST's unique experimental setup for analyzing fundamental process characteristics for machining of metals is used to generate a wealth of data that are used by companies in the manufacturing industry, such as GE Aerospace, Boeing, Pratt & Whitney/United Technologies, and Kennametal, through their use of commercially available modeling software developed by Third Wave Systems (TWS).

NIST's setup includes state-of-the-art dual spectrum (visible and infrared), high-speed camera enabling simultaneous visible and infrared images to measure temperature distribution, strain, and strain rates at the material-cutting tool interface to validate and improve machining simulation models.

Commercialization of NIST Atomic Clock Technology
The NIST Time and Frequency Division has become a world leader in research, metrology, and development of chip-scale atomic clocks (CSACs) and similar chip-scale atomic devices, including magnetometers and gyroscopes. The program began with the in-house development of a miniature all-optical atomic clock, which led to subsequent support from DARPA for development of microminiature versions. Today, NIST's CSAC technology, which was invented and nurtured within the Time and Frequency Division, has been successfully transferred to industry. For example, Symmetricom, Inc., from its manufacturing base in Beverly, Massachusetts, has begun commercial deliveries of CSACs, and Honeywell and Teledyne have development programs for captive applications of the CSAC technology. NIST continues to assist in the development and commercialization of the technology. CSACs will enable portable, low-power electronic devices to have greatly improved performance and innovative new functionality.

The CSAC product unveiled by Symmetricom weighs less than 35 grams (about 1.25 ounces) and operates on only 115 milliwatts of 3.3 VDC power. It serves as a precise and stable oscillator that is more than two orders of magnitude better than quartz-oscillator technology.

Taking advantage of the improved performance of CSACs, GPS receivers can determine their position more quickly and operate more reliably under impaired conditions. Systems that depend on GPS, such as cellular telephone networks, can hold synchronization longer during GPS signal interruptions. And where GPS is not available at all, for example underwater, early adopters of CSACs include makers of underwater seismic sensors—hydrophones or geophones using time difference-of-arrival techniques.

In military applications, CSACs can be used in backpack-mounted radios and IED jammers needed in unimproved environments, such as Afghanistan, where 70 percent of patrols move on foot because of the lack of roads. These applications require precise synchronization so that soldiers do not jam their own communications and navigation systems, while blocking detonation signals. The CSACs' low power consumption and increased stability significantly reduce the weight of the batteries that the soldiers must carry, and allow longer mission durations.

Making Connections for Microfluidic Technology

Researchers and industry practitioners of microfluidic technology—a cutting-edge approach used, for example, to develop advanced medical assays or to examine the behavior of complex fluids—face a universal problem. Fabricating the tiny channels, chambers and valves inherent to microfluidic "lab-on-a-chip" devices is now routine, but the means of connecting these devices to the pumps and the analytical equipment needed to support them involves a haphazard collection of gluing, clamping and awkward screw ports. To address this problem, NIST researchers developed and patented an elegant system of magnetic connectors that enable supporting tube lines to be attached to the input and output ports of microfluidics devices in a convenient, rapid and reliable way. Whereas gluing connections can take hours, the magnetic connectors hook up in seconds, and over the range of pressures used in microfluidics, they do not leak.

In 2010, SFC Fluidics LLC, a small business headquartered in Arkansas, licensed the NIST magnetic connector technology. Over the last year, SFC Fluidics has successfully established and marketed an entire product line of QuickConnect™ devices that leverage nearly every innovation described in the NIST patent application. QuickConnect™ products can rapidly attach single lines and tube manifolds to microfluidic devices, and they can be switched to other devices in seconds. In addition, one type of connector can act as a valve to control flow to devices. The innovative magnetic microfluidic connectors invented by NIST scientists will help researchers more efficiently prototype and test lab-on-a-chip platforms and will potentially accelerate the development of technologies such as point-of-care medical devices.

Hail and Severe Storm Risk Management Initiative

NOAA's National Severe Storm Laboratory (NSSL) and Atmospheric and Environmental Research (AER) of Lexington, Massachusetts, are collaborating on research and development of operational weather risk management solutions for insurance and other industries impacted by severe storms. Storm-related damage is a growing problem for insurance carriers and their

customers. AER uses targeted scientific analysis and builds applications for business to pinpoint the location and severity of weather events like straight-line winds, hail, rain and tornadoes.

The alliance combines NSSL's resources in weather radar data processing with AER's expertise in providing data-driven solutions that improve industry practice. As part of a CRADA, NSSL provided AER access to high-resolution radar data across the continental United States, which allowed AER to develop new weather risk management products and to test the products in the insurance industry. AER in turn provided NSSL with insurance industry feedback and quality control assessments, allowing NSSL to improve its weather radar algorithms.

AER also announced the AER Respond™ hail analysis service, which leveraged NSSL data to enable insurance carriers to reduce loss adjustment expense and cycle times by integrating property-specific analytics into the hail claims workflow. The expanded real-time hail and rain capabilities complement AER's existing services related to hurricanes, wildfires and other natural hazards.

Pathogen spread, risk model

This year, NOAA transferred a model to Maryland that forecasts where and when pathogens are most likely to be found in the Chesapeake Bay based on salinity and temperature of the water in a given location. The model generates three-day forecasts for state and county health officials. They, in turn, use these forecasts to target water quality monitoring, and to put out public health messages at high risk times. When pathogens are present, cooking shellfish and washing open wounds after contact with coastal waters minimizes risk of infection and sickness. Not only is this partnership reducing the number of people getting sick from pathogens, but it is saving these offices money because they can limit their monitoring to the places and times that are most problematic.

Department of Defense (DoD)

The purpose of the DoD's Technology Transition program, managed by the Defense Laboratories Office, is to ensure, to the maximum extent practicable, that technology developed for national security purposes is integrated into the private sector of the United States in order to enhance national technology and industrial base, reinvestment and conversion activities.

DoD is unique in applying the principles, practices, and tools of technology transfer in the execution of its mission. DoD funds and develops mission-focused technology, and technology transfer statutory authorities enable it to promote and facilitate the commercialization of that technology for both military and civilian purposes. Concurrently, DoD is a technology buyer, as it strives to purchase new technology embodied in products and systems to meet the challenges faced by our warfighters. In many instances, technology transfer and technology transition are becoming a seamless path to fielding new technology critical to responding to the new and dynamic threats of asymmetric warfare, the global war on terrorism, and the ever-expanding

role of civil assistance and disaster recovery worldwide. In the 1980s, when much of the technology transfer legislation was enacted, the Federal Government, including DoD, was the principle funding source for R&D. Consequently, technology transfer was viewed as a "spin out" to the marketplace, a stimulus to the domestic economy, and a return on investment for taxpayer-funded R&D. Today, the majority of U.S. R&D is industry-funded. This shift in funding has led to a greater emphasis on technology transfer as a collaborative effort between DoD labs and their partners in industry, academia, and state and local government.

Each of the Military Services, the Defense Agencies, and the Office of the Secretary of Defense

(OSD) maintains technology transfer websites to inform the public and make available general information.

The websites are:
http://www.arl.army.mil/main/Main/default.cfm?Action=6
http://www.onr.navy.mil/en/Science-Technology/Directorates/Transition/Technology-Transfer-T2.aspx
http://www.wpafb.af.mil/library/factsheets/factsheet.asp?id=6026
http://www.mda.mil/business/tech_apps.html
http://www.jfcom.mil/about/industry.htm

Department of Energy (DOE)

The Department of Energy's 17 national laboratories conduct much of its fundamental and applied research, and they license to and collaborate with industry and academia to develop and commercialize products and processes for commercial use. Technology partnering is an active component of DOE's overall mission to promote scientific and technological innovation that advances the economic, energy, and national security interests of the United States. Technology transfer is carried out at all 17 DOE national laboratories as well as at 5 other DOE research and/or production facilities. The contractor-operated laboratories and facilities are authorized and required to conduct technology transfer by provisions in DOE's laboratory management and operating (M&O) contracts. Motivated by mutual self-interest and notably without transfer of Federal funds to the non-federal partners, these arrangements provide a means for collaboration and cooperation between DOE and the private sector, and allow each party to leverage resources to achieve its mission.

