Annual Report on Technology Transfer:
Approach and Plans, Fiscal Year 2011 Activities and Achievements

U.S. Department of Commerce

Report prepared by:

National Institute of Standards and Technology
National Oceanic and Atmospheric Administration
National Telecommunications and Information Administration
Institute for Telecommunication Sciences

Pursuant to the
Technology Transfer and Commercialization Act of 2000 (Pub. L. 106-404)

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FOREWORD

This report summarizes technology transfer activities and achievements of the Department of Commerce's federal laboratories for fiscal year (FY) 2011. At the Department of Commerce,

technology transfer is a significant part of the mission and programmatic activities of the National Institute of Standards and Technology (NIST), the National Oceanic and Atmospheric Administration (NOAA), and the National Telecommunications and Information Administration's (NTIA) Institute for Telecommunication Sciences (ITS). Accordingly, this report focuses on the activities of these agencies.

This report is in response to the statutory requirement for an annual "agency report on utilization" (15 U.S.C. Section 3710(f)) process established by the Technology Transfer Commercialization Act of 2000 (Pub. L. 106-404). All federal agencies that direct one or more federal laboratories or conduct other activities under Section 207 and 209 of Title 35, United States Code are subject to the requirements of this statute.

This report summarizes the Department's overall and laboratory- specific approaches, and its plans for technology transfer. The report focuses on current year activities and accomplishments, but provides statistical information from FY 2007 through FY 2011.

This report has been organized and prepared with the participation of the NIST, NOAA and ITS technology transfer offices. An electronic version of this report and versions from previous fiscal years are available online at: **http://www.nist.gov/tpo/publications/index.cfm**

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CHAPTER 1

Department of Commerce Overview

Technology transfer plays an important role in the Department of Commerce's (hereinafter, the Department) mission to advance economic growth and job opportunities within the United States. The Department works in partnership with businesses, universities, state governments, and communities to promote innovation and to improve the nation's overall competitiveness in the global economy. The Department pursues these objectives through policies and programs directed at strengthening the nation's economic infrastructure, facilitating the development of cutting-edge science and technology, providing critical scientific information and data, and managing national resources.

The Department conducts research and development (R&D) in numerous areas of fundamental and advanced science and technology at the National Institute of Standards and Technology (NIST), the laboratory facilities of the National Oceanic and Atmospheric Administration (NOAA), and the National Telecommunications and Information Administration's (NTIA) Institute for Telecommunication Sciences (ITS). Technology transfer is a key part of the programmatic activities in each of these agencies' federal laboratory systems. Technology transfer is about connecting the technological advances from the Department's science and engineering programs to the American economy.

In addition to the technology transfer efforts of the Department's own laboratories, the Department is responsible for coordinating the technology transfer activities across federal agencies. Through NIST, the Department coordinates the Interagency Workgroup for Technology Transfer, which facilitates interagency discussion on policy, new approaches to technology transfer, and lessons learned from agency technology transfer programs. NIST also serves as the host agency for the Federal Laboratory Consortium for Technology Transfer, the nationwide network of federal laboratories that provides a forum to develop strategies and opportunities for linking laboratory mission technologies and expertise with the marketplace.

The Department also has a leading role in leveraging the resources of the federal government to enhance the understanding and promotion of innovation, entrepreneurship and commercialization in America. In an effort to advance these goals, NIST and the Economic Development Administration (EDA) coordinated a multi-agency effort to understand the current state of affairs in commercializing technologies developed in federal laboratories. This high-level study is helping to set the stage for future collaborative work between the Department of Commerce bureaus and other federal agencies.

More information about Department of Commerce technology transfer is available on the following websites:
NIST: http://www.nist.gov/tpo/index.cfm; NOAA: http://www.noaa.gov/
ITS: http://www.its.bldrdoc.gov/programs/tech_transfer/

Summary of Technology Transfer Activities FY 2007 – FY 2011

This annual report provides comprehensive statistics on the technology transfer activities of the Department's federal laboratories. This information covers intellectual property (patents/licenses), cooperative research and development relationships, and other technology transfer mechanisms. This report also highlights examples of successful downstream results (e.g., commercially significant technologies) from these technology transfer activities.

The Department's technology transfer activities include more than cooperative R&D agreements (CRADAs), patenting, and licensing. Technology transfer is also accomplished through technical publications, technical support development for industrial standards and reference materials, other public dissemination such as meetings and workshops, and opportunities for guest researchers, post-doctoral fellows, students and other collaborating professionals from across the United States to participate in federal laboratory activities.

The Technology Transfer Commercialization Act of 2000 (Pub. L. 106-404, codified in 15 U.S.C. Section 3710(f)) requires each federal agency to report to Congress the results of its technology transfer activities. This information is also required by Office of Management and Budget Circular A-11. The following tables present the required data. The information presented in this report is based on a stable framework of metrics that has been used traditionally to evaluate the effectiveness of technology transfer. The Department continues to explore the development of better metrics for technology transfer statistics.

Invention Disclosure and Patenting

	FY 2007	FY 2008	FY 2009	FY 2010	FY 2011
● New inventions disclosed					
NIST	29	40	36	30	25
NOAA	3	0	5[3]	4	1
ITS	0	0	0	0	0
Department	32	40	41[3]	34	26
● Patent applications filed					
NIST	6	18	19[3]	18[4]	15
NOAA	2	3	1	1	0
ITS	0	0	0	0	0
Department	8[1]	21	20[3]	19[4]	15
● Patents issued					
NIST	3	2[2]	7	10[4]	12
NOAA	0[1]	1	0	1[4]	2
ITS	0	0	0	0	0
Department	3	3[2]	7	11[4]	14

(1) Reflects correction of data from FY 2007 Report.
(2) Reflects correction of data from FY 2008 Report.
(3) Reflects correction of data from FY 2009 Report.
(4) Reflects correction of data from FY 2010 Report.

Licensing – Profile of Active Licenses

	FY 2007	FY 2008	FY 2009	FY 2010	FY 2011
● All Department of Commerce licenses	222[(1)]	29	40	41	32
Patent licenses					
NIST	30[(1)]	23	33	35	26
NOAA	6	6	7	6	6
ITS	10	0	0	0	0
Department	46[(1)]	29	40	41	32
Other invention licenses					
ITS	176	0	0	0	0

(1) Reflects correction of data from FY 2008 Report.

Characteristics of Licenses Bearing Income

	FY 2007	FY 2008	FY 2009	FY 2010	FY 2011
● All income-bearing licenses					
Department	35	25	27	26	24
- Patent licenses					
NIST	21	21	22	22	21
NOAA	4	4	5	4	3
ITS	10	0	0	0	0
▫ Exclusive, partially exclusive, non-exclusive					
NIST	16, 0, 5	14, 0, 7	15, 0, 7	15, 0, 7	14, 0, 7
NOAA	0, 0, 4	0, 0, 4	0, 0, 5	0, 0, 4	0, 0, 3
ITS	0, 0, 10	0, 0, 0	0, 0, 0	0, 0, 0	0, 0, 0
Department	16, 0, 19	14, 0, 11	15, 0, 12	15, 0, 11	14, 0, 10

Income from Licensing

		FY 2007	FY 2008	FY 2009	FY 2010	FY 2011
● Total income	Department	$224,847	$292,647	$335,889	$237,259	$276,567
	NIST	$195,347	$223,640	$197,445	$202,216	$169,347
	NOAA	$22,000	$69,007	$138,444[(1)]	$35,043	$107,220
	ITS	$7,500	$0[(2)]	$0	$0	$0

(1) Increase is due to a license with The Walt Disney Company for NOAA's Science on a Sphere for a one-time royalty of $75,000.
(2) ITS no longer licenses Video Quality Metric (VQM) technology. This software is available free of charge via open-source download.

Collaborative Relationships for Research and Development

	FY 2007	FY 2008	FY 2009	FY 2010	FY 2011
● **CRADAs***					
▪ Traditional CRADAs					
NIST	140	121	65(1)	66	103(4)
NOAA	5	4	5	6	7
ITS	9	6	31	29	23
Department	154	131	101	101	133
▪ Non-traditional CRADAs					
NIST	2,348	2,224	2,284	1,399	1,372
ITS	276	35(2)(3)	12	12	9
Department	2,624	2,259	2,296	1,411	1,381

*CRADA = Cooperative Research and Development Agreement

(1) Decrease in CRADAs attributed to successful conclusion of multi-party CRADA Consortiums.

(2) In 2008, ITS removed some of its telecommunication analysis services from the Web. These services provided network-based access to research results, models, and databases supporting applications in wireless system design and analysis. As a result, there was a significant decrease in the number of CRADAs between the government and industry that allowed for improvement to these models. ITS is working on a newer geographic information system-(GIS-) based platform for the modeling services, which will be available in the future.

(3) Reflects correction of data from FY 2007 Report.

(4) Increase in CRADAs due to new multi-party CRADA Consortiums.

Later chapters provide agency-specific information and details on the above metrics.

CHAPTER 2

National Institute of Standards and Technology

Approach and Plans for Technology Transfer

The National Institute of Standards and Technology (NIST) has a broad mission to promote U.S. innovation and industrial competitiveness by advancing measurement science, standards, and technology in ways that enhance economic security and improve the quality of life.

An important part of NIST's activities is to anticipate future measurement and standards needs of U.S. industry. Rapidly evolving sectors like nanotechnology, biotechnology, homeland security, information technology, and advanced manufacturing need sophisticated technical support systems in order to flourish and grow. NIST laboratories develop measurement techniques, test methods, standards, reference data, and other technologies and services that support U.S. industry, scientific research, and the activities of many other federal agencies. In carrying out its mission, NIST works directly with industry partners (individual companies and consortia), universities, standards organizations, other domestic and foreign associations, and other government agencies.

NIST's technology transfer activities are designed to disseminate the Institute's fundamental research results and its measurements and standards research results to industry and other interested parties. In order to provide leading-edge scientific and technical work, NIST is required to have expertise in multiple disciplines, to maintain high levels of collaboration with organizations and people with diverse capabilities, and to have highly specialized facilities and tools. For more than a century, NIST's laboratories have successfully collaborated with others to provide the measurement techniques and technical tools needed by America's innovators. NIST uses many different collaboration mechanisms to promote innovation and ensure that the resulting technologies are broadly disseminated.

Additional details on NIST's technology transfer program are available at: http://www.nist.gov/tpo/index.cfm.

