

# ANNUAL RESEARCH REPORT FY 2013

BOARD OF  
**Regents**



ARIZONA'S PUBLIC  
UNIVERSITIES

EDUCATE • DISCOVER • IMPACT

Much of the innovation that improves people's lives springs from university research and Arizona's public universities are critical incubators for such research and activity.

The body of knowledge created by university research can be measured in part by inventions, patents and start-up companies, all of which fuel the private sector and translate into jobs – high-paying, high-skill jobs.

The Arizona Board of Regents has defined several key measures to evaluate the growth of its research enterprise in the university system and it continues to make steady progress.

Through research activity at the universities, millions of dollars are reinvested annually into the community. In 2013, Arizona's public universities brought in more than \$1 billion in research expenditures, dollars that drive purchases and employment within Arizona. Research activity also directly resulted in 14 different startup companies, over 400 invention disclosures, 71 U.S. patents issued, and public-private partnerships which will help fuel Arizona's economy going forward.

Increasing the research capabilities and performance of the Arizona University System to a level of competitive prominence with peer rankings of top American research universities is a significant part of the regents' overarching goal to contribute to the vitality of Arizona's future.

The information in this report demonstrates that the discovery and innovation taking place at Arizona's public universities is expanding and that translates to more discoveries, a better quality of life for Arizonans, and more jobs for the State.

## The Report's Design

This report provides an in-depth and comprehensive review of Arizona's higher education research enterprise. It is designed to allow the reader to easily locate any single research metric or indicator for any of Arizona's three public universities and quickly compare each Arizona university's performance against those of its Board-approved peers.

The metrics are categorized into five areas for each university:

- Enterprise size
- Discovery and scholarly impact
- Economic development
- Leadership and recognition
- Technology transfer activity

A review of the metrics in these five areas will provide the reader with a better understanding of the progress being made by Arizona's public universities toward creating new knowledge, finding solutions for challenges in Arizona and worldwide, and creating economic opportunity for the state.

In addition, a final area has been added—Strategic Initiatives. This section provides a glimpse into the impact of Technology Research Initiative Fund (TRIF) investments. The full Annual TRIF report can be found on the Regents' website.

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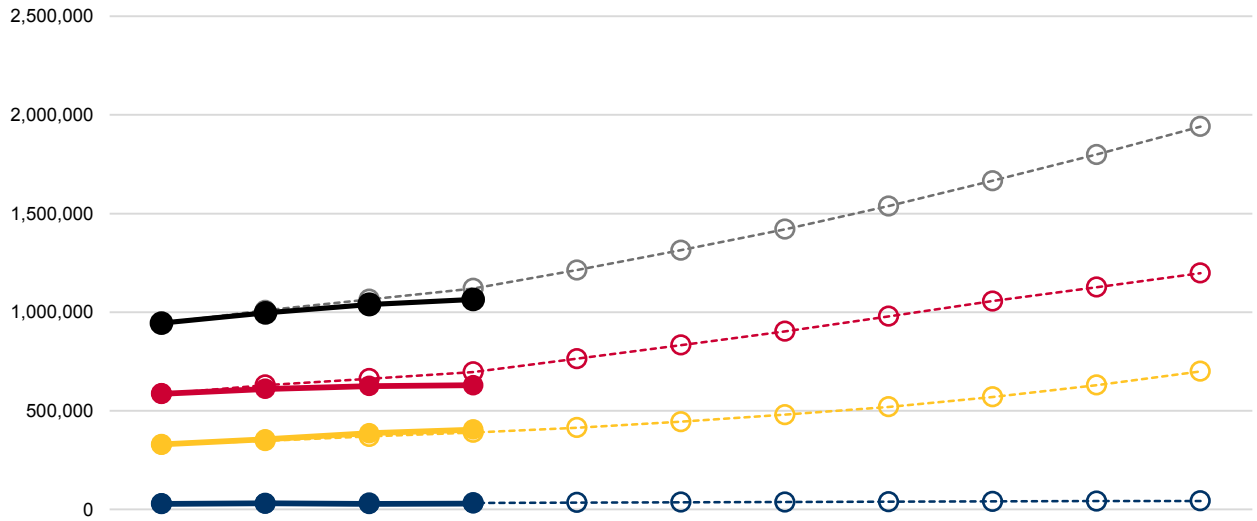
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## Enterprise Metrics

# Enterprise Size

Total Research Expenditures (in Thousands)



ABOR Enterprise Plan	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Goal	945,080	1,009,276	1,065,160	1,120,569	1,213,978	1,314,387	1,420,796	1,538,205	1,666,614	1,799,023	1,941,432
Actual	944,795	996,565	1,039,424	1,065,136							
Difference	-285	-12,711	-25,736	-55,433							

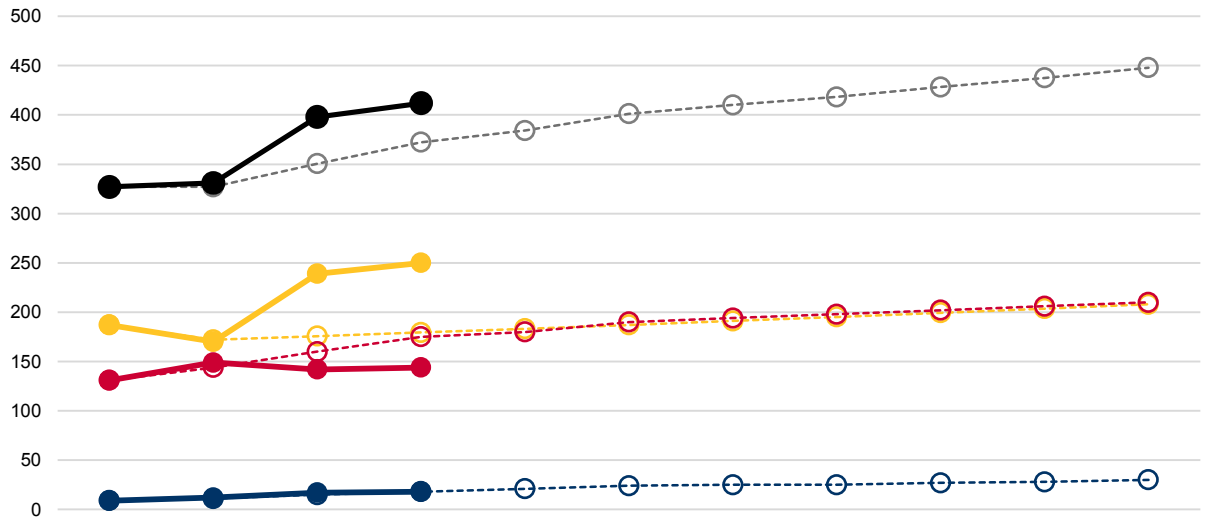
Arizona State University	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Goal	329,345	348,525	370,000	390,000	415,000	445,000	480,000	520,000	570,000	630,000	700,000
Actual	329,345	355,215	385,959	405,154							
Difference	0	6,690	15,959	15,154							