In FY2011, DOE issued a new Secretarial Policy Statement on Technology Transfer at DOE Labs and Facilities. The updated policy reflects a deepening commitment by DOE to guide, strengthen and highlight the importance of its technology transfer efforts. It underscores nine principles to guide its technology transfer program within DOE's statutory authorities:

1. Commitment to continuously improving its policies and procedures for effective technology transfer in support of its mission, and for the Nation's benefit.

2. Empowerment of innovators who discover and develop technologies at DOE Labs and Facilities.
3. Fairness of opportunity and U.S. competitiveness considerations.
4. Facilitation of commercialization transactions involving partners with viable business plans for expeditious technology development and deployment.
5. Assuring visibility of DOE Labs and Facilities to promote access to capabilities and intellectual property.
6. Leveraging of its resources in partnering transactions to complement DOE's mission, goals and objectives and demonstrably benefit the United States.
7. Assuring and measuring impact with identified measurable outcomes that are effective indicators of success and impact.
8. Predictability, streamlined processes, transparency, and appropriate flexibility in the application of policies governing technology transfer activities.
9. Cooperation throughout the DOE complex for sharing best practices and lessons learned in order to further technology transfer at the DOE, for collaborating in commercialization, for maximizing flexibility and to eliminate and avoid unnecessary barriers in order to achieve positive impact.

In FY2011, the DOE Laboratories and Facilities began tracking new measures of technology transfer that more closely measure impact. Data for these elements are presented below without reference to earlier years, for which no data were collected:

Startup Companies: 24
A company is counted as a startup if it is a new company formed in the reporting year (with or without laboratory employee involvement) based on a license for laboratory intellectual property and with a business plan based largely on DOE technology.

Commercialized Technologies: 858
A commercialized technology has been defined as a product, process, method or service that incorporates at least one DOE-developed technology and is in the marketplace, actively licensed, or otherwise provided to a non-federal entity.

Personnel Exchanges Initiated: 1,604
A personnel exchange is defined as a limited-term exchange of personnel between a non-Federal organization and a DOE laboratory/facility to share knowledge, supported by a written agreement, with or without funding.

Science Education Activities Performed: 29,809

An activity in science education is reported for individuals participating as follows:

1. Undergraduate Interns
2. Special Short Course Technical School Attendees such as "Microscope School," etc. (presuming these schools are for several days or a week or more)
3. Graduate Students involved in thesis work on site
4. Post Doctoral Appointees
5. Faculty - Student Teams -- Under the "FAST" Program. This is typically a faculty member and two students.
6. Teacher Education Programs

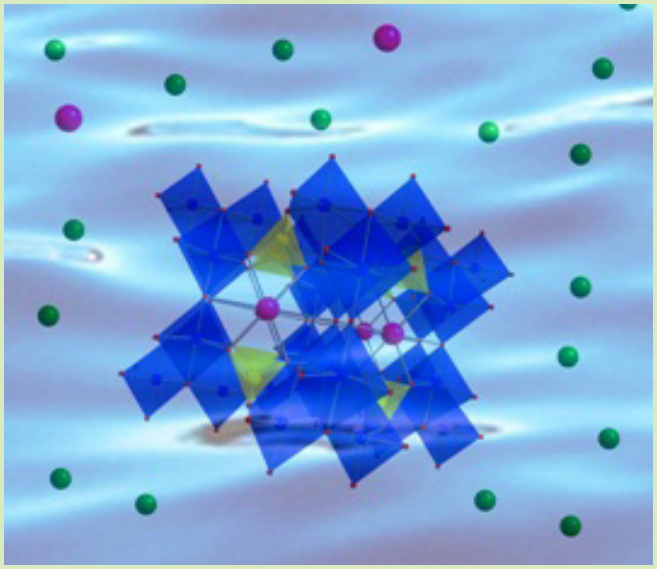
Technical Scientific Results Published: 12,968

Technical scientific results are reported as published when a technical or scientific paper is published in a primary journal and reviewed by scientific peers.

Highlight from Agency's Technology Transfer Activities

Fukushima clean-up aided by Sandia National Laboratories technology and researchers

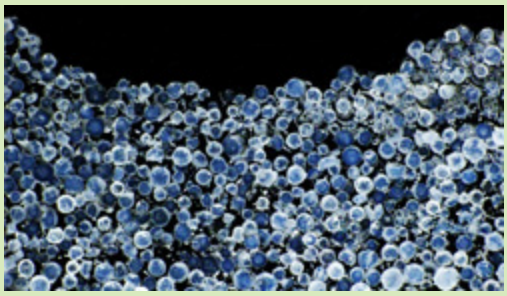
Following the March 11, 2011 earthquake and tsunami in Japan, seawater was used to cool the severely damaged reactors, leading to radioactive cesium contamination in the wastewater. Researchers at Sandia National Laboratories and UOP LLC, a Honeywell company that licensed wastewater cleanup technology from Sandia, showed that crystalline silico-titanate, or CST, a molecular sieve that can separate highly volatile elements from radioactive wastewater, can also be used to decontaminate salt water. In the days after the disaster in Japan, Sandia researchers and UOP employees separately conducted extensive testing to determine the efficacy of CST in removing cesium from contaminated saltwater. The technology was deployed to remove radioactive material from more than 43 million gallons of contaminated wastewater at the Fukushima Daiichi site.



Crystalline silico-titanate, or CST, is an inorganic molecular sieve that can capture and separate highly volatile elements from radioactive wastewater. Image: Sandia National Laboratories

The partnership between Sandia and UOP began in the early years of technology transfer at Sandia, with UOP first licensing CST technology in 1994, the year after the technology transfer was begun at Sandia. The technology was further developed through a Cooperative Research and Development Agreement between Sandia and UOP. In 1996, CST work by Sandia, Texas A&M, and UOP won an R&D 100 award. Sandia has extended UOP's licenses for CST technology through 2017, when the last of the patents expires. This received an Excellence in Technology Transfer award from the Federal Laboratory Consortium for Technology Transfer (FLC). Sandia National Laboratories is managed and operated by Sandia Corporation, a wholly owned subsidiary of Lockheed Martin Corporation, for the U.S. Department of Energy's National Nuclear Security Administration.

Another winner of the Excellence in Technology Transfer award was the **National Energy Technology Laboratory (NETL) for their Basic Immobilized Amine Sorbent (BIAS) Process for CO2 Capture.** Carbon dioxide (CO2) is considered to be one of the major greenhouse gases responsible for global warming. Consequently, it is critical that CO2 emission into the earth's atmosphere be controlled. The NETL BIAS Process utilizes low-cost, regenerable, solid CO2 sorbents in large-scale fossil fuel-burning power plants. The process entails the novel steps of (1) treating an amine compound (composed of nitrogen and hydrogen atoms) to make it more selective and reactive towards CO2; (2) depositing the amine onto a porous solid support to formulate the sorbent; (3) utilizing the sorbent to selectively react with CO2 to extract it from the flue gas; and (4) regenerating the sorbent by heating it to release the CO2 for storage, thereby refreshing the sorbent for reuse.



As a result of the technology transfer efforts of NETL, various parties are now ready to adopt the BIAS Process technology for capturing CO2 from power plants and are developing commercial applications. This could lead to a reduction in global warming trends through reduced CO2 in the atmosphere. Pressure Chemicals Company has recently manufactured large batches of the sorbent for pilot-plant testing, and ADA-ES has successfully run this sorbent on a pilot-plant scale. TVA has tested the technology and is interested in its use in power plants. Industrial collaborators of the technology, such as Fuji Silysia Company, LTD., and PQ, Inc., for the porous solid support, Pressure Chemicals Company for the bulk sorbent manufacture, and ADA-ES for actual environmental applications, are eager to commercialize the BIAS Process. Also, an MOU has been signed with NASA to investigate the technology for controlling CO2 levels in enclosed habitats in space. NETL is a government-owned and operated laboratory for the Office of Fossil Energy in the Department of Energy.