NIST uses the following mechanisms to transfer its knowledge, intellectual property and other technical assets:

- Patents and licensing
- Cooperative Research and Development Agreements (CRADAs)
- User Facilities
- Technical Publications
- Participation in Documentary Standards Committees
- Standard Reference Materials
- Standard Reference Data

- Calibration and Accreditation Services
- Software Tools
- Small Business Innovation Research (SBIR)
- Guest Researchers
- Conferences, Workshops, and Inquiries
- Training

Patents and Licensing
NIST actively seeks to identify commercially valuable inventions that result from its research. A Patent Review Committee evaluates each reported invention's potential to promote U.S. innovation and industrial competition. NIST will seek patent protection when a patent: (1) would enhance the potential for an invention's commercialization; (2) would have a positive impact on a new field of science or technology and/or the visibility and vitality of NIST (3) would further the goals of a Cooperative Research and Development Agreement (CRADA) or other agreement. NIST conducts periodic informational sessions and meetings with NIST staff to emphasize the importance of NIST invention policies and procedures, and the use of these policies and procedures to advance their research and fulfill NIST's mission. (See: http://tsapps.nist.gov/techtransfer/)

Cooperative Research and Development Agreements (CRADAs)
Cooperative research and development between federal laboratories, academia and outside partners is an effective means for technology transfer. Beyond the improved know-how and new technologies that result, these joint efforts often help collaborators to leverage each other's resources and technical capabilities. They also provide mechanisms for collaborators to gain new technical competencies and acquire new skills. Cooperative Research and Development Agreements (CRADAs) are a mechanism for establishing joint relationships with industry academia, and state and local governments. A CRADA is an agreement between a federal laboratory and one or more partners to collaborate on defined R&D projects. The legal authority for CRADAs was created by the Federal Technology Transfer Act of 1986 with the aim of encouraging federal laboratories to participate in R&D partnerships to advance promising new technologies toward commercialization. (See: http://www.nist.gov/tpo/collaborations/crada.cfm)

User Facilities
To support U.S. industry, academic institutions, NIST, and other government laboratories, NIST operates two unique and valuable laboratory facilities – the NIST Center for Neutron Research (NCNR) and the Center for Nanoscale Science and Technology (CNST). The NCNR is a national center for research using thermal and cold neutrons. Many of its instruments rely on intense beams of cold neutrons emanating from an advanced liquid hydrogen moderator. The CNST supports the development of nanotechnology from discovery to production. The Center operates a national shared-use nanofabrication and measurement facility (the NanoFab), complemented by a multidisciplinary research staff creating the next generation tools for advancing nanotechnology. (See: http://www.nist.gov/user-facilities.cfm)

Technical Publications
Technical publications are one of the major mechanisms NIST uses to disseminate the results of its research to industry, academia, and other agencies. NIST staff author more than 1,200 publications in peer-reviewed journals each year. (See: http://nvl.nist.gov/)

NIST publicizes its planned, ongoing and recently completed work in the trade and technical press, which is typically followed by the organizations most likely to have an interest in NIST's research and services. In addition to news releases, websites and contacts with the media, NIST publishes *Tech Beat*, a biweekly plain language newsletter of recent research results. (See: http://www.nist.gov/public_affairs/tech-beat/index.cfm)

Participation in Documentary Standards Committees
Documentary standards codify, among other things, measurement methods, standard practices, and product specifications. Econometric studies have concluded that standards contribute significantly to economic growth. The econometric work reviewed and evaluated by Swann (2010) [1] arrives at several conclusions. Among these conclusions: development of standards are integral to innovation; documentary standards contribute to economic growth at least as much as do patents; and the macroeconomic benefits of the development of standards extend beyond the benefits to the companies that use the standards.

NIST's participation in the development of consensus documentary standards is one of the mechanisms used to transfer NIST measurement-science research and other technologies to market use. NIST participation in standards committees enables its scientists and engineers to bring NIST technology and know-how directly into standards-setting bodies. NIST participation also helps NIST respond programmatically to needs of the private sector. NIST reports its activities in standards development to the Office of Management and Budget and to Congress, as required by the National Technology Transfer and Advancement Act of 1995. (See: http://gsi.nist.gov/global/index.cfm/L1-1)

Standard Reference Materials
Standard Reference Materials (SRMs) are a definitive source of measurement traceability in the United States. Measurements made using SRMs can be traced to a common and recognized set of basic standards that provide the basis for measurement compatibility among different laboratories. The certified property values for Standard Reference Materials often depend on the development of unique measurement capabilities within NIST. SRMs have been specified in many documentary standards and many are distributed by other reference material organizations, e.g., the LGC in the United Kingdom. (See: http://www.nist.gov/srm/index.cfm)

Standard Reference Data
The Standard Reference Data (SRD) program provides critically evaluated numeric data to scientists and engineers for use in technical problem-solving, research and development. Many types of reference data are critically important in the engineering of structures, optimizing

[1] Peter Swann, G.M., Report for the UK Department of Business, Innovation, and Skills (BIS), 2010 http://www.bis.gov.uk/assets/biscore/innovation/docs/e/10-1135-economics-of-standardization-update.pdf

chemical processes, and other industrial applications. Standard Reference Data is extracted from the scientific and technical literature, or developed from measurements made at NIST laboratories, and is critically evaluated for accuracy and reliability. NIST's SRD databases cover many areas of science, including analytical chemistry, atomic and molecular physics, biotechnology, and materials sciences. (See http://www.nist.gov/srd/index.cfm)

Calibration and Accreditation Services
The NIST laboratories provide physical measurement services for their customers, including calibration services, special tests, and measurement assurance programs. NIST's calibration services are designed to help manufacturers and users of precision instruments achieve the highest possible levels of measurement quality and productivity. NIST calibrations often provide the basis for companies that provide calibration services and calibration equipment. (See: http://www.nist.gov/calibrations/index.cfm)

The National Voluntary Laboratory Accreditation Program (NVLAP) is a voluntary and fee-supported program to accredit laboratories that are found competent to perform specific tests or calibrations, or types of tests or calibrations. Through laboratory accreditation, NIST efficiently leverages its primary calibration services to support a broader base of secondary calibrations conducted within the private sector. (See: http://www.nist.gov/pml/nvlap/index.cfm)

Software Tools
NIST provides a wide variety of application software programs and testing tools to U.S. industry, academia and other interested users. NIST develops standards, conformance tests, tools, and methods to evaluate the quality of software and the software's conformation to standards.

Small Business Innovation Research (SBIR)
NIST's Small Business Innovation Research (SBIR) program provides funding to small high technology U.S. firms. The program offers qualified small businesses the opportunity to propose innovative ideas that meet specific NIST research and development needs, and have the potential for commercialization. (See: http://www.nist.gov/tpo/sbir/index.cfm)

Guest Researchers
Each year thousands of researchers visit NIST to participate in collaborative projects. (See: http://www.nist.gov/tpo/collaborations/guestresearchers.cfm). Technology transfer involves not only inventions, innovations, data, patents and licenses, but also "people." While inventions with commercial potential are an important element of technology transfer, hosting innovative guest scientists at NIST are of equal importance in accomplishing NIST's technology transfer mission. NIST hosts many term appointment researchers and non-NIST employees working as guest researchers, collaborators, student fellows, and post-doctoral fellows. After their tenures at NIST, many seek career opportunities in academia, the private sector, or the federal government. While some guest researchers' work at NIST may result in inventions, all of them will leave NIST with technical and research skills that place them on the cutting edge of their disciplines. Each individual brings to their new careers and their new employers these skills, knowledge and a desire to employ them in innovative ways. Moreover, these "NIST alumni" bring to their new employers knowledge of how to collaborate with federal laboratories and knowledge of federal resources that are available to assist companies as they create and develop new and improved

technologies. This focus on NIST alumni reflects NIST's view that technology transfer involves "people" transferring new knowledge as well as innovative "things."

NIST has been recognized[2] as a vital contributor to encouraging and supporting the nation's efforts in science, technology, engineering and mathematics (STEM) education. As part of its mission, and to help create a long-term and well-qualified workforce for standards and measurement research, NIST has several education outreach programs and partnerships that enrich basic research programs such as:

- the Summer Undergraduate Research Fellowship (SURF) program (See: http://www.nist.gov/surfgaithersburg/index.cfm);
- the Summer High School Internship (SHIP) program (See: http://www.nist.gov/hrmd/staffing/ship.cfm); and
- the NIST Summer Institute for Middle School Science Teachers (See: http://www.nist.gov/iaao/teachlearn/index.cfm).
- the Professional Research Experience Program (PREP) (See: http://www.boulder.nist.gov/bdprepo.htm).

NIST has also begun a program to provide students and post-doctoral fellows with information on the use of science in industry, including co-sponsoring a career fair with other agencies and Rockville Economic Development, Inc.

In addition, NIST jointly operates the following research organizations established to promote cross-disciplinary collaborations (see: http://www.nist.gov/locations.cfm):

- JILA[3], Boulder, CO, a world-class physics research institute jointly operated by NIST and the University of Colorado at Boulder
- Institute for Bioscience and Biotechnology Research, Rockville, MD, an interdisciplinary partnership in cutting-edge biotechnology between NIST and the University of Maryland
- Joint Quantum Institute, College Park, MD, a new institute for advancing quantum physics research that is jointly operated with the University of Maryland
- Hollings Marine Laboratory, Charleston, SC, a national center for coastal ocean science, in which NIST is one of five federal, state, and university partners

Conferences, Workshops, and Inquiries

Some of the most important mechanisms for technology dissemination are communication, education, and interaction among researchers, developers and users of technology. NIST hosts numerous conferences, workshops, and other meetings each year to facilitate the transfer of technology. Further, NIST staff answer e-mail, telephone, and mail inquiries from the public, including inquiries from researchers requesting information and details about NIST technical developments and research results.

[2] The Federal Laboratory Consortium (FLC) gave its 2011 award for excellence in the support of STEM education to six NIST employees.

[3] When first established by NIST and the University of Colorado-Boulder, JILA stood for "Joint Institute for Laboratory Astrophysics." At present, according to common usage, JILA stands for "JILA," a joint NIST-UC research institute.

Training
Over the past five years, approximately 6,000 students have participated in NIST Seminars. During FY 2011, about 1,200 students participated in over 60 NIST measurement and documentary standards seminars. These seminars were taught by: scientists from other National Metrology Institutes in the Americas; officials from U.S. federal agencies; weights and measures officials from state government; laboratory staff from U.S. industry calibration laboratories; and middle-school science teachers. In addition to laboratory and classroom courses, NIST offers special webinars to participants.

Additional Details in FY 2011

Pursuant to the reporting requirements of the Technology Transfer Commercialization Act of 2000 and other relevant legislation, NIST provides the following data on its transfer of knowledge and technology to the private sector. The data provides collaborative relationships for research and development (CRADAs and other kinds of relationships), invention disclosures, patenting, and licensing. The data includes other technology transfer mechanisms utilized by the NIST laboratories, e.g., Standard Reference Materials, Standard Reference Data, technical publications produced, calibration tests, and guest researcher collaborations.

NIST regularly assesses the downstream impact of its research projects and technologies. NIST utilizes a diverse, yet complementary, set of performance indicators and measures to evaluate its programmatic performance over time. NIST's performance evaluation system accommodates the Institute's diverse products, and addresses the intrinsic difficulty of measuring the results of federal investments in scientific and technological products and services. NIST evaluates its performance and plans its work through: economic impact studies; peer review and other forms of external assessment; customer feedback; and quantitative output metrics. From 2000 to 2009, 14 economic impact studies were conducted on NIST research programs. These studies show that the ratio of overall return on investment is 36:1.[4] Additional details on NIST economic performance measures are available online at http://www.nist.gov/director/planning/impact_assessment.htm. NIST also reports its performance through Department of Commerce Government Performance and Results Act of 1993 (GPRA) documents, and the NIST Financial Statements.

[4] Various internal NIST studies overseen by Dr. Gregory Tassey, Senior NIST Economist.

Collaborative Relationships for Research and Development

	FY 2007	FY 2008	FY 2009	FY 2010	FY 2011
● **CRADAs**[*], total active in the fiscal year [(1)]	2,488	2,345	2,349	1,465	1,475
- New, executed in the fiscal year	1,585	1,577	1,492	1,390	1,402
▪ Traditional CRADAs, [(2)] total active in the fiscal year	140	121	65[5]	66	103[6]
- New, executed in the FY	20	12	19	16	51[6]
▪ Non-traditional CRADAs, [(3)] total active in the fiscal year	2,348	2,224	2,284	1,399	1,372
- New, executed in the fiscal year	1,565	1,565	1,473	1,374	1,351
● **Other types of collaborative R&D relationships**					
▪ Guest scientists and engineers during the fiscal year [(4)]	2,672	2,816	2,828	2,897	2,899

*CRADA = Cooperative Research and Development Agreement.

(1) "Active" means agreements in force at any time during the fiscal year. "Total active" is comprehensive of all agreements executed under CRADA authority (15 U.S.C. 3710a).

(2) CRADAs involving collaborative research and development by a federal laboratory and non-federal partners.

(3) CRADAs used for special purposes, such as laboratory accreditation, materials transfer or technical assistance that may result in protected information.