Northern Arizona University	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Goal	28,803	30,751	32,160	33,569	34,978	36,387	37,796	39,205	40,614	42,023	43,432
Actual	28,803	30,785	28,100	30,516							
Difference	0	34	-4,060	-3,053							

The University of Arizona	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Goal	586,932	630,000	663,000	697,000	764,000	833,000	903,000	979,000	1,056,000	1,127,000	1,198,000
Actual	586,647	610,565	625,365	629,466							
Difference	-285	-19,435	-37,635	-67,534							

# Discovery and Scholarly Impact

Invention Disclosures Transacted



ABOR Enterprise Plan	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Goal	327	327	351	372	384	401	410	418	428	438	448
Actual	327	331	398	412							
Difference	0	4	47	40							

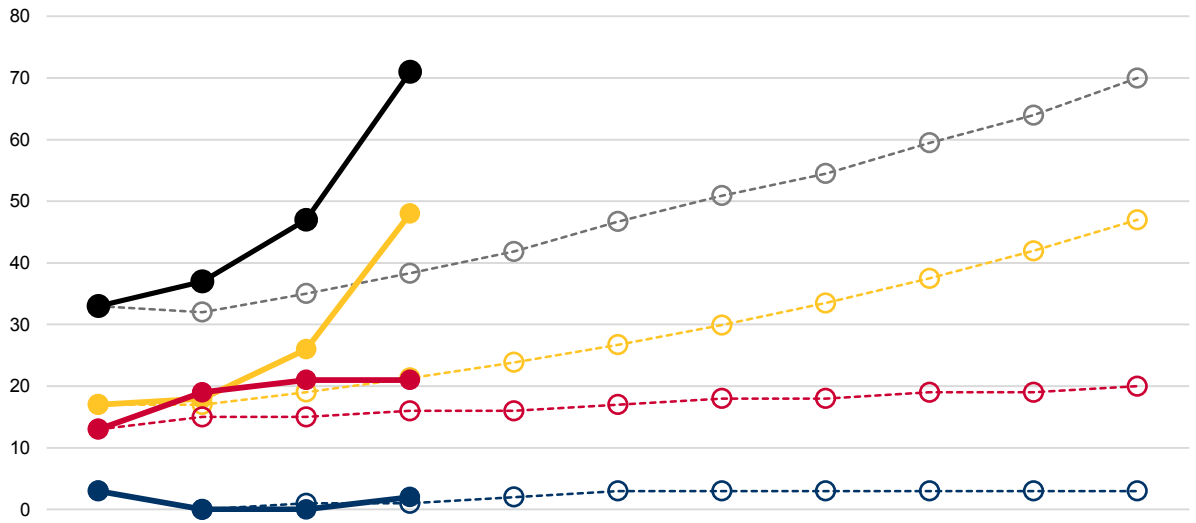
Arizona State University	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Goal	187	172	176	179	183	187	191	195	199	204	208
Actual	187	170	239	250							
Difference	0	-2	63	71							

Northern Arizona University	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Goal	9	11	15	18	21	24	25	25	27	28	30
Actual	9	12	17	18							
Difference	0	1	2	0							

The University of Arizona	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Goal	131	144	160	175	180	190	194	198	202	206	210
Actual	131	149	142	144							
Difference	0	5	-18	-31							

# Discovery and Scholarly Impact

U.S. Patents Issued



ABOR Enterprise Plan	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Goal	33	32	35	38	42	47	51	54	59	64	70
Actual	33	37	47	71							
Difference	0	5	12	33							

Arizona State University	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Goal	17	17	19	21	24	27	30	33	37	42	47
Actual	17	18	26	48							
Difference	0	1	7	27							

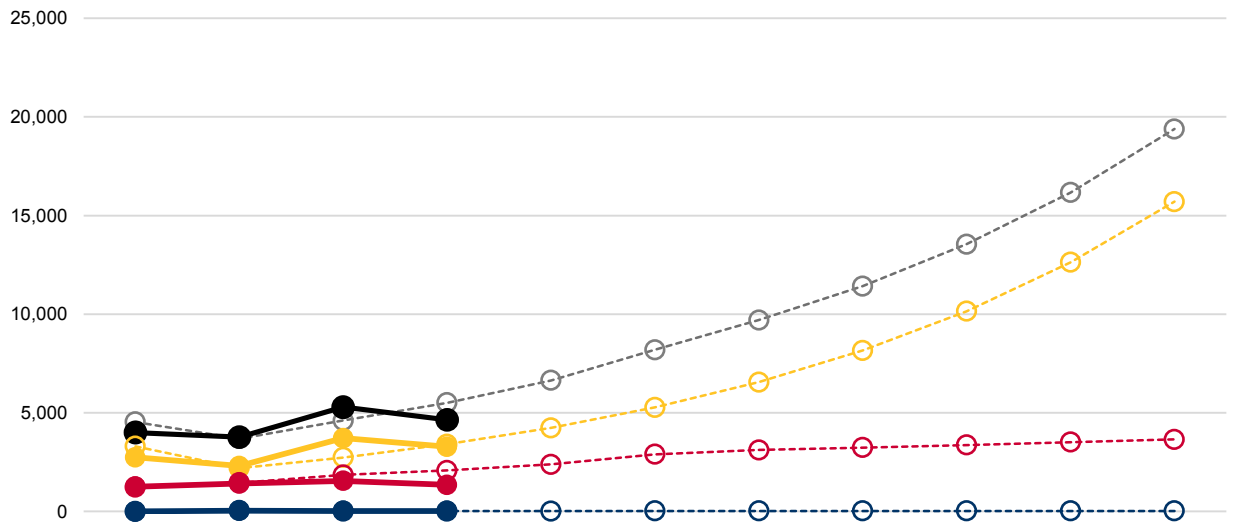
Northern Arizona University	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Goal	3	0	1	1	2	3	3	3	3	3	3
Actual	3	0	0	2							
Difference	0	0	-1	1							