And one more winner of the FLC Excellence in Technology Transfer was the **Oak Ridge National Laboratory for their Laser-Induced Fluorescence Fiber-Optic Measurement of Fuel in Oil**. This technology enables a user to measure the accumulation of fuel in engine oil, which can occur as fuel-efficient engines are operated in advanced modes to meet increasingly lower emissions regulations. Fuel found in oil is also associated with the use of biodiesel and fuel injection system control for modern diesel particulate filters. The fuel thins the oil, lowers its lubricating ability, and can lead to higher engine wear, increased oil consumption, and in extreme cases, engine failure. The technology uses a laser and fuel tagged with a fluorescent dye to detect the fuel that has mixed with the oil. When the laser illuminates the diluted oil, it excites the dye, and as the dye returns to its unexcited state, it fluoresces. The emitted light is transmitted to an instrument that determines and records the amount of fuel in the oil. Conventional techniques require sending a sample of the oil to an analytical laboratory, resulting in up to two days delay for results. This new technology can take measurements at many different points in an engine system with a small fiber optic probe; the technique is portable and provides real-time in situ feedback.

The technology was developed under a CRADA project with Cummins, Inc., which raised the need for measurement of fuel dilution of oil. Commercialization of the technology began with a patent license agreement between the UT-Battelle, LLC (the management and operations contractor for ORNL) and Da Vinci Emissions Services, Ltd. The benefit of the technology transfer effort is that a small niche market is now able to operate with significantly improved technology—faster, less expensive, and capable of detecting fuel contamination in lower amounts than other methods. As a result, monitoring oil dilution in an engine can be done in situ, which will enable faster improvements to both engine efficiency and reduced emissions while reducing product development costs. Furthermore, a small U.S. business now has the potential to double in size and eventually move the licensed technology into the global arena. Oak Ridge National Laboratory is managed and operated by UT-Battelle, LLC, for the Office of Science in the Department of Energy.

Department of Health and Human Services (HHS)

Research at the Department of Health and Human Services is conducted by the Centers for Disease Control and Prevention (CDC), the Food and Drug Administration (FDA), and the National Institutes of Health (NIH).

The NIH mission is to seek fundamental knowledge about the nature and behavior of living systems and the application of that knowledge to enhance health, lengthen life, and reduce illness and disability. The NIH Office of Technology Transfer (OTT) is responsible for identifying,

evaluating, protecting, and marketing technologies derived in NIH and FDA intramural laboratories. OTT transfers these technologies through licenses to the private sector, where they can be further developed into products used in the prevention, diagnosis, or treatment of disease.

For more information about the HHS technology transfer program please visit:

- CDC: http://www.cdc.gov/od/ads/techtran/us.htm;
- NIH: http://www.ott.nih.gov/
- FDA: http://www.fda.gov/ScienceResearch/CollaborativeOpportunities/default.htm

Effectively measuring the public health outcomes that result from such technologies is challenging and complex. Traditionally, efforts to measure the effect of technology transfer activities focus on outputs such as the number of patents and licenses or the amount of royalties generated. However, this approach does not depict the full scope of activities.

NIH has created a Product Showcase (http://www.ott.nih.gov/productshowcase/default.aspx) that displays products from its intramural research program utilized every day to detect, treat or prevent disease, or to assist researchers as they continue to explore ways to develop newer and more effective health care products and procedures. The Showcase includes products that are now or have in the past been on the market. Some are FDA-approved and many do not require FDA approval.

Highlights from Some of the Agency's Technology Transfer Activities

AAV Technology: Delivery Vehicle of Choice for Gene Therapy

Adeno-associated viruses (AAVs) are attractive delivery vectors in the field of gene therapy. Gene therapy is on the brink of becoming a common medical practice, but developing safe and effective gene therapy products has been challenging. One major issue has been finding a delivery vector to target the diseased tissues in the body, without often-devastating side effects. NIH developed AAV Type 5-based vectors for delivering gene therapy products into parts of human bodies. AAV5 is a small virus that infects humans but is not known to cause disease, and its only known side-effect is a very mild immune response. These features make AAV5 an attractive delivery vector for gene therapy. In fact, the AAV-based vectors developed at the NIH present a popular choice for gene therapy.

The AAV5 technology has been out-licensed extensively by the NIH OTT, under both commercialization licenses and research use licenses. An exemplary license agreement was a recent exclusive and non-exclusive combination license for the commercial development of AAV5-based gene therapy products. Under this license agreement, Amsterdam Molecular Therapeutics (AMT) will have exclusive rights for developing treatments for a restricted number of disease indications, but non-exclusive rights for developing treatments for other diseases. As such, NIH OTT not only allows enough incentive for the expedited therapeutic

development of AAV5 technology by one licensee, but also ensures the continued availability of AAV5 technology widely to future commercial partners. In support of the NIH's public health mission, NIH OTT also agreed to reduce royalties when AMT collaborates with academic institutions on therapies for ultra-orphan indications. This is just one approach that NIH OTT uses under its license agreements to provide incentives for companies targeting rare and neglected diseases, which broadens the application of NIH technologies to meet public health needs. The technology transfer effort of the NIH OTT has maximized the return on publicly funded research, and the commercialization of the scientific discovery of AAV5 technology has advanced the public health mission of the NIH, and will provide direct benefit to patients worldwide.

Launch of MenAfriVac

The launch of MenAfriVac®, a low-cost meningitis vaccine for sub-Saharan Africa, provides a compelling story of interagency and inter-institutional collaboration to meet a global health need. Meningitis infection can result in deafness, mental retardation, seizures, paralysis, and death. Although group C meningitis vaccines were developed in the 1960s, they had little effect in the meningitis belt of Africa, where nearly half a million people live and where group A meningitis, not found in industrialized countries, prevails.

Under a 2004 license agreement, NIH OTT transferred conjugate vaccine technology, developed by FDA inventors Drs. Che-Hung Robert Lee and Carl Frasch, to the non-profit organization PATH (Program for Appropriate Technology in Health) of Seattle, Washington, through PATH's Meningitis Vaccine Program (MVP) to facilitate product development. The result was the successful launch of a first vaccine whose development was tailored to meet the needs of a specific region.

With a focus on meeting the public health goal, NIH OTT provided PATH with the appropriate flexibility to form multiple partnerships to manufacture the vaccine. The agreement included the right to sublicense the non-exclusively licensed technology, which was atypical at that time for nonexclusive licenses and critical to allowing PATH to partner with the Serum Institute of India at essentially no cost. In exchange for technology know-how, Serum Institute is able to produce the vaccine at less than $0.50 per dose.

The license agreement also provides for distribution of millions of doses royalty-free, which are needed to support adoption of the new vaccine, as acceptance of new vaccines into any market can pose challenges. An initial vaccination campaign began in December 2010 in Burkina Faso, Mali, and Niger (three countries in which meningitis is considered hyperendemic). So far, nearly 20 million doses have been administered and much illness and many deaths have been averted.

Department of Homeland Security (DHS)

The DHS's Technology Transfer Program is housed in the Science and Technology Directorate within the Public-Private Partnerships Office. The Technology Transfer program is responsible for developing and instituting policies to facilitate technology transfer in accordance with 15 U.S.C. § 3710 throughout DHS and its laboratories. The responsibilities include:

- Standardizing and CRADAs, licensing, and other technology transfer agreements;
- Preparing application assessments for selected research and development projects in which the DHS Laboratory is involved and may have commercial application;
- Providing and disseminating information on federally owned or originated technologies which have potential application to state and local governments and private industry;
- Preparing and providing an annual report to Congress and the President through submission to NIST;
- Developing training programs on technology transfer and intellectual property for DHS employees; and
- Establishing an intellectual property program for DHS to track and prosecute patents and other intellectual property, and to develop a royalty and rewards policy.

For more information about DHS technology transfer, please visit: http://www.dhs.gov/technology-transfer-program.

The DHS has laboratories with varying capabilities throughout the United States. With the exception of the Coast Guard Research and Development Center and the Federal Law Enforcement Training Center, the DHS laboratories listed are within the Science and Technology Directorate. Data included in this report were provided by:

- Chemical Security Analysis Center (CSAC)
- Coast Guard Research and Development Center
- National Urban Security Technology Laboratory (NUSTL)
- National Biological Analysis and Countermeasures Center (NBACC)
- Plum Island Animal Disease Center (PIADC)
- Transportation Security Laboratory (TSL)
- Federal Law Enforcement Training Center (FLETC).

Highlights from Some of the Agency's Technology Transfer Activities

Joint Technology Transfer Initiative

DHS and the U.S. Army Medical Research and Materiel Command (USAMRMC) entered into a partnership with the Maryland Technology Development Corporation (TEDCO) through the Joint Technology Transfer Initiative (JTTI). The JTTI, a Congressionally-funded program, awards up to $75,000 to for-profit, small businesses that have a proposed technology that will meet the needs of DHS and/or the U. S. Army Medical Research and Materiel Command (USAMRMC).