(4) "Guest scientists and engineers" includes foreign and domestic guest researchers and researchers working at NIST under Intergovernmental Personnel Act (IPA) agreements, CRADAs, and Facility Use Agreements.

(5) The decrease in CRADAs is attributable to the successful conclusion of multi-CRADA Consortiums.

(6) The increase in CRADAs is attributable to new multi-CRADA consortiums.

Licensing Details

Multiple inventions included in a single license are counted as one license. Licenses that include both patents and copyrights (hybrid licenses) are reported as patent licenses and are not counted as copyright licenses.

Profile of Active Licenses

	FY 2007	FY 2008	FY 2009	FY 2010	FY 2011
● **All licenses**, number total active in the fiscal year [1]	30	23	33	35	26
▫ New, executed in the fiscal year	5	2	11	5	4
▪ **Invention licenses**, total active in the fiscal year	30	23	33	35	26
▫ New, executed in the fiscal year	5	2	11	5	4
- Patent licenses, [2] total active in the fiscal year	30	23	33	35	26
▫ New, executed in the fiscal year	5	2	11	5	4
- Material transfer licenses (inventions), total active	0	0	0	0	0
▫ New, executed in the fiscal year	0	0	0	0	0
- Other invention licenses, total active in the fiscal year	0	0	0	0	0
▫ New, executed in the fiscal year	0	0	0	0	0
▪ **Other IP licenses**, total active in the fiscal year	0	0	0	0	0
▫ New, executed in the fiscal year	0	0	0	0	0
- Copyright licenses (fee-bearing)	0	0	0	0	0
▫ New, executed in the fiscal year	0	0	0	0	0
- Material transfer licenses (non-inventions), total active	0	0	0	0	0
▫ New, executed in the fiscal year	0	0	0	0	0

(1) "Active" means in force at any time during the fiscal year.
(2) Includes pending patent applications.

Licensing Management

	FY 2007	FY 2008	FY 2009	FY 2010	FY 2011
● **License negotiation time,** [1] licenses granted in the fiscal year					
▪ **Invention licenses** (Patent licenses) [2]					
▫ Average, months	2.0	10.5[3]	4.8	3.0	1.9
▫ Minimum	1.0	3.0[3]	3.0	2.0	1.0
▫ Maximum	3.0	2.0	7.0	4.0	4.5
● **Licenses terminated for cause,** number in the fiscal year					
▪ **Invention licenses** (Patent licenses) [2]	0	0	0	0	0

(1) Date of license application to date of license execution. (Date of license application is the date the laboratory formally acknowledges the written request for a license from a prospective licensee and agrees to enter into negotiations.)
(2) Patent licenses include pending patent applications.
(3) These numbers reflect an increase in income-bearing licenses, which take longer to negotiate than royalty-free research licenses.

Income from licensing comes from a variety of sources: license issue fees; earned royalties; minimum annual royalties; paid-up license fees; reimbursement for full-cost recovery of goods; and services provided by the laboratory to the licensee (including patent costs).

Characteristics of Licenses Bearing Income

	FY 2007	FY 2008	FY 2009	FY 2010	FY 2011
● **All income bearing licenses,** [1] total number	21	21	22	22	21
▫ Exclusive	16	14	15	15	14
▫ Partially exclusive	0	0	0	0	0
▫ Non-exclusive	5	7	7	7	7
▪ **Invention licenses** (Patent licenses),[1] [2] total distributed, income bearing	21	21	22	22	21
▫ Exclusive	16	14	15	15	14
▫ Partially exclusive	0	0	0	0	0
▫ Non-exclusive	5	7	7	7	7
▪ **Other IP licenses**, income bearing	0	0	0	0	0
● **All royalty bearing licenses,** [3] total number	21	21	22	22	21
▪ Invention licenses, royalty bearing	21	21	22	22	21
- Patent licenses,[2] royalty bearing	21	21	22	22	21
▪ **Other IP licenses,** royalty bearing	0	0	0	0	0

(1) Detailed statistics are required under the Technology Transfer Commercialization Act of 2000 (Pub. L. 106-404) [15 U.S.C. Section 3710 (f)].

(2) Patent licenses include licenses of pending patent applications.

(3) Royalties are only one component of total license income.

Income from Licenses

	FY 2007	FY 2008	FY 2009	FY 2010	FY 2011
● **Total income,** all licenses active in FY [1]	$195,347	$223,640	$197,445	$202,216	$169,347
▪ **Invention licenses** (patent licenses) [2]	$195,347	$223,640	$197,445	$202,216	$169,347
▪ **Other IP licenses,** total active in the	0	0	0	0	0
● **Total Earned Royalty Income** (ERI) [3][4]	$195,347	$223,640	$197,445	$202,216	$169,347
▫ Median ERI	$15,000	$20,000	$15,625	$3,438	$1,844
▫ Minimum ERI	$1,280	$640	$320	$1,245	$1,500
▫ Maximum ERI	$169,067	$100,000	$100,000	$100,000	$100,000
▫ ERI from top 1% of licenses	dw	dw	dw	dw	Dw
▫ ERI from top 5% of licenses	dw	dw	dw	dw	Dw
▫ ERI from top 20% of licenses	dw	dw	dw	dw	Dw
▪ **Invention licenses** (Patent licenses) [2][4]	$195,347	$223,640	$197,445	$202,216	$169,347
▫ Median ERI	$15,000	$20,000	$15,625	$3,438	$1,844
▫ Minimum ERI	$1,280	$640	$320	$1,245	$1,500
▫ Maximum ERI	$169,067	$100,000	$100,000	$100,000	$100,000
▫ ERI from top 1% of licenses	dw	dw	dw	dw	dw
▫ ERI from top 5% of licenses	dw	dw	dw	dw	dw
▫ ERI from top 20% of licenses	dw	dw	dw	dw	dw
▪ **Other IP licenses,** total active in the	$0	$0	$0	$0	$0

"n/a" means that the data is not available from the agency at time of this report.
"dw" means data withheld to protect proprietary information.

(1) Total income includes license issue fees, earned royalties, minimum annual royalties, paid-up license fees, reimbursement for full-cost recovery of goods and services provided by the laboratory to the licensee including patent costs and Standard Reference Data.
(2) Patent license tally includes licenses to pending patent applications.
(3) "Earned royalty" is a royalty based on use of a licensed invention (usually, a percentage of sales or of units sold). Not a license issue fee or a minimum royalty.
(4) Detailed statistics are required under the Technology Transfer Commercialization Act of 2000 (Pub. L. 106-404) [15 U.S.C. Section 3710 (f)].

Disposition of Invention License Income

	FY 2007	FY 2008	FY 2009	FY 2010	FY 2011
● **Income distributed** [1] ▪ **Invention licenses,** (Patent licenses),[2] total distributed	$195,347	$223,640	$197,445	$202,216	$169,347
- To inventor(s) [3]	$65,100 (33%)	$75,140 (34%)	$66,757 (34%)	$72,157 (36%)	$56,698 (33%)
- To NIST [3]	$130,247 (67%)	$148,500 (66%)	$130,688 (66%)	$130,058 (64%)	$112,649 [4] (67%)

(1) Income includes royalties and other payments received during the fiscal year.
(2) Patent licenses include licenses on pending patent applications.
(3) Percentages indicate amounts of total licensing income to inventors and to NIST.
(4) This number reflects the distribution of $1,500 of license income to National Institutes of Health.

Other Performance Measures Deemed Important by the Agency

	FY 2007	FY 2008	FY 2009	FY 2010	FY 2011
Standard Reference Materials (SRMs) available [(1)]	1,285	1,282	1,283	1,283	1,177
Standard Reference Materials (SRMs) units sold [(2)]	32,614	33,373	29,769	31,667	32,864
Standard Reference Data (SRD) titles available [(3)]	109	102	120	120	120
Number of calibration tests performed [(4)]	27,489	25,944	18, 609	17,697	18,195
Technical publications in peer-reviewed journals[(5)]	1,272	1,271	1,463	1,243	1,210

(1) Direct and verifiable count of SRMs available to customers at the close of the fiscal year. The number of SRMs available for sale illustrates the breadth of measurements supported by NIST. Over time, NIST expects slight growth in the number of SRMs available.

(2) Direct and verifiable count of NIST SRM units sold during the fiscal year. In recent years, NIST had been expecting a continuing slight decline in the number of SRM units sold.

(3) Direct and verifiable count of SRD products developed and disseminated by NIST. Of the titles currently available, about 40% are available for sale, and 60% are free online systems. Over time, a larger percentage of SRDs will be distributed via the Internet.

(4) Calibration tests performed by the NIST laboratories.

(5) Annual number of NIST's technical publications appearing in scientific peer-reviewed journals.

Downstream Outcomes from NIST 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 IR 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 Time and Frequency Division has become a world leader in research, metrology, and development of chip-scale atomic clocks (CSAC) and similar chip-scale atomic devices, including magnetometers and gyroscopes. The program began with in-house development of a miniature all-optical atomic clock, which led to subsequent support from DARPA for development of microminiature versions. Today, NIST assists in the commercialization of the technology. Symmetricom, Inc., has begun commercial deliveries of chip-scale atomic clocks (CSACs), a technology invented and nurtured within the Time and Frequency Division. In addition to Symmetricom, Honeywell and Teledyne have development programs for captive applications.

CSACs will enable portable, low-power electronic devices to have unprecedented performance and innovative new functionality. The CSACs are manufactured in Beverly, Mass.

The 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.
With this improved performance, GPS receivers can determine their position quicker 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, underwater, early adopters of CSACs include makers of underwater seismic sensors—hydrophones or geophones using time difference-of-arrival techniques.

In military applications, CSACs will be used in backpack-mounted radios and IED jammers needed in settings with few roads, such as Afghanistan, where 70 percent of patrols move on foot. These applications require precise synchronization so that soldiers don't 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 technologies—a cutting-edge approach used, for example, to develop advanced medical assays or examine the behavior of complex fluids—face a universal plumbing 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 analytical equipment needed to support them involves a haphazard collection of gluing, clamping and awkward screw ports. To address this problem, in 2009 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. Where gluing connections can take hours, the magnetic connectors hook up in seconds, and for the range of pressures used in microfluidics they don't leak.

In 2010, SFC Fluidics LLC (www.sfc-fluidics.com), a small business headquartered in Arkansas, licensed the NIST magnetic connector technology. Over the last year, they have gone on to establish and market an entire product line of QuickConnect™ devices that leverage nearly every

innovation in the NIST patent. 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 valves to control flow to devices. Overall, the QuickConnect™ products will help researchers more efficiently prototype and test lab-on-a-chip platform, and potentially accelerate the development of technologies such as point-of-care medical devices.

NIST, ASTM Land a One-Two Punch to Fight Explosives Terrorism

SRMs are among the most widely distributed and used NIST products. The agency prepares, analyzes and distributes more than 1,000 different carefully characterized materials that are used throughout the world to check the accuracy of instruments and test procedures used in manufacturing, clinical chemistry, environmental monitoring, electronics, criminal forensics and dozens of other fields.

Trace-explosives detectors (TEDs) are an increasingly common sight at airports and on loading docks, and emergency response personnel carry them to evaluate suspicious packages. A new test material developed by NIST in cooperation with ASTM International enables users of these products to evaluate their performance and reliability.

This SRM fully satisfies the need for independent test materials with low uncertainties in concentrations necessary for reliable TED evaluation. These new reference materials are consistent with ASTM International's Standard Practice E2520 Standard Practice for Verifying Minimum Acceptable Performance of Trace Explosive Detectors. Equipment vendors may use the SRM, in conjunction with the consensus standard, to improve and optimize their designs and demonstrate to their customers how well their machines function. Buyers may use the SRM to make sound procurement decisions. The combination of a validated standard practice and SRM will provide TED users with a reliable means of verifying initial and continuing field performance of their equipment, contributing to the fight against explosives terrorism.