The University of Arizona	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Goal	13	15	15	16	16	17	18	18	19	19	20
Actual	13	19	21	21							
Difference	0	4	6	5							



# Economic Development

Intellectual Property Income (in Thousands)



ABOR Enterprise Plan	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Goal	4,533	3,690	4,607	5,506	6,647	8,193	9,700	11,422	13,544	16,164	19,389
Actual	4,003	3,764	5,288	4,645							
Difference	-530	74	681	-861							

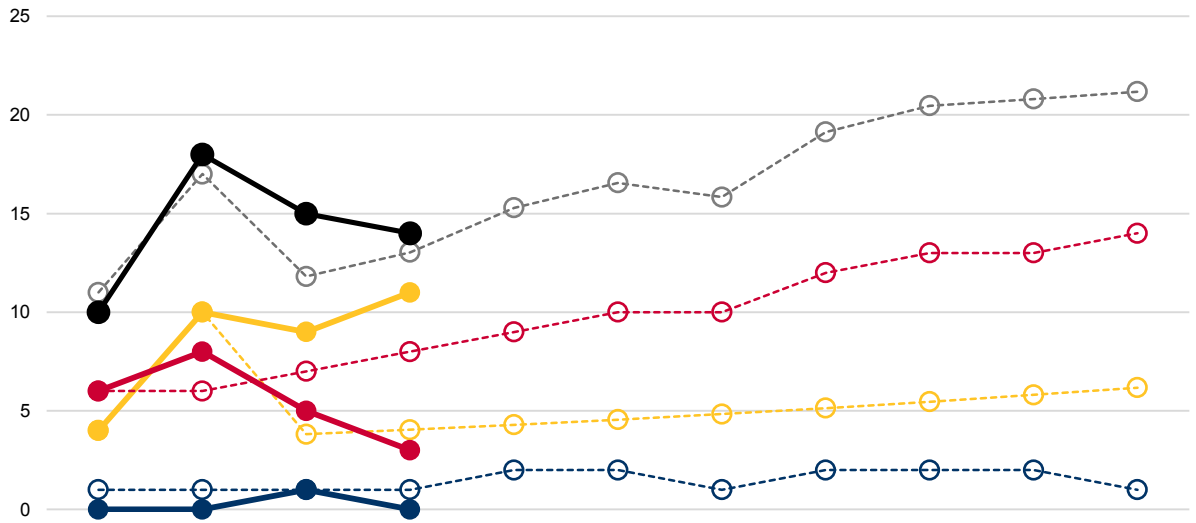
Arizona State University	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Goal	3,300	2,200	2,737	3,405	4,236	5,271	6,557	8,158	10,149	12,627	15,709
Actual	2,742	2,307	3,716	3,275							
Difference	-558	107	979	-130							

Northern Arizona University	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Goal	3	40	20	21	21	22	23	24	25	27	30
Actual	3	43	22	25							
Difference	0	3	2	4							

The University of Arizona	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Goal	1,230	1,450	1,850	2,080	2,390	2,900	3,120	3,240	3,370	3,510	3,650
Actual	1,258	1,414	1,550	1,345							
Difference	28	-36	-300	-735							

# Economic Development

## Startup Companies



ABOR Enterprise Plan	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Goal	11	17	12	13	15	17	16	19	20	21	21
Actual	10	18	15	14							
Difference	-1	1	3	1							

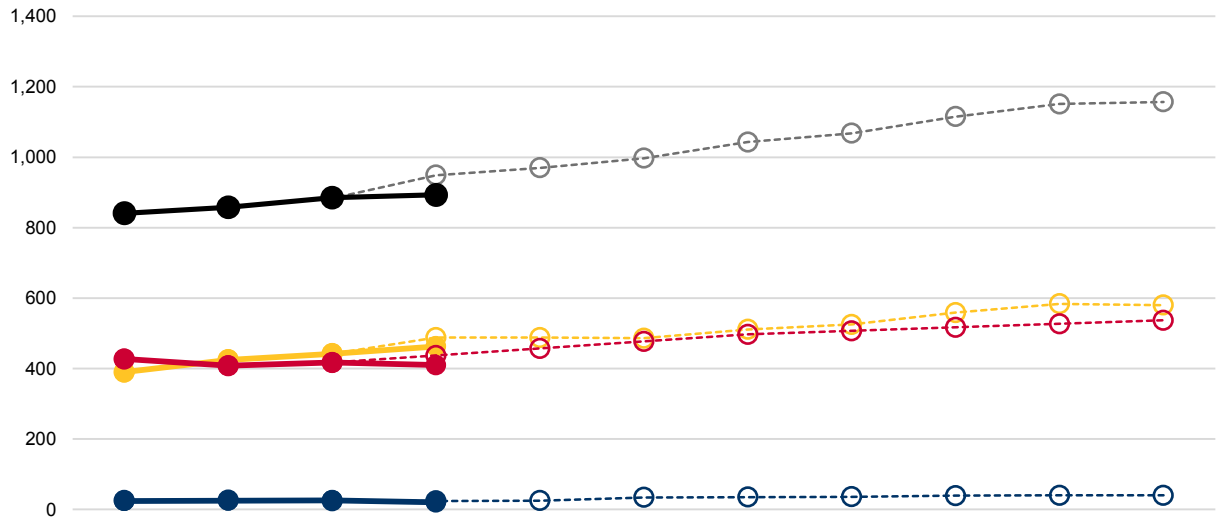
Arizona State University	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Goal	4	10	4	4	4	5	5	5	5	6	6
Actual	4	10	9	11							
Difference	0	0	5	7							

Northern Arizona University	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Goal	1	1	1	1	2	2	1	2	2	2	1
Actual	0	0	1	0							
Difference	-1	-1	0	-1							