As a result of this partnership, DHS entered into collaborative agreements with three Maryland companies: TRX Systems, Inc.; Smart Imaging Systems, Inc.; and Emerging Science and Technologies (ES&T) Group, Inc.

- TRX Systems, Inc., located in Greenbelt, MD, developed the Sentrix system, which provides the capability to track personnel in global positioning system (GPS)-denied environments. The Sentrix system uses ranging data to provide corrections to the estimated position of the tracked individuals. The DHS Science and Technology Directorate (S&T) Infrastructure Protection Division entered into an agreement with TRX Systems, Inc., to implement and pilot test the GPS-denied tracking integrated with radio frequency (RF) ranging.
- Smart Imaging Systems, Inc., located in Beltsville, MD, is building the world's smallest X-ray scanner mounted on a small robot for inspection of unidentified and suspicious objects. The system can be driven inside buildings and can be easily deployed by first responders. The DHS S&T Explosives Division entered into an agreement to collaborate on the development of the next generation X-ray imaging system for threat diagnostics.
- ES&T, Inc., located in Boonsboro, MD, developed an early-stage technology, MEDUSA, to disable blasting caps by introducing electrical energy in a specific sequence of voltage, current, and waveforms. The DHS S&T Explosives Division entered into a CRADA to investigate the DaveyFire bridgewire detonator's physical, material, and metallurgical failure aspects.

TEDCO awarded each company $75,000 to participate in collaborative efforts with DHS.

Technology Optimization Partnerships (TOPs)

In FY 2011, the DHS Transportation Security Laboratory (TSL) continued to help technology developers mature their products with several CRADAs through TSL's Technology Optimization Partnerships (TOPs) process. The TOPs process assists with expediting the maturation and deployment of technologies aligned with the DHS S&T mission. Through CRADAs and the TOPs process, TSL conducts research, development, test and evaluation activities to help CRADA partners advance their technologies so that those technologies meet performance requirements. With the use of CRADAs, the TOPs process provides industry a means to bring emerging technology to TSL, enabling them to obtain test samples, have their system evaluated, and provide technical input that assists in the maturation of such technology. Additionally, the TOPs process can provide requirements-based information to technology developers through rigorous test and evaluation by subject matter experts at TSL. Three levels of partnerships have been created to support system development, selection of which depends on the different stages of the CRADA partner's technological readiness:

- Exploratory TOPs (eTOPs): For early proof-of-concept, feasibility, or laboratory experiments.
- Readiness Assistance (RA): For partners providing working prototypes or production-ready systems who wish to receive test and evaluation data and development guidance; may or may not be correlated to a particular acquisition window.
- Readiness Testing (RT): For partners involved in a certification or qualification window.

[4]P.L 108-426, November 30, 2004 (118 STAT.2423).

In FY 2011, TSL applied the TOPs process, which resulted in a partnership agreement through the use of CRADAs, to support a major DHS initiative for enhancing the efficiency of airport checkpoint technology. While several different instruments can detect explosives on persons and in carry-on bags, these technologies must be matured to meet the requirements for effectiveness, efficiency, and passenger privacy. Through Readiness Assistance TOPs, CRADA partners used TSL test methodology to improve the performance of Advanced Technology Checkpoint X-ray Equipment for carry-on articles as well as Advanced Imaging Technology (AIT) Suicide-bomb Detection Equipment. By utilizing technology transfer, these two significant advances in explosive detection are closer to being deployed and integrated into checkpoints.

In FY 2011, TSL started on Readiness Testing TOPs for AITs; TSL entered into two CRADAs with AIT system manufacturers and will be entering into more in 2012 and beyond. For this effort, TSL began developing innocuous test articles that simulate actual explosives to aid in testing and evaluation of both X-ray and millimeter wave AIT platforms. TSL played a key role in the evaluation of both the original and modified AITs, which use automated threat recognition and an "avatar" outline of a person. The development of test articles and appropriate use protocols was significant in that it rapidly established the safety protocols for data collection necessary for the development of automatic threat recognition of explosives and weapons. Each CRADA partner will be able to further improve the performance of its technology following the TOPs interaction with TSL.

Through several CRADAs, TSL was able to assist vendors of Advanced Technology Checkpoint X-ray equipment in FY 2011. TSL assisted with the development of the enhanced performance of Advanced Technology Checkpoint X-ray equipment by providing CRADA partners with data and information to develop "smarter" algorithms and then validate the performance of these algorithms. With TSL's help, these advanced technology systems will decrease the amount of time necessary to screen carry-on luggage at checkpoints, and benefit both the government and the American public.

The Richard Stockton College of New Jersey

TSL continues to share benefits from a CRADA with The Richard Stockton College of New Jersey. Located within a few miles from one another, Stockton students and faculty work with TSL scientists on a range of research efforts. For example, incoming freshmen students are provided with opportunities to enroll in Stockton Chemistry "Honors" Classes, allowing them to be trained on homeland security-related chemistry projects. As these students advance in their academic career, they perform advanced independent research and have the opportunity to work at TSL as summer interns.

In Fiscal Year 2011, Stockton and TSL collaborated on several different projects, including the work by Stockton/TSL summer interns on an advanced vapor generator system (in TSL labs). In the future, this vapor test bed will be the single tool used to test and evaluate trace explosive vapor detectors for DHS and its collaborators. In addition, research was performed

at Stockton College under the guidance of Stockton professors and TSL scientists regarding exploration into the shelf life stability of TSL Trace Explosive Test and Evaluation standards; specifically, the research was on the effect of light on those explosive test standards. Stockton has also provided access to scientific equipment and facilities for an assortment of TSL-hosted technology meetings, research, and workshops. Along these lines, TSL scientists have given presentations at the College to help students better understand science and technology issues related to homeland security. In general, these and other projects will continue into the future for the greater success of TSL and the education of Stockton College science technology engineering and math (STEM) students.

Department of the Interior (DOI)

The United States Geological Survey (USGS) The mission of the USGS is to serve the Nation by providing reliable scientific information to describe and understand the Earth, minimize loss of life and property from natural disasters, manage water, biological, energy, and mineral resources, and enhance and protect our quality of life.

Since delivery of science information is a primary purpose of the agency, technology transfer activities with the public sector and the private sector, including academia and non-profits, typically support the collection and transfer of scientific data (knowledge dissemination). The USGS cooperates with its public and private collaborators to help them maintain necessary services, better understand the environmental consequences of their commercial and non-commercial activities, and develop new products and services. For more information please visit: http://www.usgs.gov/tech-transfer/index.html

Bureau of Reclamation (Reclamation) Reclamation is responsible for water and hydropower deliveries throughout 17 Western states. Reclamation's stated mission is to "manage, develop, and protect water and related resources in an environmentally and economically sound manner in the interest of the American public." In support of this mission, Reclamation operates 348 reservoirs and 58 hydroelectric plants, making it the Nation's largest wholesale water supplier and the second-largest producer of hydroelectric power in the West. Reclamation conducts and sponsors research in the following four mission-related focus areas:

- Water & Power Infrastructure Reliability & Safety
- Water Delivery Reliability
- Reservoir & River Operations Decision Support
- Water Supply Technologies

Reclamation research solutions demonstrate mission relevancy by improving Reclamation water management practices, increasing water supply, and/or ensuring cost-effective power generation operations that benefit Reclamation's project managers and stakeholders, the

western water community, other Federal agencies, the non-federal sector and the general public. The broad scope of some of Reclamation research solutions can be viewed from the link: http://www.usbr.gov/research/science-and-tech/research/results/index.html.

Highlights from Some of the Agency's Technology Transfer Activities

CRADA to Improve Earthquake Hazard Assessments

The Pacific Gas and Electric Company (PG&E), a publicly regulated utility providing service within California, is engaged in a long-term, multi-element, action-based seismic risk management program to reduce the impact of future earthquakes on the performance of its gas and electric systems, and to maintain acceptable levels of customer service. To further this program, PG&E and the USGS have been involved in a series of CRADAs since 1992.

In 2009, the USGS and PG&E extended their CRADA for five years. In this period, PG&E seeks (1) the development and rapid application of data, methods, and technologies that improve earthquake hazard assessments in the regions where its electric power and natural gas facilities, service centers, and office buildings are located and where its customers live and work; and (2) the improvement of emergency response to earthquake occurrence by incorporating real-time earthquake hazard information.