Free Online Tool Aids Decisions on Fire Sprinkler Systems for Homes

For the many states, communities, new-home builders and prospective buyers now mulling over the pluses and minuses of installing residential fire suppression sprinklers, NIST has developed a free online tool to help them sort through the costs and benefits of the technology. NIST's new, Web-based "sprinkler use decisioning" tool enables experts and non-experts alike to assess the cost-effectiveness of fire sprinklers for their particular jurisdiction, development, or dwelling.

More than 200 communities and a handful of states, including California, Maryland, and South Carolina, have adopted the code. So has Pennsylvania. But the Pennsylvania House of Representatives recently voted to repeal the mandate, sending the measure on to the State Senate for its consideration. Debate and disagreement over proposed sprinkler ordinances have flared in other areas as well.

The NIST tool can help to inform these kinds of policy discussions, providing the means for "apples to apples" comparisons of different installation scenarios. It is based on the economic framework that NIST researchers developed in their 2007 report, *Benefit-Cost Analysis of Residential Fire Sprinkler Systems*.

Commercial Industrial Training Seminars Incorporate NIST Machining Videos
Industrial training seminars, such as those developed by Peterson Tool Company (PTC) for the Precision Machined Products Association (PMPA) National Technical Conference, incorporate NIST machining videos. PMPA represents an industrially diverse base of small and medium manufacturing companies that produce highly engineered components using advanced production technologies.

In the case of PTC, training seminars relied heavily on videos created at NIST using the NIST MAnufacturing Deformation MAcrovideography System (MADMACS). MADMACS uses a multi-camera system to teach practitioners about machining process control, chip management, tool design, surface quality, and product integrity. The MADMACS videos depict a variety of desirable and undesirable cutting process behaviors at an unprecedented combination of high magnification, resolution, and frame rate in visible and infrared spectra.

NIST Engineering Laboratory and Safe and Effective Fire Fighting
NIST-led research into wind driven fire-fighting tactics has provided the fire service with the technical information necessary to implement positive pressure ventilation (PPV) tactics in a manner to enable safe and effective fire-fighting and provide effective evacuation of building occupants. Fire departments across the USA and Canada have incorporated the results into operational procedures, leading to a transformational change in fire department tactics.

Positive pressure ventilation uses portable fans to pressurize or blow air into structures. When used properly, PPV provides cooler and safer conditions for building occupants to evacuate and better conditions for fire fighters to work. While fire departments are equipped with PPV fans, they did not understand enough about ventilation, whether naturally occurring or generated by PPV fans, to understand when or how PPV fans should be used. The technical challenge was to develop the measurement science necessary to understand positive pressure ventilation and natural wind effects on building fires, and then to transfer that information in a manner usable by the U.S. Fire Service.

New Website Offers Easy Access to NIST Disaster and Failure Study Data
For more than 40 years, scientists and engineers at NIST have studied structural failures caused by natural disasters, fires and man-made factors, and used the lessons learned to improve building and fire codes, standards and practices. With the launch of the Disaster and Failure Events Data Repository, NIST has begun to make this valuable information accessible more easily online.

The repository will ensure that data collected during and after a disaster or failure event, as well as data generated from related research, is organized and maintained to enable study, analysis and comparison with future severe disaster events. It also will serve as a national archival database where other organizations can store the research, findings and outcomes of their disaster and failure studies.

As the database grows, it will include data on significant hazard events; how buildings and other structures performed during those events; associated emergency response and evacuation procedures; and the technical, social and economic factors that affect pre-disaster mitigation

activities and post-disaster response efforts. By making this data available online, NIST hopes to support the development of standards and new technologies that enable more efficient collection of data on disaster and failure events.

Individual Staff Researcher Awards with Technology Transfer Impact

In 2011, NIST researchers received numerous external awards for their achievements in science and technology. One such type of award includes the election of the NIST researchers Fellows in scientific, engineering, and standards organizations, a distinction reserved for select few with extraordinary record of accomplishments. Some NIST staff elected as Fellows of the American Association for the Advancement of Science (AAAS) and the American Physical Society (APS):

- Joseph Stroscio for "distinguished contributions to the fields of surface and condensed matter physics, particularly for the development of scanning tunneling microscopy." (AAAS Fellow)
- Muhammad Arif for "pioneering contributions in neutron interferometry, imaging and detection, with applications ranging from precise measurements of neutron scattering lengths to the imaging of flows in hydrogen fuel cells." (APS Fellow)
- Thomas Silva for "fundamental contributions to the experimental studies of the spin-torque oscillators, their interactions, and collective states, and for the development of new quantitative experimental methods for the investigation of magnetization dynamics in films and nanostructures." (APS Fellow)
- John Kasianowicz for "pioneering contributions to the field of biophysics including detection, identification, characterization, and quantification of biological and chemical polymers, and for the development of a new method for protein structure determination."

CHAPTER 3

National Oceanic and Atmospheric Administration

Approach and Plans for Technology Transfer

The National Oceanic and Atmospheric Administration's (NOAA) 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. This 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.

NOAA is one of the nation's premier scientific agencies. NOAA science and technology impact the daily lives of the nation's citizens, and have a significant impact on the national economy. About one-third of the U.S. economy (approximately $3 trillion) is weather sensitive. Industries related to agriculture, energy, construction, health, travel, and transportation are almost entirely weather dependent. Weather data and forecasts play a critical role in these major economic sectors. Weather related information is transferred to the industry and the public via the media, internet, and NOAA Weather Radio. Federal, state, and local governments and the public use weather warnings to save lives and prevent destruction of property. Television stations, and many weather related firms, use weather data and forecasts in their daily operations. Industry uses NOAA data in home construction and design, crop selection, disease control, and fuel delivery and supply. Weather data have been used for deciding such diverse applications as automobile fuel delivery system design, the best time to market umbrellas, and even for determining optimum conditions for breeding honeybees. Accurate and longer range weather forecasts depend on an ongoing program of research and development.

Research by NOAA's laboratories is primarily aimed at assisting NOAA's operational components. Recent examples demonstrating the direction of NOAA's research are weather forecasting, solar emission forecasting, estimating fish stocks, predicting water resources, tsunami warning, and charting ocean bottom topography. Research results are transferred to NOAA's operational components to improve prediction, management, and other mission activities.

NOAA provides details of its research and technology to the public in the form of information products and services. These include weather and climate forecast data, El Niño prediction and monitoring, tides and currents, satellite imagery, fishery statistics, information on protected species, air quality, coastal conditions, beach temperatures, nautical charts, and databases on climate, oceans, ice, atmosphere, geophysics and the sun.

NOAA's primary technology transfer mechanism has historically been the open dissemination of scientific and technical information to individuals, industry, government, and universities. This means of transfer is consistent with the agency's mission and scientific tradition. Although NOAA finds this method of technology transfer to be more efficient and economical, NOAA continues to transfer certain intellectual property through licenses and Cooperative Research and Development Agreements (CRADAs) when it provides a competitive edge to U.S. companies.

In FY 2011, NOAA's technology transfer program disseminated applications resulting from its meteorological and oceanographic technologies to individuals, industry, government, and universities. In addition, NOAA provided daily weather forecasts and warnings through the media and NOAA Weather Radio. NOAA also transferred its technology through presentations at scientific meetings, publication in peer-reviewed scientific journals, and through NOAA scientific and technical publications.

NOAA collaborates with other federal research agencies on topics of joint interest in science and technology development. For example, NOAA and the Environmental Protection Agency (EPA) teamed up to provide new experimental air quality forecast guidance that enables state and local agencies to issue more accurate and geographically specific air quality warnings to the public. The annual cost of poor air quality to the U.S. from air pollution-related illnesses has been estimated at $150 billion.

To ensure that United States benefits from and fully exploits scientific research and technology developed abroad, NOAA collaborates and shares information with organizations in countries throughout the world. Through these international relationships, NOAA receives technology that may eventually benefit U.S. industries and public users. For example, the understanding and forecasting of global phenomena that occur in the atmosphere, oceans, and on the sun require worldwide collaboration and information sharing. This is accomplished through formal agreements with individual countries and participation in international organizations, such as the World Meteorological Organization (WMO), the Intergovernmental Oceanographic Commission (IOC), and the International Astronomical Union (IAU). NOAA participates in international scientific programs, such as in the Global Earth Observation System, and shares technology and scientific data. This effort involves nearly 50 countries, the European Commission, and 29 international organizations. NOAA also provides technical assistance and training to individuals from other countries, and participates in an international visiting scientist program. Further, NOAA shares environmental data through its participation in the World Data Center program.

In the future, NOAA will continue to direct its technology transfer and international collaboration activities toward four mission goals:

1. **Climate Adaptation and Mitigation:** An informed society anticipating and responding to climate and its impacts;
2. **Weather-Ready Nation:** Society is prepared for and responds to weather-related events;
3. **Healthy Oceans:** Marine fisheries, habitats, and biodiversity are sustained within healthy and productive ecosystems; and
4. **Resilient Coastal Communities and Economies:** Coastal and Great Lakes communities are environmentally and economically sustainable.

Additional Details in FY 2011

Collaborative Relationships for Research & Development

	FY 2007	FY 2008	FY 2009	FY 2010	FY 2011
● **CRADAs*,** total active in the fiscal year [1]	5	4	5	6	7
- New, executed in the fiscal year	0	1	2[4]	2	2
▪ Traditional CRADAs,[2] total active in the fiscal year	5	4	5	6	7
- New, executed in the fiscal year	0	1	2[4]	2	2
▪ Non-traditional CRADAs,[3] total active in the fiscal year	0	0	0	0	0
- New, executed in the fiscal year	0	0	0	0	0
● **Other types of collaborative R&D relationships**	0	0	0	0	0

CRADA = Cooperative Research and Development Agreement.

(1) "Active" = legally in force at any time during the fiscal year. "Total active" is comprehensive of all agreements executed under CRADA authority (15 USC 3710a).

(2) CRADAs involving collaborative research and development by a Federal laboratory and non-Federal partners.

(3) CRADAs used for special purposes, such as material transfer or technical assistance that may result in protected information.

(4) FY 2009: Correction made to "newly executed" CRADAs; there were two not one as previously reported.

Licensing Details

Profile of Active Licenses

	FY 2007	FY 2008	FY 2009	FY 2010	FY 2011
● **All licenses**, number total active in the FY [1]	6	6	7	6	6
▫ New, executed in the FY	3	0	1*	0	0
▪ **Invention licenses**, total active in the FY	6	6	7	6	6
▫ New, executed in the FY	3	0	0	0	0
- Patent licenses,[2] total active in FY	6	6	7	6	6
▫ New, executed in the FY	3	0	0	0	0
- Material transfer licenses (inventions), total active	0	0	0	0	0
▫ New, executed in the FY	0	0	0	0	0
- Other invention licenses, total active in the FY	0	0	0	0	0
▫ New, executed in the FY	0	0	0	0	0
▪ **Other IP licenses**, total active in the FY	0	0	0	0	0
▫ New, executed in the FY	0	0	0	0	0
- Copyright licenses (fee bearing)	0	0	0	0	0
▫ New, executed in the FY	0	0	0	0	0
- Material transfer licenses (non-inventions), total active	0	0	0	0	0
▫ New, executed in the FY	0	0	0	0	0
- Other, total active in the FY	0	0	0	0	0

	FY 2007	FY 2008	FY 2009	FY 2010	FY 2011
▫ New, executed in the FY	0	0	0	0	0

Multiple inventions in a single license are counted as one license. Licenses that include both patents and copyrights (hybrid licenses) are reported as patent licenses and are not included in the count of copyright licenses.
(1) "Active" = legally in force at any time during the FY.
(2) Patent license tally includes patent applications which are licensed.
* One-Time License only with one-time flat fee royalty

Licensing Management

	FY 2007	FY 2008	FY 2009	FY 2010	FY 2011
● **Elapsed execution time**,[(1)] licenses granted in the FY					
▪ **Invention licenses**					
▫ Average, months	5.0	*	7.0	7.0	7.0
▫ Minimum	6.0				
▫ Maximum	7.0				
- Patent licenses [(2)]					
▫ Average, months	5.0	*	7.0	7.0	7.0
▫ Minimum	6.0				
▫ Maximum	7.0				
● **Licenses terminated for cause**, number in the FY					
▪ Invention licenses	0	0	0	0	0
- Patent licenses [(2)]	0	0	0	0	0

Data included in this table (intentionally) addresses only invention licenses, with patent licenses distinguished as a sub-class.
* No new licenses were executed in FY 2008.
(1) Date of license application to the date of license execution. (Date of license application is the date the lab formally acknowledges the written request for a license from a prospective licensee and agrees to enter into negotiations.)
(2) Patent license tally includes patent applications which are licensed.