The University of Arizona	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Goal	6	6	7	8	9	10	10	12	13	13	14
Actual	6	8	5	3							
Difference	0	2	-2	-5							

# Economic Development

## Ph.D. Degrees Conferred



ABOR Enterprise Plan	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Goal	842	859	883	949	970	997	1,043	1,068	1,115	1,151	1,157
Actual	841	858	885	893							
Difference	-1	-1	2	-56							

Arizona State University	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Goal	390	425	442	488	488	486	511	525	559	584	580
Actual	390	425	442	463							
Difference	0	0	0	-25							

Northern Arizona University	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Goal	25	26	24	24	25	34	35	36	39	40	40
Actual	24	25	26	20							
Difference	-1	-1	2	-4							

The University of Arizona	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Goal	427	408	417	437	457	477	497	507	517	527	537
Actual	427	408	417	410							
Difference	0	0	0	-27							

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**Annual Research Report - FY2013**

I am excited to present the fiscal year 2013 annual research update for Arizona State University (ASU). We have continued our trajectory of rapid research advancement, achieving more than \$400 million in research expenditures, and ASU is now ranked 15th in the country by the National Science Foundation for total research expenditures among institutions without a medical school. The rapid progress of our research enterprise continues to place us among the 10 fastest growing universities in the country with research expenditures over \$100 million.



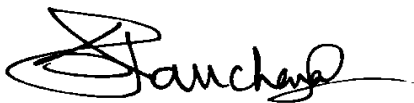
ASU takes a highly entrepreneurial approach to university research and is focused on solving society's biggest challenges. The power of ASU's innovation ecosystem is in our strategically constructed pipeline, in which use-inspired research based on fundamental discovery is guided to produce solutions that benefit society as well as create positive economic impact. We are also increasingly involved in partnerships with premier global partners and strategic projects. For example, funding by agencies such as the United States Agency for International Development represent new avenues to advance our research and innovation agenda.

Our faculty publish in prestigious journals and their work garners national and international attention. For example, research on protein structures at the Biodesign Institute has been profiled as a top 10 breakthrough of 2012 in the journal *Science*, and the technological innovations at our Flexible Electronics Display Center was recently included in CNN's Top Ten Ideas. The work of our faculty significantly impacts the marketplace, as illustrated by ASU's fourth-place ranking for number of patents issued in 2012 among universities without a medical school. Our innovation ecosystem is attracting high-tech companies to Arizona, such as the relocation of Zocdoc and development of a General Motors Innovation Center.

Our students graduate not only with a world-class education but also with a commitment to making a positive societal change. ASU students have earned a record number of prestigious Fulbright awards, placing us third in the nation for the number of Fulbright scholars produced. For the past three years, ASU students were among the top five finalists in the Entrepreneur Magazine "College Entrepreneur of the Year" competition.

The enclosed report details ASU's numerous achievements which is a testament to the high caliber of our faculty and students who are engaged in research and technology transfer activities.

Sincerely,

A handwritten signature in black ink, appearing to read "Sethuraman Panchanathan". The signature is stylized and fluid.

Sethuraman "Panch" Panchanathan  
Senior Vice President of Knowledge Enterprise Development

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**Enterprise Size**

# Enterprise Size

## Introduction

As the New American University, ASU has built its research enterprise on the principles of conducting transdisciplinary, use-inspired, and socially embedded research. ASU not only continues to be one of the fastest growing research enterprises among U.S. universities but also remains nimble and responsive to emerging research and economic development opportunities.

The research enterprise continues to make significant progress towards achieving \$700 million in research expenditures by 2020. As a result of our consistent achievement, ASU is ranked among the top U.S. universities for total research expenditures in the most recent National Science Foundation Higher Education Research and Development survey:

- 15th overall among institutions without a medical school
- 8th in social sciences
- 13th in humanities

Total research volume, proposal submissions, and extramural awards in FY13 further testify to our progress:

- \$405.2 million in total research expenditures representing 5% growth over FY12
- Proposal submissions worth \$1.25 billion
- Extramural funding awards of \$321.5 million

ASU's reputation as a world-class research institution enables the strategic recruitment of top quality students and faculty. In the past year, Dr. Douglas Granger was recruited from Johns Hopkins University School of Medicine to direct the new Institute for Interdisciplinary Salivary Bioscience Research. Over 85 research projects from fields as diverse as economics, psychology, social work, sports medicine, and neuroscience are being conducted at this institute.

Our highly qualified faculty, students, and researchers in new and core initiatives across the university fuel our ecosystem of innovation. In fiscal year 2014, we will continue to rapidly expand the research enterprise, generating economic and societal impact. We are launching new initiatives such as the Center for Molecular Design and Biomimicry at the Biodesign Institute, as well as the Planet Works initiative, anchored in the Global Institute of Sustainability, to diversify our research portfolio and also strengthen signature research programs.



## Enterprise Size

*Selected Accomplishments*

Dr. Kurt VanLehn, professor in the School of Computing, Informatics, and Decision Systems Engineering, secured **\$7.3 million** in funding from **the Bill and Melinda Gates Foundation** and the **Office of Naval Research** to develop new approaches for mathematics and science education.

Dr. Amy Landis has earned a **\$6.9 million grant from the Biomass Research and Development Initiative of the U.S. Department of Agriculture and the U.S. Department of Energy**. Dr. Landis is an associate professor in the School of Sustainable Engineering and the Built Environment and will advance her research on developing biomaterial that will produce a more environmentally and economically sustainable tire.

Funding from the **Department of Energy's Advanced Research Projects Agency-Energy (ARPA-E)** is highly competitive and selected projects must clearly demonstrate high economic impact. **ASU has secured more than \$12.5 million in ARPA-E funds to date**, including over \$600,000 in FY13 to advance development of technologies to capture carbon emissions from power plants.

**The National Institutes of Health have invested over \$48 million in ASU research** in the past fiscal year, including **\$22.2 million for research at the Biodesign Institute**. For example, we secured **\$3.3 million from the National Institute on Drug Abuse** to use DNA nanoscaffolds as a platform for developing a vaccine to reduce nicotine dependence.