Determining If Attic and Wall Insulation Is Contaminated

The USGS owns a pending patent property entitled "Spectral Method for Determining the Source of Vermiculite Insulation in Attics and Walls" which may be used to determine both the source of vermiculite, an ore used in attic insulation, and whether it is contaminated with fibrous amphiboles (which are types of asbestos). Approximately 1 million homes in the United States use expanded vermiculite attic insulation. Before 1990, there were four primary sources of vermiculite in the world, in (1) Enoree, South Carolina, (2) Louisa, Virginia, (3) Libby, Montana, and (4) Palabora, South Africa. Health studies in Libby, Montana, showed that fibrous amphibole was present in significant quantities in the vermiculite taken from the Libby mine but was not found in significant quantity at the other major vermiculite sources. A strong connection was found between the presence of fibrous amphibole in vermiculite and incidences of asbestos-related lung disease. Prior to its closing in 1990, the Libby mine supplied up to 80 percent of the world's vermiculite.

Greater awareness of the potential health risks posed by exposure to fibrous amphiboles in connection with preparing for home improvements or maintenance has engendered increasing interest in determining the personal risk of asbestos exposure. The method currently in use involves taking vermiculite samples to off-site laboratories for analysis. This is time-consuming (results take a week or more to obtain), costly, and generates hazardous waste that must be disposed of properly. The USGS invention addresses these shortcomings by employing portable field spectrometers to measure the wavelengths and intensities of a material's radiation spectrum. Such measurements can reveal, on the spot, the source of the analyzed vermiculite as well as the presence of any asbestos contamination. This is a significant improvement over the current method.

Borehole Geophysical Logging for Ground and Surface Water Monitoring of an Ecologically Sensitive Aquifer

In 2010, the USGS's Fort Lauderdale Water Science Center entered into a Technical Assistance Agreement (TAA) with Florida Power & Light Company (FPL) to collaborate on a study of salinity intrusion into groundwater at FPL's Turkey Point Nuclear Plant in southeastern Florida. This power plant uses a recirculating cooling system. The salinity of the cooling water is greater than natural groundwater salinities in the highly permeable carbonate Biscayne aquifer located in the area. Aquifers in terrain with landforms and hydrology created from the dissolution of soluble rocks, also known as karst aquifers, are highly vulnerable to contamination due to the hydrogeology of the landscape. In the U.S., about 40% of the groundwater used for drinking comes from such aquifers. Because of this vulnerability of the Biscayne aquifer near the Turkey Point plant, a monitoring plan for groundwater was implemented.

Recirculating cooling systems at thermoelectric power plants are of considerable interest to USGS because engineered cooling systems are common in populated areas. Power plants are the third largest consumptive users of water, after irrigation and industry. The Turkey Point site is important because the facility is located several miles away from public water supply well fields and is adjacent to sensitive ecological areas. As the primary Federal science agency for water-resources information, the USGS is responsible for monitoring the quantity and quality of water in the Nation's rivers and aquifers and assessing the sources and fate of contaminants in aquatic systems. The goal of the TAA was to study the effect of salinity and temperature differences and aquifer heterogeneity on density-driven convection, and the combined impact on surface water, groundwater, and ecologic conditions at the Turkey Point Nuclear Plant.

A primary task in the TAA was the construction of 14 groundwater monitoring well sites in and around the power plant. USGS staff used geophysical logs and observations of rock core to identify the base of the Biscayne aquifer and zones of higher permeability within the aquifer, and to plan the construction of several additional monitoring wells.

In FY 2011, the TAA was amended to include applied research involving near-surface geophysical methods. The information collected using these methods will allow collaborators to determine which combinations of methods provide the type of information required for developing the surface geophysical monitoring strategy. This will add to the overall scientific knowledge on density-driven interaction between surface water with elevated salinities and fresh groundwater in a karst carbonate aquifer, and will help monitor, design and plan for the future construction of closed-loop cooling-canal system facilities for power plants.

Next-generation Desalination Membranes

For several years, Reclamation has been conducting research on next-generation desalination membranes and process technologies in partnership with Separations Systems Technology, Inc. (SST) of San Diego, CA. SST is a small, but internationally recognized, private sector research business focusing on desalination membrane separation technologies. The collaboration brings together unique capabilities that catalyze the innovation process. The collaboration is

further enhanced and leveraged through DoD research grants that have been awarded to SST to develop these technologies for DoD applications.

Reclamation funds its research chemists and chemical engineers to team up with research chemists at SST to formulate and synthesize new chemistry targeted at improving the performance of desalination membranes and lowering the overall cost of desalination/water purification processes. Once new promising chemical formulations are identified and synthesized, SST develops new membrane materials for bench and small pilot scale testing. Reclamation tests these materials at the Water Quality Improvement Center, a desalination and water purification technology testing and demonstration facility co-located with Reclamation's Yuma Desalting Plant in Yuma. AZ. Based on this testing, the more promising membrane alternatives are patented, and the search begins for partners among U.S. membrane manufacturers who might help develop and, ultimately, commercialize the technology.

For example, polyamide desalting membranes are the backbone of the desalination industry because of their unsurpassed ability to process and purify higher volumes of water contaminated by salts and other substances. Unfortunately, polyamide membranes deteriorate rapidly when exposed to chlorine, yet chlorine disinfection is essential upstream of the desalination process to control microorganisms to prevent water-borne diseases and to reduce the possibility that these microorganisms would biofoul and clog the membrane. Consequently, a polyamide desalination membrane that tolerates chlorine exposure without sacrificing water production capacity has been long sought by the global desalination industry. Such a material might revolutionize the economics of desalination.

In FY 2011, the U.S. Patent and Trademark Office issued one patent to the Reclamation/SST team for novel chlorine resistant polyamides and their associated desalination membranes. An additional related patent application was pending. The patent and patent application also includes a third collaborating inventor from the University of Denver, who contributed chemical expertise to the research team and contributed to the invention.

Also in FY 2011, with patent advice from USDA-ARS under an existing interagency agreement, the Reclamation/SST team submitted two additional patent applications to the U.S. Patent and Trademark Office. One is for a more effective cellulose acetate desalination membrane. While polyamide membranes are the dominant type in use today, about 25% of desalination plants utilize cellulose acetate membranes. The latter allow more salts to pass through the membrane and require higher operating pressures than polyamide membranes. While improving water supply technologies is Reclamation's mission objective, a more effective cellulose acetate membrane could also have broad application in the commercial sector, e.g., the beverage processing industry.

A fourth Reclamation/SST patent application involves advances made in the area of forward osmosis, which is a candidate for the next-generation of desalination technology that utilizes a natural osmotic process instead of the energy-intensive, high pressure, reverse osmosis process commonly used today.

Reclamation, through a formal agreement with its patent partners, has the responsibility to transfer the technology to U.S. industries for commercialization. In FY 2011, with consultation and assistance from the USDA-ARS Technology Transfer Office, and TechComm, which is part of the network of partnership intermediaries used by ARS and DoD, Reclamation conducted a series of initial outreach efforts to U.S. industries. By the end of FY 2011, Reclamation had entered into two material transfer agreements with two separate U.S. industry representatives. One agreement involves the chlorine resistant polyamide membrane ,and the other agreement involves the new cellulose acetate membrane. Under each agreement, the companies will evaluate these new membrane technologies, including manufacturing full scale "operational ready" membranes for side-by-side testing against the standard industry products in actual field conditions at Reclamation's Yuma Desalting Plant and at the U.S. Navy's seawater desalination test facility at Port Hueneme, CA. Reclamation anticipates completing the testing program in FY 2012 and, if appropriate, entering into license agreements with industry to ensure faster and greater utilization of the technologies.

Department of Transportation (DOT)

The U.S. Department of Transportation (DOT) is the federal steward of the Nation's transportation system. DOT consists of multiple modal Operating Administrations, which carry out mission-related Research, Development and Technology (RD&T) programs in support of the DOT strategic goals: Safety; Livable Communities; State of Good Repair; Economic Competitiveness; and Environmental Sustainability. In 2004, the Research and Innovative Technology Administration (RITA) was charged by its enabling legislation (Public Law 108-426, November 30, 2004 (118 STAT. 2423)) with coordination of DOT-wide RD&T and technology transfer activities.
Technology Transfer activities are executed by the following DOT laboratories: Federal Aviation Administration's (FAA's) William J. Hughes Technical Center (Atlantic City, NJ); Federal Highway Administration's (FHWA's) Turner-Fairbank Highway Research Center (McLean, VA); and RITA's Volpe National Transportation Systems Center ("Volpe Center," Cambridge, MA).