Characteristics of Licenses Bearing Income

	FY 2007	FY 2008	FY 2009	FY 2010	FY 2011
● **All income bearing licenses**, total number	4	4	5	4	3
▫ Exclusive	0	0	0	0	0
▫ Partially exclusive	0	0	0	0	0
▫ Non-exclusive	4	4	5	4	3
▪ **Invention licenses**, income bearing	4	4	5	4	3
▫ Exclusive	0	0	0	0	0
▫ Partially exclusive	0	0	0	0	0
▫ Non-exclusive	4	4	5	4	3
- Patent licenses,(1) income bearing	4	4	5	4	3
▫ Exclusive	0	0	0	0	0
▫ Partially exclusive	0	0	0	0	0
▫ Non-exclusive	4	4	5	4	3
▪ **Other IP licenses**, income bearing	0	0	0	0	0
▫ Exclusive					
▫ Partially exclusive					
▫ Non-exclusive					
- Copyright licenses (fee bearing)					
▫ Exclusive					
▫ Partially exclusive					
▫ Non-exclusive					
● **All royalty bearing licenses**,(2) total number	4	4	5	4	3
▪ **Invention licenses**, royalty bearing	4	4	5	4	3
- Patent licenses,(1) royalty bearing	4	4	5	4	3
▪ **Other IP licenses**, royalty bearing	0	0	0	0	0
- Copyright licenses (fee bearing)	4	4	5	4	3

In general, license income can result from various sources: license issue fees, earned royalties, minimum annual royalties, paid-up license fees, and reimbursement for full-cost recovery of goods and services provided by the lab to the licensee including patent costs.

(1) Patent license tally includes patent applications which are licensed.

(2) Note that royalties are one component of total license income.

Income from Licenses

	FY 2007	FY 2008	FY 2009	FY 2010	FY 2011
● **Total income**, all licenses active in the FY [1]	$22,000	$69,007	$138,444[4]	$35,044	$107,220
▪ **Invention licenses**	$22,000	$69,007	$138,444	$35,044	$107,220
- Patent licenses [2]	$22,000	$69,007	$138,444	$35,044	$107,220
▪ **Other IP licenses**, total active in the FY	0	0	0	0	0
- Copyright licenses					
● **Total Earned Royalty Income** (ERI) [3]	$22,000	$69,007	$138,444	$35,044	$107,220
▫ Median ERI	$4,000	$9,007	$19,000	$5,000	$34,000
▫ Minimum ERI	$1,000	$1,000	$1,000	$1,000	$1,000
▫ Maximum ERI	$9,000	$25,000	$75,000	$17,044	$69,000
▫ ERI from top 1% of licenses	$9,000	$25,000	$75,000	$17,044	$69,000
▫ ERI from top 5% of licenses	$9,000	$25,000	$75,000	$17,044	$69,000
▫ ERI from top 20% of licenses	$9,000	$25,000	$75,000	$17,044	$69,000
▪ **Invention licenses**	$22,000	$69,007	$138,444	$35,044	$107,220
▫ Median ERI	$4,000	$9,007	$19,000	$5,000	$34,000
▫ Minimum ERI	$1,000	$1,000	$1,000	$1,000	$1,000
▫ Maximum ERI	$9,000	$25,000	$75,000	$17,044	$69,000
▫ ERI from top 1% of licenses	$9,000	$25,000	$75,000	$17,044	$69,000
▫ ERI from top 5% of licenses	$9,000	$25,000	$75,000	$17,044	$69,000
▫ ERI from top 20% of licenses	$9,000	$25,000	$75,000	$17,044	$69,000
- Patent licenses [2]	$22,000	$69,007	$138,444	$35,044	$107,220
▫ Median ERI	$4,000	$9,007	$19,000	$5,000	$34,000
▫ Minimum ERI	$1,000	$1,000	$1,000	$1,000	$1,000
▫ Maximum ERI	$9,000	$25,000	$75,000	$17,044	$69,000
▫ ERI from top 1% of licenses	$9,000	$25,000	$75,000	$17,044	$69,000
▫ ERI from top 5% of licenses	$9,000	$25,000	$75,000	$17,044	$69,000
▫ ERI from top 20% of licenses	$9,000	$25,000	$75,000	$17,044	$69,000
▪ **Other IP licenses**, total active in the FY	0	0	0	0	0

(1) Total income includes license issue fees, earned royalties, minimum annual royalties, paid-up license fees, and reimbursement for full-cost recovery of goods & services provided by the lab to the licensee including patent costs.

(2) Patent license tally includes patent applications which are licensed.

(3) "Earned royalty" = royalty based upon use of a licensed invention (usually, a percentage of sales or of units sold). Not a license issue fee or a minimum royalty.

(4) Increase is due to a license with Walt Disney for NOAA's Science on a Sphere for a one-time royalty of $75,000.

Disposition of License Income

	FY 2007	FY 2008	FY 2009	FY 2010	FY 2011
● **Income distributed** [1]					
▪ **Invention licenses**, total distributed	$22,000	$69,007	$138,444	$35,044	$107,220
- To inventor(s)	$12,200 (55%)	$22,802 (32%)	$45,153 (33%)	$14,514 (41%)	$34,266 (32%)
- To other	$9,800 (45%)	$46,205 (68%)	$93,291 (67%)	$20,530 (59%)	$72,954 (68%)
- Patent licenses, [2] total distributed	$22,000	$69,007	$138,444	$35,044	$107,220
- To inventor(s)	$12,200 (55%)	$22,802 (32%)	$45,153 (33%)	$14,514 (41%)	$34,266 (32%)
-To other	$9,800 (45%)	$46,205 (68%)	$93,291 (67%)	$20,530 (59%)	$72,954 (68%)

Invention licenses are the chief policy interest regarding disposition of income; content of table reflects this focus.
(1) Income includes royalties and other payments received during the FY.
(2) Patent license tally includes patent applications which are licensed.

Other Performance Measures Deemed Important by the Agency:

	FY 2007*	FY 2008*	FY 2009*	FY 2010	FY 2011
Journal articles published	909	838	789	709	1,034
Technical reports published	284	258	186	158	150

*Publication counts have been recently updated by the NOAA Laboratories for FY 2007, FY 2008 and FY 2009.

GREAT LAKES ENVIRONMENTAL RESEARCH LABORATORY	FY 2007	FY 2008	FY 2009	FY 2010	FY 2011
Website hits (HTML pages)	2,244,420	3,086,605	2,790,351	2,941,319	3,598,240
Website downloads (PDF pages)—brochures, research papers, technical memos, etc.	65,740	110,880	93,400	95,137	107,078

Downstream Outcomes from NOAA Technology Transfer Activities

Hail and Severe Storm Risk Management Initiative (NSSL)
Atmospheric and Environmental Research (AER) and the National Severe Storm Laboratory (NSSL) 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 Cooperative Research and Development Agreement (CRADA), NSSL provided AER access to high-resolution radar data across the continental United States so AER could develop value-added products and test the products in the insurance industry. AER in turn provided insurance industry feedback and quality control assessments to NSSL for inclusion back into their 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.

"NSSL is world renowned for their knowledge and leadership in storm observation and prediction," said Paul Walsh, AER senior vice president. "Pairing this data with the insurance expertise and analytic capabilities within our enterprise enables AER to provide a game-changing weather risk management capability for the insurance industry. An example is AER Respond, which catastrophe teams can use to reduce expense and claims cycle times, determine resource demand and logistics, and validate the date of loss of each weather-related claim."

Cooperative Partnerships for an Improved Great Lakes Observing System (GLERL)
NOAA's Great Lakes Environmental Research Laboratory (GLERL) takes an open design approach to developing new observing system technology. Scientists and engineers publish designs in peer-reviewed literature and on the internet, allowing private companies and other agencies to benefit equally from advances. Sometimes they choose to work with GLERL directly, providing mutual benefit. Cooperative partnerships have developed with Nortek, Fondriest Environmental, and SeaLandAire that have helped advance real-time observation technology in the Great Lakes region and at GLERL. Examples of cooperative technologies and applications include:

- Real-time ice observation technology
- Buoy hull designs
- Fixed platform, buoy-based, and autonomous vehicle sensor arrays
- Single and two-point mooring systems
- Bottom platforms
- Near shore wave measurement systems

- Battery and solar power systems
- Data logging technologies
- New communications technologies.

These projects benefit the Great Lakes Observing System (GLOS) Regional Association (IOOS), GLERL modeling research, researchers from other institutions, the Coast Guard, commercial shippers, fishermen, and the public.

Expanded Use of Biofuels in Federal Marine Vessels: Technology Transfer to U.S. Army Corps of Engineers and Others (GLERL)
NOAA's Great Lakes Environmental Research Laboratory (GLERL) worked with technology they had developed to convert hundreds of Federal vessels to the use of Bio-products for fuels and lubricants, eliminating their dependency on oil based products. GLERL has had significant success transferring this technology to other vessels and organizations. The latest result of this effort was a feasibility study by the U.S. Army Corps of Engineers (USACE). The study used GLERL's methodology to convert four working USACE vessels (36 to 97 feet long) in different locations (CA, MO, OH, and DC) to biodiesel (B100) fuel, and to monitor respective operational and environmental parameters. The impact of technology developed at GLERL appears to be poised to expand from current use on hundreds of vessels, approximately 500 vessels, to future use on thousands of vessels.

Tsunami Training (PMEL)
The Pacific Marine Environmental Laboratory (PMEL) NOAA Center for Tsunami Research (NCTR) has developed and updated multiple training curricula to assist states and cooperating nations to improve tsunami readiness for their citizens. Training includes Tsunami Awareness aimed at emergency management, instruction in the development and implementation of tsunami forecast systems through the web-enabled ComMIT interface, and the award winning "Train-the-Trainer" classes aimed at emergency managers and decision makers for improving tsunami readiness at the local level.

Tsunami Awareness Training
The NCTR, in conjunction with the Natural Disaster Preparedness Training Center (NDPTC) at the University of Hawai'i, has developed a training course targeting emergency management, firefighters, police, health providers, and public works employees. The 6.5 hour long course was posted on the FEMA website and made available as AWR-217 on 3 Dec 2010. The focus of the course is on tsunami mitigation, risk analysis, preparedness, and recovery.

Five courses were presented in federal fiscal year 2011. Pilot course #3 occurred 6-8 October 2010 in Honolulu, HI, Tsunami Teacher class was presented 6-10 December 2010, and a Tsunami Awareness Pilot for NDPTC was presented to approximately 50 students on 7 October 2010 in Camp Murray, WA. On 18 November 2010, a Vertical Evacuation, question and answer workshop was attended by 50 people at Camp Murray, WA and on 21 April 2011, an Earthquake and Tsunami Preparedness Fair for Kids was held for 50 participants of the Shoalwater Bay Tribe. A total of 150 students were trained over the course of FY2011.