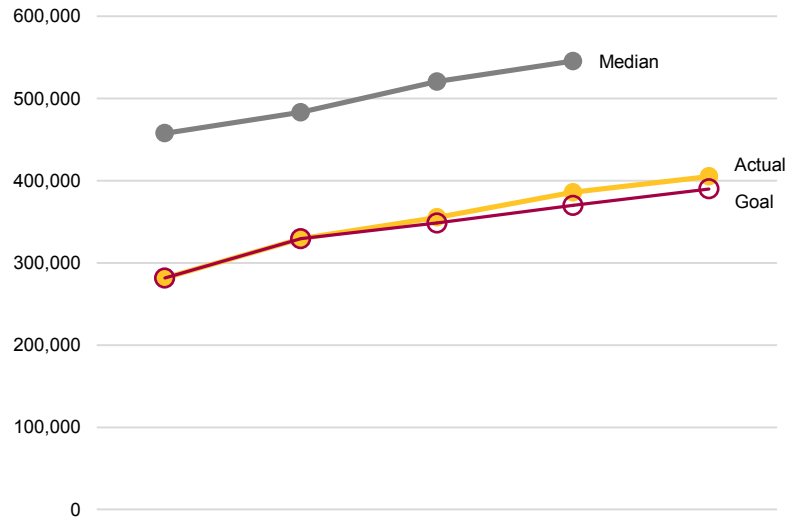
Our new approach to securing funding for global efforts is already realizing success. For example, through a highly competitive process, **our faculty secured \$3.3 million from the United States Agency for International Development** for the following:

- Dr. Victor Agadjanian, professor in the Sanford School of Social and Family Dynamics, is advancing the project, "Advancing Gender Equality and Women's Empowerment in Armenia," focusing on women's leadership in that country.
- The College of Technology and Innovation's ongoing global Vocational Training and Education for Clean Energy (VOCTEC) program will provide education for solar photovoltaic energy equipment and technology to up to 12 Pacific Island nations.
- A collaboration between the Department of English and the Center for the Study of Religion and Conflict will empower Pakistani women through an exchange program, workshops and discussions.



# Enterprise Size

Total Research Expenditures (in Thousands)

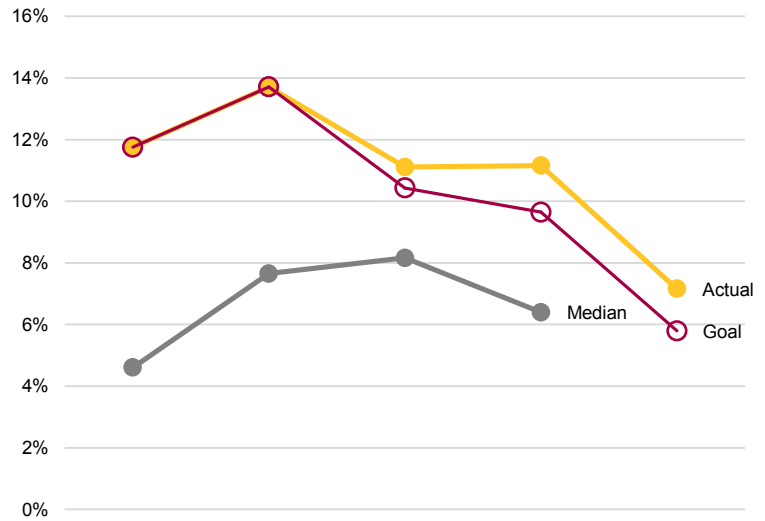


ABOR Enterprise Plan	2009	2010	2011	2012	2013
Actual	281,588	329,345	355,215	385,959	405,154
Goal	281,588	329,345	348,525	370,000	390,000
Difference	0	0	6,690	15,959	15,154

ABOR Peer Group	Med. Sch. NSF Adj.	2009	2010	2011	2012	2013	Rank
University of Wisconsin - Madison	X	952,119	1,029,295	1,111,642	1,169,779		1
University of Washington - Seattle	X	778,046	1,022,740	1,148,533	1,109,008		2
University of California - Los Angeles	X	889,995	936,995	982,357	1,003,375		3
University of Minnesota - Twin Cities	X	740,980	786,074	847,419	826,173		4
Ohio State University - Columbus	X	716,461	755,194	832,126	766,513		5
Pennsylvania State University - University Park	X	662,955	677,995	699,464	705,946		6
University of Texas - Austin		506,369	589,502	632,171	621,538		7
University of Illinois - Urbana-Champaign		563,710	515,133	545,669	583,754		8
Michigan State University	X	373,184	431,373	454,248	507,061		9
University of Maryland - College Park		409,190	451,415	495,382	502,406		10
University of Iowa	X	329,901	444,034	443,893	446,429		11
Rutgers the State University of NJ - New Brunswick	X	320,275	428,432	432,306	434,901		12
<b>Arizona State University</b>		<b>281,588</b>	<b>329,345</b>	<b>355,215</b>	<b>385,959</b>	<b>405,154</b>	<b>13</b>
Florida State University	X	195,244	227,329	230,411	225,378		14
Indiana University - Bloomington	X	156,930	177,520	184,096	184,486		15
University of Connecticut - Storrs	X	130,626	137,987	144,661	146,407		16
Median		457,780	483,274	520,526	545,408		

# Enterprise Size

Average Growth Rate in Total Research Expenditures Over 3 Years

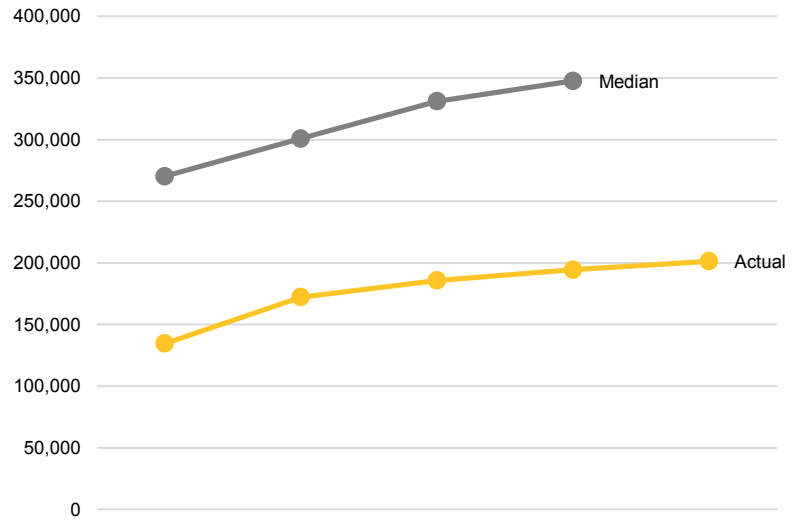


ABOR Enterprise Plan	2009	2010	2011	2012	2013
Actual	11.8%	13.7%	11.1%	11.2%	7.2%
Goal	11.8%	13.7%	10.4%	9.6%	5.8%
Difference	0	0	0.7%	1.5%	1.4%