For more information about the DOT technology transfer, please visit:
FAA http://www.faa.gov/about/office_org/headquarters_offices/ang/offices/tc/initiatives/ttp/
FHWA http://www.fhwa.dot.gov/everydaycounts/
RITA http://www.volpe.dot.gov/ourwork/techtrns.html

Highlights from Some of the Agency's Technology Transfer Activities

Early Win for NextGen in 2011: Leaner, Greener Aircraft Arrivals
San Francisco (SFO), Los Angeles (LAX) and Miami (MIA) International Airports reported fuel savings and emissions reductions after three years of testing oceanic Tailored Arrival (TA), a project that supports the FAA Next Generation Air Transportation System (NextGen) program

and includes the RITA Volpe Center, FAA air traffic control facilities, NASA, airlines and aircraft manufacturers. In an oceanic TA situation, a properly–equipped aircraft approaching a coastal destination from the ocean follows a path that optimizes fuel use during its descent. TA trials at SFO demonstrated significant benefits including reduced controller and pilot workload by decreasing the number of discrete arrival clearances and radio transmissions; decreased fuel burn and emissions by flying at near-idle thrust engine settings during descent; improved overall efficiency; and predictability of flight paths.

The FAA Office of NextGen Operations Planning led this collaborative project with the active participation and support of RITA's Volpe Center NextGen team. Volpe Center supported the TA test phase by providing project management assistance, analyzing emissions data, developing standard operational and measurement procedures, and accelerating procedural documentation of the trials. For example, Volpe Center aviation measurement experts quantified fuel savings from the TA trials at MIA that demonstrate worthwhile fuel and emissions savings with the new oceanic TA operations, as compared to standard approaches.

With the completion of the flight trial phase, the FAA Air Traffic Organization's En Route and Oceanic Services (ATO-E) took over the management of the TA project. These results have provided an "early win" for NextGen by pointing to future success in advancing economic and environmental benefits as ATO-E replicates the successful trials at other U.S. airports and Air Force bases.

Volpe Center Enhances Rail Passenger Equipment Crashworthiness and Occupant Protection

Protecting train occupants in the event of a collision or derailment is an ongoing area of research investment and attention for DOT's Federal Railroad Administration (FRA). The FRA relies on Volpe Center engineers to improve its understanding of the factors involved in protecting occupants and absorbing crash energy, focusing on the types of structural modifications that can prevent rail equipment from crushing and then limit or control any crush that does occur. Volpe Center engineers have investigated many severe passenger train accidents; staged impact tests; analyzed car-crush zones; and studied train and occupant dynamics to improve accident survivability. The Volpe Center has developed modeling tools and passenger rail equipment design strategies with improved crashworthiness over existing designs. Volpe Center crashworthiness research is being applied as the FRA develops new regulations and supports industry standards.

Volpe Center technical studies on crashworthiness, including locomotive crashworthiness, are widely disseminated and shared with the rail industry, and the application of results from these studies has contributed to safer designs and new standards development for both passenger and freight rail. Through the American Public Transportation Association (APTA) and the Association of American Railroads, the railroads and their equipment suppliers are involved in planning and conducting these studies, to ensure technology transfer. In this regard, results were presented to stakeholders at the 2011 Joint Rail Conference (JRC), where Volpe Center

experts organized and chaired sessions. Findings were documented and disseminated in FRA/Volpe Center reports and in technical papers for the American Society of Mechanical Engineers (ASME), the Transportation Research Board (TRB), and APTA.

FHWA: A New World of Ultra-High Performance Concrete

As the Nation looks to build longer-lasting bridges and more rapidly renew its highway infrastructure, the use of high-strength and high-performing materials is more important than ever. For more than 10 years, FHWA's structural concrete R&D program has worked to take concrete to new levels with the implementation of ultra-high performance concrete (UHPC). Exhibiting superior properties such as exceptional durability, high compressive strength, and long-term stability, UHPC components can facilitate accelerated construction and allow for the use of longer bridge spans. States including Iowa, New York, and Virginia are now beginning to use the new technology. In Buchanan County, Iowa, for example, the construction of the Jakway Park Bridge received a boost with the successful use of a new type of UHPC bridge girder developed through the FHWA R&D program. This was the first bridge in the country to be built using the UHPC technology, demonstrating the viability of the concept from design, through construction, and into everyday use.

UHPC research focal areas are advancing, including through a Transportation Pooled Fund project being conducted in partnership with the New York State Department of Transportation (NYSDOT) and the Iowa Department of Transportation. The project is evaluating the performance of novel field-cast UHPC connections linking prefabricated bridge girders to precast concrete bridge decks. While the use of modular bridge deck components can produce higher quality, more durable bridge decks, the required connections have often been lacking, diminishing the overall system performance. The new UHPC connection eliminates the conflict points between the deck reinforcing bars and the girder shear connectors, allowing for easy field assembly. NYSDOT hopes to use the concept in a highway interchange reconstruction project.

Volpe Center Modeling Tool Helps FAA Ease Airport Congestion

Boarding an airplane, pushing back from the gate, and then getting caught in a long departure queue on the runway, is a common and annoying aspect of air travel. RITA's Volpe Center is applying operations research techniques to support the FAA's Collaborative Departure Queue Management initiative (CDQM). CDQM is one of many technologies under development as part of the NextGen program. The FAA has invested heavily in tools and technologies to address congestion of the airspace, and now is examining how to reduce congestion on the airport surface, with Volpe Center technical support.

Easing congestion on the airport surface potentially improves the level of customer satisfaction and significantly cuts down on the amount of fuel burned during taxi operations. An added benefit is a reduction in greenhouse gas emissions.

As part of the CDQM prototype evaluation at the Memphis, TN, airport, flight schedules and air capacity data are shared between flight operators (e.g., airlines) and air traffic control.

Sophisticated algorithms are used to assess real-time surface capacity and provide flight operators recommendations on when aircraft can push back and begin taxi-out procedures to minimize wait times. In some cases, aircraft may push back from the gate and sit in a virtual queue without starting their engines, and then begin the taxi-out procedure only when the actual departure runway queue is short. In other cases, passengers may be held in the terminal and begin boarding only when surface capacity has opened up sufficiently to allow for departure. Volpe Center's Aviation Systems Engineering Division has developed a modeling and simulation tool being used by the FAA to assess the applicability and likely benefits of implementing CDQM in other airports. The data from the modeling and simulation tool, along with results of the Memphis CDQM evaluation, will provide key insight into the effectiveness of CDQM as an airport congestion management system. The FAA estimates that when fully implemented at the Memphis airport, CDQM can potentially reduce taxi-out time by 5000 hours per year, resulting in savings of thousands of gallons of fuel.

Volpe Assessments of Pavements for Highway Traffic Noise Reduction

The Volpe Center's acknowledged expertise in tire-pavement noise issues and highway traffic noise prediction led two state transportation agencies to ask the Volpe Center to help assess various pavement types in terms of vehicle and highway traffic noise levels. Excessive levels of highway traffic noise affect people in houses, schools, parks, offices, and other facilities in the vicinity of the highways. Transportation agencies typically construct noise barriers to help reduce highway traffic noise, and they are looking for additional noise reduction strategies.

The Arizona Department of Transportation (ADOT) asked the Volpe Center to conduct two studies. The first study examined three different safety surface treatments for Portland Cement Concrete (PCC) and ranked these in terms of noise. The outcome resulted in a change of standard practice in Arizona to the quietest of the three surface treatments. The second study was part of the Quiet Pavement Pilot Program (QPPP), a partnering research program of FHWA and ADOT, which is examining the noise reducing benefit of rubberized asphalt over time. The QPPP allows ADOT to account for the benefits of quieter pavement in noise impact analyses and barrier designs.

The California Department of Transportation (Caltrans) also asked the Volpe Center to help conduct two studies. The first study examined various safety surface treatments for PCC and ranked these in terms of noise. The second study examined noise associated with five asphalt pavement formulations. The noise reduction benefit of each pavement was investigated in terms of pavement age, pavement composition, and vehicle type. Ultimately, this study will contribute to recommended pavement use throughout the State of California.