ComMIT Training
A Community Model Interface for Tsunami (ComMIT) provides an easily accessible avenue to transfer modeling expertise and capabilities from NOAA to, and between, worldwide coastal constituencies, such as Indian Ocean countries. USAID and UNESCO provided funding to PMEL to develop ComMIT and accompanying tools now available to enable government agencies and regional researchers to run tsunami models, using data from local or remote databases, with an internet-enabled interface. Access to tools for the construction of tsunami inundation maps under selectable scenarios and for real-time tsunami forecast applications provides an easily accessible, critical tool for building tsunami-resilient communities. This approach allows nations without a significant cadre of trained modelers to build tsunami modeling capability for forecast and hazard assessment, allows nations with restrictions on sharing geo-spatial data to input that data locally and not share it with other web-based model users. Most significantly, the internet-based approach creates a virtual regional and global community of modelers using the same tools and approaches to understand tsunami threats all the while providing the capability to share information and insights among themselves.

In 2011, ComMIT training was provided to 28 students in Citeko, Indonesia from 4-8 Oct 2010, to 17 students in Moputo, Mozambique from 14-18 Feb 2011, and to 14 students in Dar es Salaam, Tanzania from 5-11 Mar 2011. A total of 59 students were trained in the use of ComMIT in federal fiscal year 2011.

Tsunami "Train the Trainer" Training
The Washington State Train-the-Trainer program is a joint effort of the NOAA Center for Tsunami Research (NCTR) and the Washington state Emergency Management Division (WA EMD) to provide an educational curriculum suitable for training qualified Tsunami Public Education Instructors. On 7 June 2011, WA EMD hosted Gray's Harbor County Tsunami Train-the-Trainer Workshop in Montesano, WA. The workshop was the 3rd Annual during which NCTR staff in collaboration with WA EMD conducted a Trainer program with the goal of graduating qualified Tsunami Public Education Instructors, as identified by WA EMD. A total of 30 personnel from counties and communities along coastal Washington jurisdictions such as Emergency Management and Community Emergency Response Team (CERT) participated in the workshop.

This critical component of the National Tsunami Hazard Mitigation Program's educational Plan has been recognized as an outstanding educational program. The Overall Award in Excellence in the category of Outreach to the General Public went to Washington State Military Department. The Emergency Management Division Award went to the Tsunami Public Education Instructor: Train the Trainer (T-3) Program, as announced on 9 March 2011. Complete information is available at: http://www.wsspc.org/awards/2011/PR_awards11_FINAL.pdf

NOAA's Hydrometeorology Testbed Legacy Project in California (ESRL PSD and GSD)
The California Department of Water Resources (CA-DWR) has signed a five-year agreement with NOAA's Earth System Research Laboratory (ESRL) to provide CA-DWR with a 21st-century solution to their water management and flood control issues. This joint project between CA-DWR, ESRL, and the Scripps Institute for Oceanography (SIO) is part of CA-DWR's Enhanced Flood Response and Emergency Preparedness (EFREP) Program. This project builds on research conducted under NOAA's Hydrometeorology Testbed (HMT).

During northern hemisphere winters, the western coast of North America is battered by landfalling storms. The impact of these storms is a paramount concern to California, where water supply and flood protection infrastructure are being challenged by the effects of age, increased standards for urban flood protection and projected climate change impacts. In addition, there is a built-in conflict between providing flood protection and the other functions of major water storage facilities in California: water supply, water quality, hydropower generation, water temperature and flow for at risk species, and recreation.

Because antecedent soil conditions can determine whether a storm produces a flood, soil moisture sensors are being placed at 43 sites across the state. CA-DWR is partnering with SIO to install soil moisture sensors in the upper elevations of CA by taking advantage of existing infrastructure at interagency Remote Automated Weather Station (RAWS) sites. ESRL is installing soil moisture sensors at lower elevation sites and primarily at California Department of Forestry fire station (CalFire) facilities.

Water vapor is the primer that fuels precipitation, and GPS technology provides a viable method of measuring the column-integrated water vapor. Hundreds of GPS receivers exist in California for geodetic science. By installing surface meteorology sensors with the GPS receivers and by upgrading real-time communications, these GPS receiver sites can provide water vapor measurements in real time. ESRL is partnering with UNAVCO, the operators of the Plate Boundary Observatory (PBO) where many GPS receivers already exist, to provide water vapor measurements from 37 locations across the state.

The snow level is also a significant variable with respect to flooding in mountainous watersheds because it determines the surface area throughout the watershed that is exposed to snow versus rain. Engineers at ESRL have invented new compact, frequency-modulated, continuous wave radar at S-band designed to measure the snow level at much reduced cost compared to the traditional pulsed-Doppler radars used by ESRL scientists for this purpose. As part of this project these "snow-level radars" are being installed in ten key watersheds across the state.

The winds contained in the low-level jets of landfalling winter storms contribute to the heavy orographic precipitation on the windward slopes of the coastal and inland mountain ranges of California. These jets are often accompanied by enhanced water vapor in the so-called warm conveyor belt of extratropical storms. The narrow band of enhanced integrated water vapor is also referred to as an atmospheric river (AR). ESRL scientists have combined a wind profiler with a GPS receiver and other meteorological sensors to form an AR observatory (ARO). Four coastal AROs are being installed as part of this project.

To take full advantage of the observing networks being installed and to provide advanced lead time of high impact weather, this project involves a numerical weather prediction component using the HMT WRF ensemble. Special display systems that can provide this value-added information in the Weather Forecast Office and River Forecast Center settings are also being implemented. Finally, decision support tools, that will allow water managers and other decision makers to make optimal use of the information, are being developed. Observation and modeling datasets are available on dedicated ESRL web pages. Observation datasets are also available

through the NOAA MADIS program and are sent to NWS Western Region with SHEF-encoding.

Air Quality Model Internationally Used for Forecasting
HYSPLIT (HYbrid Single-Particle Lagrangian Integrated Trajectory) model registered user statistics is 3,121 hits for FY11. This number includes users from the commercial sector, government (federal, state, and foreign), universities (US and foreign), military, non-profits, and private pilots (balloonists, glider pilots). The HYSPLIT model is a complete system for computing simple air parcel trajectories to complex dispersion and deposition simulations. The model can be run interactively on the web through ARL's Real-time Environmental Applications and Display sYstem (READY) or the code executable and meteorological data can be downloaded to a Windows or Mac PC and run using a graphical user interface. The model code is made available to other organizations (government and academia) in order to facilitate improvements to the model through collaborative research and development efforts. ARL scientists have also provided a yearly workshop on the practical use of the model for air quality analysis and forecasting to small groups of users on a first come basis since 2004. A subset of the workshop has been presented several times in Spain as part of a collaborative effort between ARL scientists and the University of Huelva - Centro Internacional de Estudios y Convenciones Ecológicas y Medioambientales (CIECEM).

Earth System Modeling Framework (ESRL Director's Office)
The Earth System Modeling Framework (ESMF) is high performance, open source software for building complex models. It was developed collaboratively by multiple agencies and is used with Weather Service, Department of Defense, NCAR, NASA, DOE, and other model codes. ESMF contributes to NOAA's ability to develop integrated environmental modeling systems. These modeling systems often require grid and other transformations between the software components representing different physical domains or processes. ESMF is used to "couple" the components together and it also provides software libraries for common modeling functions that many codes can share. Within ESRL, the ESMF software was used to couple the Flow-following finite volume Icosahedra Model (FIM) developed in the Global Systems Division to the new NOAA Environmental Modeling System (NEMS) developed at the national Centers for Environmental Prediction. The FIM-NEMS coupling has the potential to improve NOAA weather model forecasts by increasing the scalability and resolution of the forecast model.

NOAA/AOML Research Products Transitioned and Used by Partners
During 2010-2011, multiple NOAA/AOML research products were developed, transitioned, and implemented in a variety of cooperative venues with governmental and non-governmental partners, including other federal agencies, states, foreign nations, universities, and the private sector.

New Parameterization Leads to Improved Storm Size Prediction (AOML)
Hurricane data assimilation requires a background field (generally a prior forecast or other numerical forecast) to initialize the next forecast cycle. Often, storms in the background field may be too large or too small, so the storm size needs to be corrected based on observations. Prior to 2011, the operational Hurricane Weather Research and Forecast Model (HWRF) utilized a single parameter (the radius of maximum wind) to initialize the new forecast cycle. In the 2011 operational HWRF upgrade, a second parameter (radius of the outermost closed isobar)

was developed and implemented by Kevin Yeh (AOML/HRD). This new parameter improves the overall forecast and leads to more accurate hurricane track and intensity forecasts. Which are shared with many of NOAA's weather partners.

Real-time Quality Control Software Enables Incorporation of Real-Time Tail Doppler Radar into Operational Hurricane Forecast Models (AOML)
During the 2010 and 2011 hurricane season, NOAA P-3 Hurricane Aircraft were outfitted with a Tail Doppler Radar (TDR) and the collected data were transmitted to NCEP Central Operations (NCO) and Environmental Modeling Center (EMC) for assimilation into a parallel run of the operational Hurricane Weather and Research Forecast Model for Hurricane Tomas (2010) and Hurricane Irene (2011). Once collected, the TDR data are quality-controlled (QC) by AOML/HRD personnel on-board the P-3s using an AOML/HRD developed real-time, automated Doppler quality control software product. Once collected and quality controlled, the data are delivered to NCO and EMC for use in a parallel model experiment.

NOAA/AOML H*WIND Product Used by DHS-FEMA for Hurricane Irene Post-Storm Damage Assessment (AOML)
Since 1996, the AOML Hurricane Research Division has developed, implemented, and operated the H*Wind product (AOML/HRD M. Powell). The H*Wind product is designed to provide an integrated tropical cyclone observing system in which wind measurements from a variety of observation platforms are used to provide an objective analysis of the distribution of wind speeds in a hurricane prior to and after landfall. This product is designed to improve understanding of the extent and strength of the wind field, and to improve the assessment of a hurricane's intensity and its attendance damages. Recently, the W*Wind project has developed an experimental swath map that is available in image and gridded form as well as GIS shape files. During Hurricane Irene, 42 swath maps were created and provided to DHS-FEMA for their post-storm damage assessment.

Unified Dropsonde Quality Assurance and Visualization Capability Developed (AOML)
In conjunction with the National Center for Atmospheric Research (NCAR), NOAA/AOML (M. Black, AOML/HRD) has developed a Unified Dropsonde Quality Assurance and Visualization Capability. The joint AOML and NCAR project provides an operational software suite to quality control GPS dropsondes in real time from NOAA and Air Force research and reconnaissance aircraft. The software also provides National Hurricane Center (NHC) forecasters with increased capability to visualize and assess dropsonde data in real time and for post-storm analyses. The software is currently being tested by NOAA, the Air Force, and NCAR, and is expected to be fully operational in FY2012.

National Ocean Service
National Centers for Coastal Ocean Science (NCCOS)
Many technologies developed by NCCOS are made available to the organization funding or requesting the technology, and links to the innovation are available on the web to any interested parties.

Modeling Coastal Estuarine Systems
Coastal Resource Managers hesitate to use existing modeling tools for coastal systems because of the complexity of the systems and models. NOAA created a downloadable software tool to

simplify the process of modeling coastal systems where the user does not have to manipulate complex equations and spreadsheets. This tool can evaluate different water quality scenarios and display the likely outcomes on a map so managers can easily view the implications of management decisions. This tool requires only user input of routinely monitored water quality data and displays the output in tables, graphs and maps. In 2011, NOAA delivered the beta version of the tool to the Massachusetts Department of Environmental Protection to test in two estuaries with known depth information and optical water quality data.

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. These models generate 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. The model does not predict the abundance of pathogens or the susceptibility of people to illness. The Center for Disease Control is responsible for research on susceptibility.

International workshop

In response to a request from the European Union, partners from Portugal, Sweden, and Israel were trained on theoretical aspects of the Bio-optical Water Quality Model and its application for monitoring and managing seagrass ecosystems. Funded by the European Union, this workshop was part of collaboration between NCCOS, Smithsonian Environmental Research Center (SERC) and European Partners in the Cooperation in Science and Technology Program.