ABOR Peer Group	Med. Sch. NSF Adj.	2009	2010	2011	2012	2013	Rank
University of Washington - Seattle	X	0.0%	11.4%	15.1%	13.4%		1
Rutgers the State University of NJ - New Brunswick	X	4.6%	15.7%	14.1%	11.8%		2
University of Iowa	X	-0.6%	9.3%	15.6%	11.7%		3
<b>Arizona State University</b>		<b>11.8%</b>	<b>13.7%</b>	<b>11.1%</b>	<b>11.2%</b>	<b>7.2%</b>	<b>4</b>
Michigan State University	X	1.4%	6.4%	8.5%	10.8%		5
University of Texas - Austin		5.5%	9.8%	8.8%	7.3%		6
University of Maryland - College Park		5.0%	7.9%	7.9%	7.2%		7
University of Wisconsin - Madison	X	4.6%	7.0%	8.0%	7.1%		8
Indiana University - Bloomington	X	3.4%	7.4%	7.0%	5.7%		9
Florida State University	X	1.8%	6.6%	8.3%	5.2%		10
University of California - Los Angeles	X	3.1%	4.4%	4.1%	4.1%		11
University of Connecticut - Storrs	X	7.7%	8.5%	9.7%	3.9%		12
University of Minnesota - Twin Cities	X	7.6%	8.0%	7.5%	3.8%		13
Ohio State University - Columbus	X	3.3%	1.6%	5.9%	2.6%		14
Pennsylvania State University - University Park	X	5.4%	5.2%	4.1%	2.1%		15
University of Illinois - Urbana-Champaign		5.9%	3.2%	3.3%	1.4%		16
<b>Median</b>		<b>4.6%</b>	<b>7.7%</b>	<b>8.2%</b>	<b>6.4%</b>		

# Enterprise Size

Federally Financed Research Expenditures (in Thousands)

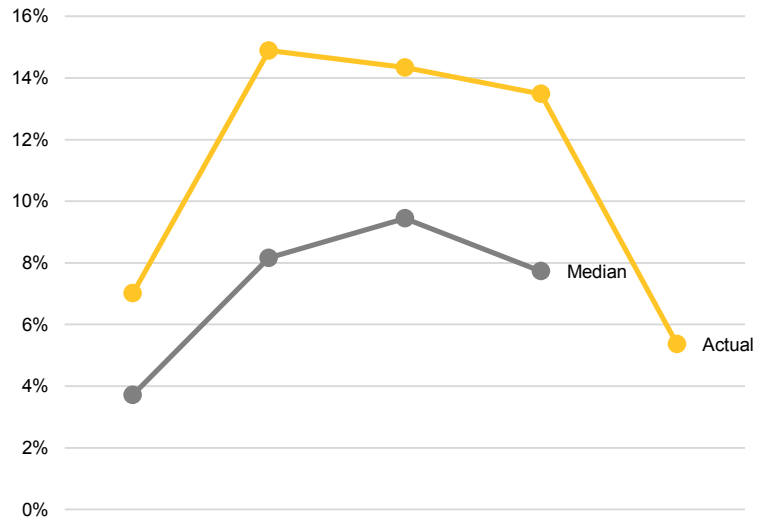


	2009	2010	2011	2012	2013
Actual	134,598	172,202	185,766	194,376	201,363

ABOR Peer Group	Med. Sch. NSF Adj.	2009	2010	2011	2012	2013	Rank
University of Washington - Seattle	X	619,353	829,885	948,976	909,652		1
University of Wisconsin - Madison	X	507,898	545,189	593,633	580,661		2
University of California - Los Angeles	X	467,505	538,521	563,560	539,054		3
University of Minnesota - Twin Cities	X	390,602	426,359	489,480	485,462		4
Pennsylvania State University - University Park	X	386,490	408,980	412,460	470,308		5
Ohio State University - Columbus	X	339,820	399,942	493,130	445,635		6
University of Illinois - Urbana-Champaign		288,013	303,852	323,454	359,989		7
University of Texas - Austin		309,125	350,308	355,437	354,873		8
University of Maryland - College Park		246,985	297,896	338,780	340,180		9
Rutgers the State University of NJ - New Brunswick	X	151,193	224,894	239,908	279,161		10
University of Iowa	X	252,336	282,465	283,627	269,734		11
Michigan State University	X	164,198	214,134	240,837	268,952		12
<b>Arizona State University</b>		<b>134,598</b>	<b>172,202</b>	<b>185,766</b>	<b>194,376</b>	<b>201,363</b>	<b>13</b>
Florida State University	X	117,294	134,794	140,850	140,419		14
University of Connecticut - Storrs	X	51,887	75,336	82,240	87,360		15
Indiana University - Bloomington	X	78,431	71,208	74,143	79,727		16
Median		270,175	300,874	331,117	347,527		