These Volpe Center studies and noise measurement protocols could influence standard practice of pavement choice for highway projects in these and other states, as well as the national FHWA policy on accounting for the effects of pavements in highway traffic noise impact prediction and analysis.

Volpe Center Supports New Tools for Regional Transportation Planning

Over the past four years, RITA's Volpe Center has supported the Federal Highway Administration's efforts to accelerate deployment of the Transportation Analysis and Simulation System (TRANSIMS). TRANSIMS is an open-source transportation planning model, intended for regional use, which provides several capabilities beyond those of traditional planning models, including the use of either tours or trips, a very fine-grained time-of-day detail, and the ability to perform traffic simulation over a region. Volpe Center staff support the TRANSIMS online community, participate in peer reviews, and provide oversight over several TRANSIMS projects.

One significant milestone was reached in 2011 with the completion of the Moreno Valley TRANSIMS project. Moreno Valley is located approximately 50 miles east of Los Angeles, California, near Riverside. This project, with work primarily done by City of Moreno Valley personnel, used TRANSIMS to examine regional economic development and freight issues. Accomplishments included:

- Use of parallel processing to route the Southern California Association of Governments (SCAG) network under both current and future (2035) conditions; some 48 million daily trips are projected in the year 2035
- Micro-simulation of approximately two million projected daily trips over a substantial area, i.e., the city of Moreno Valley and environs
- Achieving results quality comparable to that from the current planning model

The work involved significant collaboration, with local agencies such as SCAG and Riverside County, as well as the Transportation Analysis and Computing Center (TRACC) of Argonne National Labs. The TRACC cluster provided the computing capability to run the SCAG network (one of the largest regional planning networks in the Nation), and Argonne National Labs personnel provided initial training to city of Moreno Valley collaborators on TRANSIMS.

Environmental Protection Agency (EPA)

EPA's Federal Technology Transfer Act (FTTA) Program was established to promote collaboration between private sector and Federal researchers. EPA offers exceptional opportunities to develop and commercialize new technologies. Through the authority given to EPA by the Federal Technology Transfer Act of 1986 (Public Law 99-502), EPA facilitates the transfer of new technologies to the marketplace while protecting intellectual property rights of all parties.

Partners in the FTTA Program have the benefit of collaborating with world class EPA scientists involved in leading-edge research. Collaboration enhances the quality of research projects and helps move environmental technologies into the marketplace, resulting in better protection of human health and the environment.

For more information please visit: http://www.epa.gov/osp/ftta.htm.

Highlights from Some of the Agency's Technology Transfer Activities

Removing Mercury, Arsenic and Other Metals from Contaminated Water Streams
MAR Systems of Cleveland, Ohio, and the EPA National Risk Management Research Laboratory (NRMRL) partnered under a Cooperative Research and Development Agreement (CRADA) to investigate the reuse of spent catalysts from the Claus Process (a final polishing step for light hydrocarbons to remove trace amounts of sulfur). The spent Claus Catalysts have historically required disposal, but the researchers found a reuse opportunity for them.

The researchers used the spent Claus Catalysts to remove soluble metal contaminants from contaminated water streams. The feasibility and economics of utilizing the spent catalysts were investigated initially to remove ionic mercury from power plant scrubber water and to remove elemental mercury from power plant stack gas.

The collaboration has continued through an exclusive license for commercialization, and the technology has been developed into a media (Sorbster) that is manufactured and used to treat mercury, selenium, arsenic, and other metals in waste water streams at pH 3-12. This includes contaminated water streams, ground and surface water, and industrial waste streams. The technology achieves Clean Water standards, and is also cost-effective, simple, and reliable.

Through Sorbster, the spent Claus Catalyst technology is now commercially available for purchase and use. There have been a number of demonstration projects established with small units (less than 10 gallons-per-minute), and a commercial scale (250 gallon-per minute-system) has been installed at a chemical manufacturing facility. Additional commercial installations are under discussion.

The future direction is to optimize the technology for additional metals removal. The partners are also investigating metals removal of vapor or stack emissions, as well as metals removal from wastewater associated with hydraulic fracturing. Additionally, MAR Systems is scaling up its manufacturing capability.

Fecal Source Identification Protocol Project (SIPP)
Fecal microbes are a common biological contaminant worldwide. Currently, the EPA and World Health Organization recommend indicator methods that do not discriminate between animal sources in contaminated water. Yet there are a number of technologies that have been developed that claim to distinguish between animal sources of fecal matter in water samples. This could be useful in determining how to address the sources of contamination found at beaches, in drinking water, and other water sources, affecting public health.

EPA embarked on a collaboration, called the Source Identification Protocol Project (SIPP), comprised of five laboratories: University of California Los Angeles; Stanford University; University of California Davis; the NRMRL; and the Southern California Coastal Water Research Project (SCCWRP). The SIPP is testing technologies that identify fecal sources in water. The

SIPP created a series of blind challenge test samples (comprised of 12 different animal sources, some samples mixed and some single-source) for any city, state, Federal, academic, or commercial laboratory to use to test their technology of choice. Thirty-nine technologies were used for this effort. Technologies ranged from bacterial genetic markers to canine scent detection. Four of the technologies tested were developed by EPA researchers.

A secondary component of this project involved analyzing the repeatability of fecal sourcing identification technologies. Twelve technologies were selected for the repeatability analysis, including two EPA-patented technologies. These two technologies were licensed to the other collaborating laboratories for the purposes of this study.

The SIPP method evaluation study is the largest of its kind ever performed. The benefits of this collaboration include the ability to select a technology that accurately identifies the sources of fecal contamination that exist in a municipality's water. This is beneficial because if the municipality can determine the source of the contamination, then it can work more effectively to mitigate it. Additionally, the potential market for highly effective technologies is considerable. Municipalities will be able to purchase these technologies for testing, and once the guidance manual is implemented by the State of California for fecal source identification, the demand for these technologies is expected to increase. Any state or municipality will be able to use the test result information gained through this collaboration to help select the most appropriate and effective technology for detecting fecal sources in their water systems.

Final results are just becoming available, and indicate that EPA's HF183Taqman assay, developed by EPA researcher Orin Shanks, performed the best during testing. It demonstrated 100% sensitivity and quantitative specificity superior to all other technologies tested.

For the EPA, it is anticipated that these technologies will play a role in future Total Maximum Daily Load programs, evaluation of agricultural best management practices, identification of faulty human waste management infrastructure, and modeling public health risk from exposure to fecal pollution from specific animal sources.

All fecal source identification technologies patented by the EPA were recently licensed to MicrobialInsights, Inc., of Rockford, Tennesssee, for commercialization. It is anticipated that these technologies will be available to consumers early in 2012.

Characterizing Activity and Exhaust Emissions from Mobile Sources in the Houston-Galveston Area

Mobile sources contribute significantly to ambient concentrations of air contaminants, including particulate matter. EPA's National Vehicle and Fuel Emissions Laboratory undertook a collaboration to develop a new sampling methodology and technical approaches to determine the amount and frequency of emissions within the Houston-Galveston, Texas area that pertain to the heavy-duty vehicle population. In particular, heavy-duty drayage vehicles used at ports were studied to determine their emissions contribution. Over 40 vehicles were studied in-depth

for both emissions as well as activities, double the number originally anticipated due to the team's enhanced efficiencies as the project progressed.

Under a CRADA, both parties provided technical expertise, and the EPA contributed equipment and specialized expertise in statistical sampling and vehicle emissions measurement methodologies. The collaborators also worked with the Port Authority of Houston to enhance the data acquired on the amount of time vehicles were in the port area.

Although final results are not yet available, EPA anticipates the ability to improve on its mobile source emission model (MOVES) to include port data acquired in this project. For a small cash contribution, the Houston-Galveston Area Council gained a much clearer picture of the contributions of port vehicles to their overall air emissions.

More broadly, the benefits of this research are in the potential for states to more accurately estimate the amount of emissions coming out of heavy-duty vehicle usage areas, such as ports. As EPA's models are enhanced to include more real-world data, states can better anticipate how they will comply with National Ambient Air Quality Standards (NAAQS).