Deepwater Horizon Oil Disaster Monitoring

NCCOS researchers are developing indices to monitor changes in health, social and economic conditions resulting from the Deepwater Horizon oil disaster. Through measures collected from secondary sources, NCCOS researchers developed and created an operational structure for social, economic, demographic and environmental indicators while developing methodology and conducting data collection of baseline indicators in counties impacted by oiled shorelines.

Algal Bio-fuel Research

NCCOS researchers have joined with the Department of Energy's Savannah River National Laboratory to focus on understanding potential algal toxicity in large scale algal bio-fuel research efforts.

Tracking Algal Bloom Toxins

NCCOS provided Ohio EPA forecasts and tracks of Microcystis algae bloom densities along Lake Erie beaches and drinking water intakes, which enabled them to focus meager resources on areas where noxious blooms may be concentrated to search for high toxin levels.

National Geodetic Survey

New technology is developed at the NOAA's National Geodetic Survey by NOAA employees or in cooperation with university and other outside partners. None of the technology developed is licensed or patented. For most applications, scientific papers are published in a variety of scholarly journals.

International Technology Transfer Through Cooperation
NGS hosted visiting scientists from Taiwan, Germany, Mongolia, South Korea and China. Scientists from a variety of national and international institutions were invited and supported for mutual research projects at NGS.

Real-time Processing Components of the Meteorological Assimilation Data Ingest System (MADIS)
MADIS components were transitioned to the NWS National Center for Environmental Prediction (NCEP) and the NWS Telecommunications Operation Center (TOC), with the official declaration of Initial Operating Capability (IOC) signed in Oct 2010. Full Operational Capability (FOC) testing is scheduled for March 2013. MADIS includes quality controlled observations from NOAA, other government agencies, universities, aircraft, and private sector. With MADIS, NOAA can effectively leverage investments of non-NOAA observing systems resulting in huge cost savings.

Geo-Targeted Alerting System (GTAS)
GTAS is an implementation of the latest developments in plume modeling, high resolution weather models, and network enabled operations. The GTAS project determines how state and local governments can better use advanced technologies, weather, and toxic plume models for emergency response on a near real-time basis and quickly evacuate areas in danger of chemical spills, chemical attacks, smoke, dust, volcanic ash, etc. All GTAS tasks sponsored by the Department of Homeland Security (DHS)/Federal Emergency Management Agency (FEMA) were transitioned to seven Weather Forecasting Offices (WFOs) and many Emergency Operation Centers (at city, county and state levels). The project, funded by FEMA's IPAWS program, is now stood up at seven WFOs. Global Systems Division (GSD) partnered with the Air Research Laboratory (ARL) and the National Ocean Services' (NOS) Office of Response and Restoration to stand up the systems. The GTAS program may expand dependent on future FEMA funding.

Advanced Weather Interactive Processing System (AWIPS)
Global Sciences Division updated and transitioned several hundred AWIPS-1 Smart Tools and Display-2-Dimensional (D2D) drawing tools to AWIPS-2 for use on the first AWIPS-2 deployed system at the Omaha WFO. This was an emergency request from the National Weather Service (NWS)/Office of Science and Technology (OS&T) since Omaha NWS forecasters could not operate AWIPS-2 without them. Only a few of these tools had been previously requested. GSD completed this tasking within a few months and received praise from the highest levels of NWS. The Real-time processing components of the Meteorological Assimilation Data Ingest System (MADIS) were transitioned to the NWS National Center for Environmental Prediction (NCEP) and the NWS Telecommunications Operation Center (TOC), with the official declaration of Initial Operating Capability (IOC) signed in Oct 2010. Full Operational Capability (FOC) testing is scheduled for March 2013. MADIS includes quality controlled observations from NOAA, other government agencies, universities, aircraft, and private sector. With MADIS, NOAA can effectively leverage investments of non-NOAA observing ystems resulting in huge

cost savings.

Programmable Flask Package Technology Transferred to Commercial Suppliers
The Global Monitoring Division developed a computer controlled air sampling system (Programmable Flask Package 12-pack or PFP) that automatically takes air samples for later trace gas analysis. The technology and design for the system was transferred to companies (Atmospheric Observing Systems and High Precision Devices (both in Boulder, CO) that were willing to construct the PFPs. The PFPs weigh ~60 pounds and cost in the region of $25K each. In addition to the 150 units that NOAA has purchased, the two companies are selling the systems around the globe.

AirCore
AirCore is a NOAA-patented, revolutionary, exceptionally cheap and robust system for sampling profiles of the atmosphere's composition from the edge of space to the surface. The AirCore is essentially a long thin tube that is carried aloft by a high altitude balloon that is parachuted to earth from up to 25 miles above the surface. As the thin coil descends air pressure fills the tube which is capped when reaching the surface. The air molecules do not mix and the varying composition of the atmosphere can be analyzed by pumping the air out of the tube and analyzing small amounts in sequence. This technique is rapidly being adopted by research institutes, NASA, and university groups.

Greenhouse Gas Observation Systems
Working closely with Chinese and Brazilian scientists, GMD has shared knowledge on all aspects of greenhouse-gas observation, from actual measurement to network design, including building and helping to maintain instrumentation. Now the Chinese Academy of Meteorological Sciences (China) and Institute for Nuclear and Energy Research (Brazil) are running nationwide GHG networks similar to that of the United States. Data compatibility and standards are equivalent across the networks.

CarbonTracker
CarbonTracker is a computer-based data assimilation and atmospheric model system developed over the past decade to keep track of carbon dioxide uptakes and releases at the Earth's surface over time. It uses actual greenhouse-gas measurements coupled with observed meteorology and feedbacks from biosphere, fossil fuel combustion and ocean uptake to map areas of CO_2 release and uptake on time scales of days. NOAA's Global Monitoring Division has trained numerous scientists both in the US and abroad how to operate CarbonTracker (a many month process) including scientists from the Indian Institute of Tropical Meteorology, Korean Meteorological Agency, Brazil's Centro de Previsão de Tempo e Estudos Climáticos and agencies in the Netherlands and Australia that all now have national CarbonTracker programs.

SkySonde
SkySonde is a complex but highly reliable and accurate laptop-based telemetry program developed by the Global Monitoring Division to collect data and transmit it to the ground in real time from ascending balloon-borne ozone and water vapor sondes. This program was immediately adopted by NASA and the US Navy for their similar balloon programs.

Associated with this system is software that allows balloon launching users to see a prediction of where the balloon will travel as well as where it may land. This provides the launch personnel a good idea of where the balloon is traveling and if the launch should be avoided or balloon flight terminated due to the payload going towards an airport or any other potentially dangerous area. This software is used by many civilians and other researchers alike.

Continuous Light Absorption Photometer
The Continuous Light Absorption Photometer is a new instrument developed by the Global Monitoring Division to continuously monitor the light absorption characteristics (black carbon content) of atmospheric aerosols in real time. The units have been adopted as a core instrument for aerosol measurements at World Meteorological Organization Global Atmosphere Watch stations and are now deployed at 12 global stations with an additional 12 global sites awaiting construction and delivery of the units.

Prestigious Awards for NOAA's Science and Technology received in FY 2011

NOAA Technology Transfer Award:
A group of PMEL scientists and engineers was awarded the FY2011 NOAA Technology Transfer Award "For developing a sensor to measure carbon dioxide concentrations in the surface ocean and overlying atmosphere and transferring this design to a commercial vendor." Award winners were: Christopher Sabine, Stacy Maenner Jones, Randy Bott, Christian Meinig, Patrick McLain, Noah, Lawrence-Slavas.

Individual Staff Researcher and Division Awards with Technology Transfer Impact:
Dusan Zrnic was awarded the 2010 Technology Transfer Award for "developing a novel way to measure linear orthogonal polarimetric variables without a switch that was patented and transferred to the private sector producing significant savings in the implementation of commercial dual polarization radars."

NSSL's Radar Research and Development Division was honored for scientific and engineering excellence in converting complex military technology used for tracking aircraft and missiles to a civilian weather detection radar. The phased-array radar has shown severe weather detection improvements of four and five times faster. In addition, the scanning flexibility is leading to new scanning strategies and improved data gathering methods. The faster data is also being used to initialize storm scale models that are required to move from a "warn-on-observation" to a "warn-on-forecast" environment.

CHAPTER 4

National Telecommunications and Information Administration
Institute for Telecommunication Sciences

Approach and Plans for Technology Transfer

The Institute for Telecommunication Sciences (ITS) is the chief research and engineering arm of the National Telecommunications and Information Administration (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.

In 2003, ITS added a new metric under the "Other Performance Measures" category: number of publications approved through the Editorial Review Board (ERB) process. This metric provides a useful working indicator of the number of quality publications released to the public. In 2004, ITS added a measure for participation on standards committees. In 2006, ITS added another metric: the total number of hits on the publications listed on the "ITS Online Documents." This metric provides more directly an indication of ultimate benefit to the public.

ITS uses three principal means for achieving technology transfer: cooperative research and development; technical publications; and leadership and technical contributions in the development of telecommunications standards.

Cooperative Research and Development
CRADAs, based on the Federal Technology Transfer Act (FTTA) of 1986, are a means through which ITS aids the private sector. The FTTA provides the legal basis for, and encourages, shared use of government facilities and resources with the private sector in advanced telecommunications technologies.

These partnerships aid in the commercialization of new products and services, as well as enhance the capabilities of ITS laboratories. They also provide insights into industry's needs for productivity growth and competitiveness. This enables ITS to adjust the focus and direction of its programs for effectiveness and value.

In FY 2011, ITS' efforts in technology transfer and commercialization fostered cooperative telecommunications research in areas where U.S. companies can directly benefit from improved competitiveness and market opportunities. These efforts will continue in future years. ITS also participated—as it has for a number of years—in CRADAs with private-sector organizations to design, develop, test, and evaluate advanced telecommunication concepts. The private industry

partner benefits through such cooperative relationships, as does the Institute, because the partner is able to research in commercially important areas that it would not otherwise undertake.

To date, major contributions to personal communication services (PCS), local multipoint distribution service (LMDS), ultra wideband (UWB), and Broadband over Power Line (BPL) technologies have been achieved through CRADAs. These have aided U.S. efforts to rapidly introduce new socially constructive communications technologies. More recently, CRADAs in the areas of objective audio and video quality, advanced antennas for wireless systems, and remote sensing and global position (GPS) technology have allowed ITS to contribute to the development of new products and services.

Technical Publications

Publication has historically been the means through which ITS has transferred research results to other researchers, the commercial sector, and government agencies. Many of these publications—both internal reports and monographs and peer-reviewed articles in external scientific journals—have become standard references in several telecommunications areas.

Technical publication remains a principal means for ITS technology transfer. Most of these technical publications are released only after going through an internal peer review process managed by the ITS Editorial Review Board (ERB). Of the publications released through the ERB process in recent years, approximately one-half were approved for external publication in the scientific literature.

Development of Telecommunication Standards

This method of ITS technology transfer directly addresses improvement of U.S. competitiveness in telecommunications. For several decades, ITS has provided leadership and technical contributions to organizations, both national and international, responsible for developing telecommunication standards. For example, a plurality of the technical recommendations of the International Telecommunication Union (ITU), a treaty organization, are based on research conducted at ITS. Also, key national quality-of-service standards developed under the American National Standards Institute (ANSI) T1 committee for video, audio, and digital data incorporate research results obtained at ITS.

ITS continues to chair numerous committees and working groups in the ITU, ANSI T1 (now ATIS – Alliance for Telecommunications Industry Solutions), and other telecommunication standards organizations, providing technical leadership that is trusted by the commercial-sector participants. ITS's technical inputs are relied upon as technically advanced and sound, and as unbiased by commercial interests.