# Enterprise Size

Average Growth Rate in Federally Financed Research Expenditures Over 3 Years

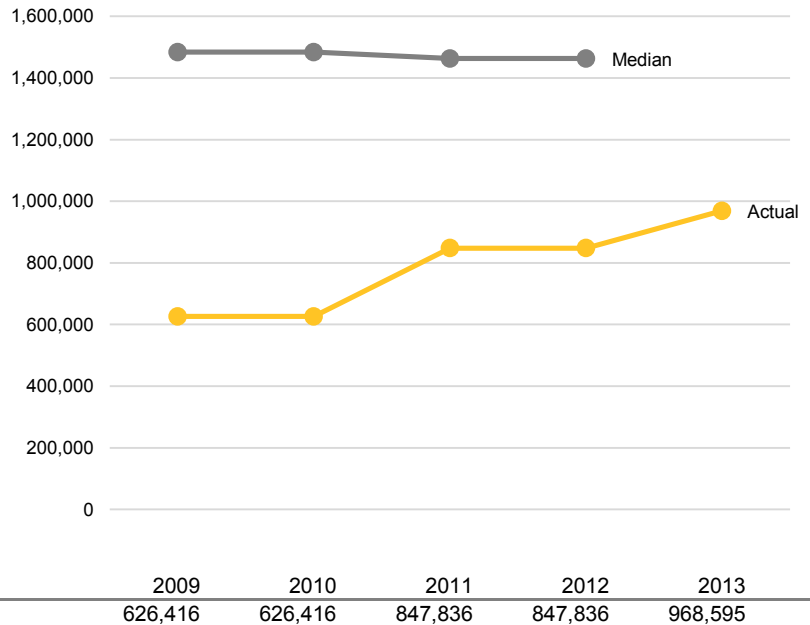


	2009	2010	2011	2012	2013
<b>Actual</b>	7.0%	14.9%	14.3%	13.5%	5.4%

ABOR Peer Group	Med. Sch. NSF Adj.	2009	2010	2011	2012	2013	Rank
Rutgers the State University of NJ - New Brunswick	X	8.4%	22.9%	23.6%	23.9%		1
University of Connecticut - Storrs	X	-8.2%	11.1%	14.4%	20.2%		2
Michigan State University	X	-0.7%	9.2%	16.8%	18.2%		3
University of Washington - Seattle	X	-1.6%	11.3%	16.4%	14.7%		4
<b>Arizona State University</b>		<b>7.0%</b>	<b>14.9%</b>	<b>14.3%</b>	<b>13.5%</b>	<b>5.4%</b>	<b>5</b>
University of Maryland - College Park		5.6%	11.0%	12.9%	11.6%		6
Ohio State University - Columbus	X	2.5%	8.7%	14.1%	10.5%		7
University of Illinois - Urbana-Champaign		3.0%	6.2%	6.6%	7.7%		8
University of Minnesota - Twin Cities	X	6.2%	8.1%	10.4%	7.7%		9
Pennsylvania State University - University Park	X	6.6%	7.3%	4.7%	6.9%		10
Florida State University	X	2.1%	6.1%	8.5%	6.4%		11
University of California - Los Angeles	X	-1.1%	3.6%	6.3%	5.2%		12
University of Texas - Austin		4.4%	6.9%	3.4%	4.9%		13
University of Wisconsin - Madison	X	1.2%	5.2%	7.8%	4.7%		14
University of Iowa	X	5.3%	8.3%	7.4%	2.5%		15
Indiana University - Bloomington	X	5.1%	3.8%	3.2%	0.8%		16
<b>Median</b>		<b>3.7%</b>	<b>8.2%</b>	<b>9.4%</b>	<b>7.7%</b>		

# Enterprise Size

Net Assignable Square Feet



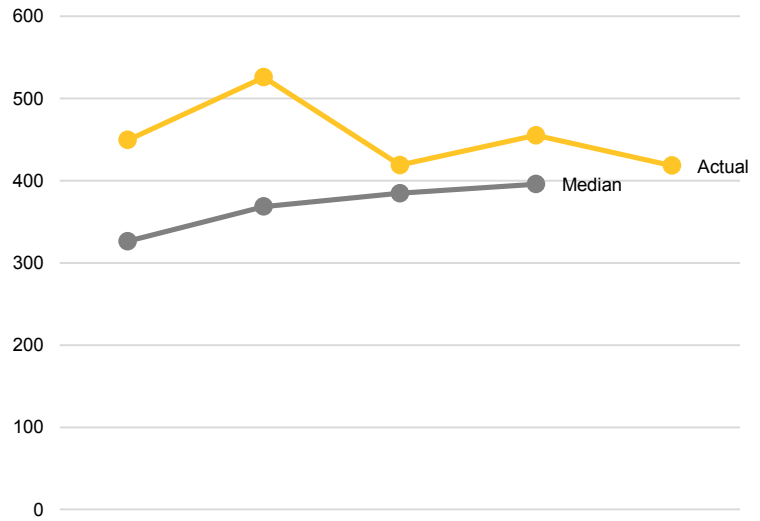
	2009	2010	2011	2012	2013
Actual	626,416	626,416	847,836	847,836	968,595

ABOR Peer Group	Med. Sch. NSF Adj.	2009	2010	2011	2012	2013	Rank
University of Illinois - Urbana-Champaign		4,561,500	4,561,500	4,631,400	4,631,400		1
University of Minnesota - Twin Cities	X	3,684,378	3,684,378	3,531,048	3,531,048		2
University of Wisconsin - Madison	X	2,844,272	2,844,272	2,935,571	2,935,571		3
University of California - Los Angeles	X	2,496,563	2,496,563	2,632,450	2,632,450		4
Pennsylvania State University - University Park	X	2,637,870	2,637,870	2,577,736	2,592,382		5
Michigan State University	X	2,324,423	2,324,423	2,274,375	2,274,375		6
University of Washington - Seattle	X	1,795,359	1,795,359	1,874,449	1,874,449		7
University of Texas - Austin		1,480,462	1,480,462	1,478,523	1,478,523		8
Ohio State University - Columbus	X	1,487,468	1,487,468	1,447,310	1,447,310		9
Rutgers the State University of NJ - New Brunswick	X	1,007,105	1,105,494	1,106,675	1,106,675		10
<b>Arizona State University</b>		<b>626,416</b>	<b>626,416</b>	<b>847,836</b>	<b>847,836</b>	<b>968,595</b>	<b>11</b>
University of Maryland - College Park		712,085	712,085	769,581	769,581		12
University of Iowa	X	616,700	616,700	659,913	659,913		13
Indiana University - Bloomington	X	493,885	1,387,317	591,765	591,765		14
University of Connecticut - Storrs	X	445,397	445,397	512,265	512,265		15
Florida State University	X	675,000	675,000	511,000	511,000		16
<b>Median</b>		<b>1,483,965</b>	<b>1,483,965</b>	<b>1,462,917</b>	<b>1,462,916.5</b>		