Sampling methodologies were also enhanced through this project, and the EPA established a more thorough, statistically accurate sampling methodology for heavy-duty vehicles. These methodologies could be applied at numerous other geographic locations with heavy port usage to determine emissions contributions to the local area, as well as to further enhance the data used by the EPA to feed into its emissions models.

National Aeronautics and Space Administration (NASA)

Since its creation in 1958, NASA's mandate has included the broad dissemination of its research results for the public benefit. In FY 2011 a new Office of Chief Technologist was created to serve as the focal point for overall coordination of the agency's technology development efforts, as well as to manage a new Space Technology Program. The Innovative Partnerships Program was merged into this new Office. The technology transfer functions that were performed by the Innovative Partnerships Program are now the responsibility of the Innovative Partnerships Office (IPO) within the Office of Chief Technologist. In addition to its NASA Headquarters office in Washington, DC, the IPO has locations within each of NASA's ten centers, and is dedicated to fostering technology transfer and technology development partnerships with industry, academia, government agencies, and national laboratories. The IPO is responsible for facilitating intellectual property protection and transfer of NASA-developed technology for commercial application and other public benefit. NASA continues to seek dual use technology development partnerships that advance agency mission goals and, at

the same time, apply NASA technology for the benefit of commerce and the public good.

NASA has a long history of being a leader in technology development and transferring its space and aeronautics research to the public. The benefits of NASA research are all around us. Knowledge provided by weather and navigational spacecraft, efficiency improvements in both ground and air transportation, super computers, solar- and wind-generated energy, the cameras found in many of today's cell phones, improved biomedical applications including advanced medical imaging and even more nutritious infant formula, as well as the protective gear that keeps our military, firefighters and police safe, have all benefitted from our Nation's investments in aerospace technology.

NASA technologies have made us healthier and safer, introduced space-age efficiencies to our manufacturing processes, made transportation safer, and paved the way for cleaner and greener technologies. Meanwhile, these same technologies have launched companies, even industries, saved lives, and created jobs.

In the coming years, as NASA renews its technology-development emphasis, the agency's technology transfer program will work to meet this influx of new inventions, and the public should experience a commensurate increase in the benefits of NASA's research and development activities.

NASA's new technology investment strategy will drive the next wave of innovation, enabling missions to be performed in new ways and creating missions never possible before. NASA's innovations will provide countless opportunities for advances in science, engineering, transportation, public safety, computer science, industrial productivity, consumer goods, health, and medicine, while supporting the U.S. global leadership in innovation.

NASA will implement a robust effort that matures technologies so that they are used by NASA missions as well as other government agencies and the private sector. NASA will identify and patent those technologies that are promising. Industry will license existing patents. Some technologies may be distributed via other collaborative research partnerships. Those that are successfully transferred to the commercial market will be highlighted in the annual Spinoff publication.

Each year, NASA documents examples of notable successes from its technology transfer efforts in its annual Spinoff *magazine publication. The magazine is available online at* http://spinoff.nasa.gov/. To date, over 1,700 examples of technology transfer successes have been documented in the publication, all of which are searchable through an online database available through www.sti.nasa.gov/spinoff/database. In addition, NASA has established a website called NASA Home and City, located at http://www.nasa.gov/city, which helps to make the public aware of NASA's contributions to the quality and safety of everyday life. NASA

participates with several other Federal agencies in highlighting technologies available for licensing for commercial and research application. Details on this and other initiatives are available on the Office of Chief Technologist web site:
http://www.nasa.gov/offices/oct/home/index.html

Highlights from Some of the Agency's Technology Transfer Activities

Thermal Components Boost Performance of HVAC Systems

A Rockledge, Florida-based company, Mainstream Engineering Corporation, works with NASA to develop advanced thermal control technology for spacecraft. Most recently, Mainstream developed new products, based on SBIR work with Johnson Space Center, that improve air conditioner performance and filtration—a boon for allergy and asthma sufferers.

Control Algorithms Charge Batteries Faster

Advanced Power Electronics Corporation of Orlando, Florida, partnered with Glenn Research Center through the SBIR program to develop an advanced power converter for space systems. The company incorporated control algorithms created through the partnership into a solar charger that charges batteries 30 percent faster than comparative devices.

Rugged Analyzers Measure Greenhouse Gasses, Airborne Pollutants

Los Gatos Research Inc., of Mountain View, California, partnered with Ames Research Center to develop instrumentation for detecting signs of life in deep sea and deep space environments. This led the company to commercialize a range of highly accurate and sensitive analyzers for detecting pollutants and greenhouse gasses. Los Gatos plans to grow from 30 to nearly 50 full-time employees by the end of 2011.

Custom Machines Advance Composite Manufacturing

Through the SBIR program, Accudyne Systems Inc., of Newark, Delaware, developed a device for creating thermoplastic composite structures without the use of an expensive autoclave. The partnership yielded technology for the company's commercial, custom-built composite manufacturing machines, helping advance composite part fabrication.

Integrated Design Tools Save Time, Money

Thanks in part to a SBIR award with Langley Research Center, Phoenix Integration Inc., based in Blacksburg, Virginia, modified and advanced software for process integration and design automation. For NASA, the tool has resulted in lower project costs and reductions in design time; clients of Phoenix Integration are experiencing the same rewards.

Department of Veterans Affairs (VA)

The Department of Veterans Affairs (VA) operates, through the Veterans Health Administration (VHA), a substantial research program in connection with the research programs at many of the medical institutions with which VA is affiliated. As a result, many of our researchers also hold academic appointments with our affiliates. Some of our best and most beneficial inventions have come out of this setting, and VA wants to continue to promote this research environment and relationship, as it benefits our veterans and the public generally.
Although VA can assert an ownership right in inventions made by our employees under Executive Order 10096, and its implementing regulations, it cannot and does not do so to the exclusion of our university partners or the inventors. Since many of VA's researchers hold dual appointments with VA and a university, VA recognizes that the universities may have an interest in an invention made at a VA facility, leading to joint ownership.

To further enhance the unique relationship and the cooperation between the research affiliates and VA, and to facilitate the technology transfer process, the Office of Research and Development's (ORD's) Technology Transfer Program (TTP) developed a Cooperative Technology Administration Agreement (CTAA). This agreement encompasses the obligations of the university partner and the interests of VA while fostering the relationship between the two organizations. It further outlines relevant definitions, terms, and conditions for handling intellectual property (IP) on behalf of both organizations. Using the CTAA allows ownership to remain with VA while providing the university unimpeded access and authority to patent and market the IP in question. Using CTAAs creates a mutually beneficial situation for VA and its academic affiliates while strengthening and expanding existing partnerships to the advantage of both organizations. Currently, VA has 59 active CTAAs that include the leading research institutions in the country. This agreement format has proven extremely efficient in handling jointly owned intellectual property, and VA has not encountered any substantive problems.

More information is available on the VA's Technology Transfer Program website: http://www.research.va.gov/programs/tech_transfer/default.cfm

CONCLUSION

Technology transfer is an active and essential mission of Federal research and development laboratories. By leveraging our Nation's innovative nature and investing in science and technology, we strengthen our economy and American competitiveness in world markets. This report details the results of technology partnering activities of Federal agencies.

The statistical data provided in this report indicate that over the five-year span from 2007 through 2011, CRADA collaborations with Federal laboratories increased somewhat, corresponding to a small upward growth of new CRADAs. Invention disclosures, patent applications filed, and patents issued remained steady over the period from Fiscal Year 2007 through Fiscal Year 2010, followed by significant increases in Fiscal Year 2011. Licensing activity showed an increasing trend over the past five years; however, licensing revenue remained relatively flat over the same period.

These numbers, however, do not tell the whole story. Federal laboratories transfer many technologies through a variety of mechanisms not reflected in this report. A number of studies and workgroups are underway to evaluate technology transfer and develop appropriate metrics to accurately describe and measure the role of Federal research in supporting our over-all economic well-being.

The sampling of success stories presented in this report provides examples of how society benefits from technology transfer activities across the Federal laboratories. As technology advances and the needs of the economy change, Federal laboratories will continue to play a vital role in keeping America in the forefront of innovation. Federal research and development continues to support our economic growth and international competitiveness by successfully transferring and facilitating commercialization of federally created technologies.

National Institute of
Standards and Technology
U.S. Department of Commerce

100 Bureau Drive, Gaithersburg, MD 20899-2200 | http://www.nist.gov