In FY 2011, ITS continued its technical leadership and contributions to communications standards for public safety, particularly for first responders. ITS's primary area of contribution has been interoperability standards and testing procedures. ITS's objective video quality measurement method has been made a national standard by ANSI. This method was also the best-performing metric in comparison testing by the ITU with other methods from around the world.

Additional Details in FY 2011

Collaborative Relationships for Research & Development

	FY 2007	FY 2008 (1)	FY 2009	FY 2010	FY 2011
● **CRADAs,** total active in the fiscal year (1)	285	41	43	41	32
- New, executed in the fiscal year	280	7	18	15	17
▪ Traditional CRADAs,(2) total active in the fiscal year	9	6	31	29	23
- New, executed in the fiscal year	4	6	10	9	10
▪ Non-traditional CRADAs,(3) total active in the fiscal year	276	35	12	12	9
- New, executed in the fiscal year	276	1	8	6	7
● **Other types of collaborative R&D relationships**					
▪ Collaborative standards contributions,(4) (5) total active in FY	25	25	20	21	21
-New, executed in the fiscal year	9	10	5	1	0

CRADA = Cooperative Research and Development Agreement.

(1) In 2008, ITS took down from the Web some of its telecommunication analysis services. These services provided network-based access to research results, models, and databases supporting applications in wireless system design and analysis. As a result, the number of CRADAs between the government and industry, which allowed for improvement to these models, were down significantly. NTIA-ITS is working on a newer geographic information system- (GIS-) based platform for the modeling services, which will be available in future years.

(2) "Active" means in force at any time during the fiscal year. "Total active" includes all agreements executed under CRADA authority (15 USC 3710a).

(3) CRADAs involving collaborative research and development by a Federal laboratory and non-Federal partners.

(4) ITS' Telecommunications Analysis Services (TA Services) is Internet-accessible through Web-based electronic CRADAs. TA Services provides analysis support to private industry and public agencies in the areas of wireless system design and evaluation, and site selection. The service is provided on a cost-reimbursable basis, 24 hours a day, 7 days a week, throughout the year. TA Services currently reaches numerous government and private-sector users across the nation, providing the latest versions of ITS-developed telecommunications models, databases, and tools. Use of the CRADA makes TA Services available to users in a short time and on a cost-reimbursable basis. Additionally, CRADA partners provide useful evaluations of the ITS software used. This information aids ITS to improve existing software tools for wireless system design and analysis and to develop new ones, benefiting both ITS' own research capabilities and the resources that outside users can draw upon. The CRADA agreement also allows ITS to gain valuable insights from users' feedback about the rapidly changing needs of industry and government in telecommunications technology.

(5) ITS works with industry to apply research results to the development of telecommunication performance standards and guidelines. In FY 2011 ITS worked collaboratively with the ITU, the Telecommunications Industry Association, the ATIS, and various Federal public safety groups to interpret and analyze standards and regulations.

Invention Disclosure and Patenting

	FY 2007	FY 2008	FY 2009	FY 2010	FY 2011
● New inventions disclosed in the fiscal year [1]	0	0	0	0	0
● Patent applications filed in the fiscal year [2]	1	0	0	0	0
● Patents issued in the fiscal year	1	0	0	0	0
● Active patents, end of the fiscal year	8	7	7	2	2

(1) New invention disclosed and provisional patent filed.
(2) Includes: U.S. patent applications, foreign patent applications filed on cases for which no U.S. application was filed, divisional applications, and continuation-in-part applications. Excludes: provisional, continuation, duplicate foreign, and PCT applications.

Licensing Details
Profile of Active Licenses

	FY 2007	FY 2008*	FY 2009	FY 2010	FY 2011
● **All licenses,** number total active in the fiscal year [1] [2]	186	0	0	0	0
▫ New, executed in the fiscal year	179	0	0	0	0
▪ **Invention licenses,** total active in the fiscal year	186	0	0	0	0
▫ New, executed in the fiscal year	179	0	0	0	0
- Patent licenses,[3] total active in the fiscal year	10	0	0	0	0
▫ New, executed in the fiscal year	3	0	0	0	0
- Material transfer licenses (inventions), total active	0	0	0	0	0
▫ New, executed in the fiscal year	0	0	0	0	0
- Other invention licenses, [4] total active in the fiscal year	176	0	0	0	0
▫ New, executed in the fiscal year	176	0	0	0	0
▪ **Other IP licenses,** total active in the fiscal year	0	0	0	0	0

Multiple inventions in a single license are counted as one license. Licenses that include both patents and copyrights (hybrid licenses) are reported as patent licenses and not included in the count of copyright licenses.
* The number of licenses for FY2008 through FY 2011 is zero because ITS no longer licenses Video Quality Metric (VQM) technology. Instead, ITS has made this software available via open-source download.
(1) "Active" = legally in force at any time during the fiscal year.
(2) As of FY 2008 VQM software is available for download without a license.
(3) Patent license tally includes patent applications that are licensed.
(4) International copyright licenses (non-fee-bearing) for VQM technology

Licensing Management

	FY 2007	FY 2008*	FY 2009	FY 2010	FY 2011
● **License Negotiation time**,[1] licenses granted in the fiscal year					
▪ **Invention licenses** (Patent licenses) [2]	1.0	0	0	0	0
▫ Average (or median), months	0.5	0	0	0	0
▫ Minimum	1.5	0	0	0	0
▫ Maximum					
● **Licenses terminated for cause,** number in the fiscal year					
▪ **Invention licenses** (Patent licenses) [2]	0	0	0	0	0

Data included in this table (intentionally) address only invention licenses, with patent licenses distinguished as a subclass.

* The number of licenses for FY 2008 through FY2011 is zero because ITS no longer licenses Video Quality Metric (VQM) technology. Instead, ITS has made this software available via open-source download.

(1) Date of license application to the date of license execution. (Date of license application is the date the laboratory formally acknowledges the written request for a license from a prospective licensee and agrees to enter into negotiations.)

(2) Patent licenses include patent applications that are licensed.

Characteristics of Licenses Bearing Income

	FY 2007	FY 2008*	FY 2009	FY 2010	FY 2011
● **All income-bearing licenses,** total number	10	0	0	0	0
▫ Exclusive	0	0	0	0	0
▫ Partially exclusive	0	0	0	0	0
▫ Non-exclusive	10	0	0	0	0
▪ **Invention licenses,** (Patent licenses), [1] income-bearing	10	0	0	0	0
▫ Exclusive	0	0	0	0	0
▫ Partially exclusive	0	0	0	0	0
▫ Non-exclusive	10	0	0	0	0
▪ **Other IP licenses,** income-bearing	0	0	0	0	0
● **All royalty-bearing licenses,** total number	0	0	0	0	0
▪ **Invention licenses,** (Patent licenses) royalty-bearing	0	0	0	0	0
▪ **Other IP licenses,** royalty-bearing	0	0	0	0	0

In general, license income can result from various sources: license issue fees, earned royalties, minimum annual royalties, paid-up license fees, and reimbursement for full-cost recovery of goods and services provided by the laboratory to the licensee including patent costs.

* The number of licenses for FY 2008 through FY2011 is zero because ITS no longer licenses Video Quality Metric (VQM) technology. Instead, ITS has made this software available via open-source download.

(1) Patent licenses include patent applications that are licensed.

(2) Note that royalties are one component of total license income.

Income from Licenses

	FY 2007	FY 2008*	FY 2009	FY 2010	FY 2011
● **Total income,** all licenses active in the fiscal year [1]	$7,500	$0	$0	$0	$0
▪ **Invention licenses** (Patent Licenses) [2]	$7,500	$0	$0	$0	$0
▪ **Other IP licenses,** all active licenses in FY	$0	$0	$0	$0	$0
● **Total Earned Royalty Income** (ERI) [3]	$0	$0	$0	$0	$0
▪ **Invention licenses** (Patent licenses) [2]	$0	$0	$0	$0	$0
▫ Median ERI	$0	$0	$0	$0	$0
▫ Minimum ERI	$0	$0	$0	$0	$0
▫ Maximum ERI	$0	$0	$0	$0	$0
▫ ERI from top 1% of licenses	$0	$0	$0	$0	$0
▫ ERI from top 5% of licenses	$0	$0	$0	$0	$0
▫ ERI from top 20% of licenses	$0	$0	$0	$0	$0
▪ **Other IP licenses,** total active in the fiscal year	$0	$0	$0	$0	$0

* The number of licenses for FY2008 through FY2011 is zero because ITS no longer licenses Video Quality Metric (VQM) technology. Instead, ITS has made this software available via open-source download.

(1) Total income includes license issue fees, earned royalties, minimum annual royalties, paid-up license fees, and reimbursement for full cost recovery of goods and services provided by the laboratory to the licensee including patent costs.

(2) Patent licenses include patent applications which are licensed.

(3) "Earned royalty" means royalty based upon use of a licensed invention (usually, a percentage of sales or of units sold). Not a license issue fee or a minimum royalty.

Disposition of License Income

	FY 2007	FY 2008*	FY 2009	FY 2010	FY 2011
● **Income distributed** [1] ▪ **Invention licenses,** (Patent licenses), [2] total distributed	$7,500	$0	$0	$0	$0
- To inventor(s)	$5,050 (67%)	$0	$0	$0	$0
- To other [3]	$2,450 (33%)	$0	$0	$0	$0

Invention licenses are the chief policy interest regarding disposition of income; the content of this table reflects this focus.

* The number of licenses for FY2008 through FY2011 is zero because ITS no longer licenses Video Quality Metric (VQM) technology. Instead, ITS has made this software available via open-source download.

(1) Income includes royalties and other payments received during the fiscal year.

(2) Patent license tally includes patent applications which are licensed.

(3) To ITS/NTIA.

Other Performance Measures Deemed Important by the Agency

	FY 2007	FY 2008	FY 2009	FY 2010	FY 2011
Technical publications produced	3	15	12	17	15
Total number of hits on online publications	1,426,125	1,526,409	3,020,629	3,667,000	3,850,350

See "Technical Publications" above in the first section of this report for additional information on this topic.

	FY 2007	FY 2008	FY 2009	FY 2010	FY 2011
Technical publications produced - ITS	3	15	12	12	15
Collaborative contributions - ITS	25	25	20	20	25

Downstream Outcomes from ITS Technology Transfer Activities

The following are examples of downstream outcomes from ITS technology transfer efforts:

Table Mountain Research

The Table Mountain Field Site and Radio Quiet Zone supports fundamental research in the nature, interaction, and evaluation of telecommunication devices, systems, and services. Each year, private companies, universities and other organizations conduct research at Table Mountain under Cooperative Research and Development Agreements (CRADAs). The following are brief descriptions of some of these recent CRADAs:

- For the past five years, the University of Colorado's Research and Engineering Center for Unmanned Vehicles has conducted measurements on the performance of ad hoc wireless networks with both ground-based and airborne terminals at Table Mountain.
- In FY 2011, several companies have performed antenna, Light Detection and Ranging (LIDAR)/Global Positioning Satellite(GPS), and other testing at the Table Mountain turntable facility under a CRADA.
- Lockheed Martin Coherent Technologies is in its twelfth year field-testing and characterizing components, subsystems and systems for eye-safe coherent laser radar. This has benefited NTIA and the Department of Defense.

SUMMARY

Technology transfer is an essential mission of the Department of Commerce, using our nation's innovation and investment in science and technology to strengthen our economy and competitiveness in world markets. This report details the results of technology partnering activities originating from the Department of Commerce's federal laboratories. Federal research is a complex process that provides the opportunity for new ideas and innovations to be successfully marketed to serve citizens. The success stories in this report provide examples of how society benefits from technology transfer activities across the Department of Commerce's federal laboratories. As knowledge advances and the needs of the economy change, the Department of Commerce will continue to play a role in keeping America in the forefront of innovation and supporting our economy by aiding in the transfer and commercialization of knowledge.