# Enterprise Size

Total Research Expenditures per Net Assignable Square Foot

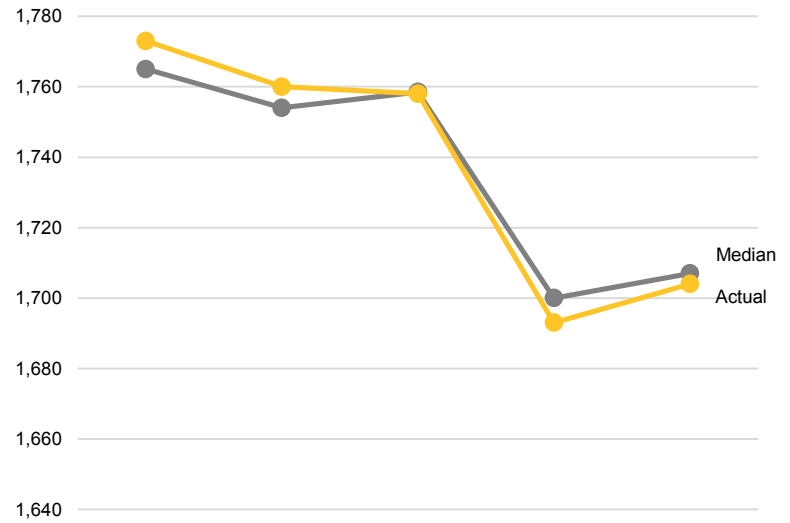


	2009	2010	2011	2012	2013
Actual	450	526	419	455	418

ABOR Peer Group	Med. Sch. NSF Adj.	2009	2010	2011	2012	2013	Rank
University of Iowa	X	535	720	673	676		1
University of Maryland - College Park		575	634	644	653		2
University of Washington - Seattle	X	433	570	613	592		3
Ohio State University - Columbus	X	482	508	575	530		4
<b>Arizona State University</b>		<b>450</b>	<b>526</b>	<b>419</b>	<b>455</b>	<b>418</b>	<b>5</b>
Florida State University	X	289	337	451	441		6
University of Texas - Austin		342	398	428	420		7
University of Wisconsin - Madison	X	335	362	379	398		8
Rutgers the State University of NJ - New Brunswick	X	318	388	391	393		9
University of California - Los Angeles	X	356	375	373	381		10
Indiana University - Bloomington	X	318	128	311	312		11
University of Connecticut - Storrs	X	293	310	282	286		12
Pennsylvania State University - University Park	X	251	257	271	272		13
University of Minnesota - Twin Cities	X	201	213	240	234		14
Michigan State University	X	161	186	200	223		15
University of Illinois - Urbana-Champaign		124	113	118	126		16
<b>Median</b>		<b>326</b>	<b>369</b>	<b>385</b>	<b>395.7</b>		

# Enterprise Size

Total Faculty Population

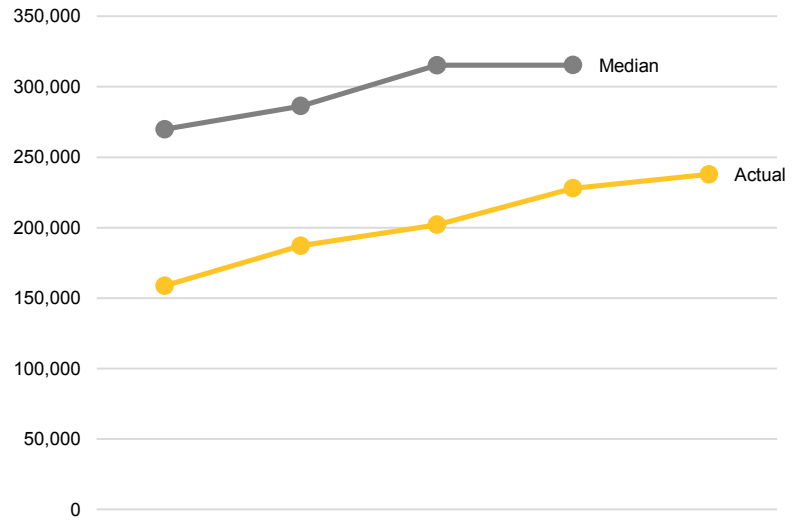


	2009	2010	2011	2012	2013
Actual	1,773	1,760	1,758	1,693	1,704

ABOR Peer Group	Med. Sch. NSF Adj.	2009	2010	2011	2012	2013	Rank
Ohio State University - Columbus	X	2,605	2,602	2,560	2,511	2,489	1
University of Minnesota - Twin Cities	X	2,377	2,319	2,277	2,251	2,412	2
University of Wisconsin - Madison	X	2,053	2,047	2,057	2,014	2,067	3
University of Texas - Austin		1,913	1,981	1,954	1,910	1,910	4
University of California - Los Angeles	X	1,829	1,840	1,822	1,776	1,747	5
Michigan State University	X	1,921	1,948	1,906	1,883	1,732	6
Pennsylvania State University - University Park	X	1,757	1,748	1,759	1,763	1,731	7
University of Illinois - Urbana-Champaign		1,883	1,856	1,778	1,707	1,710	8
<b>Arizona State University</b>		<b>1,773</b>	<b>1,760</b>	<b>1,758</b>	<b>1,693</b>	<b>1,704</b>	<b>9</b>
University of Iowa	X	1,599	1,572	1,527	1,538	1,576	10
Rutgers the State University of NJ - New Brunswick	X	1,489	1,519	1,518	1,546	1,514	11
University of Washington - Seattle	X	1,568	1,548	1,536	1,525	1,487	12
University of Maryland - College Park		1,485	1,472	1,463	1,501	1,483	13
Indiana University - Bloomington	X	1,334	1,368	1,351	1,356	1,344	14
University of Connecticut - Storrs	X	1,049	1,186	1,200	1,235	1,264	15
Florida State University	X	1,076	1,079	1,040	989	1,027	16
<b>Median</b>		<b>1,765</b>	<b>1,754</b>	<b>1,759</b>	<b>1,700</b>	<b>1,707</b>	

# Enterprise Size

Total Research Expenditures per Faculty

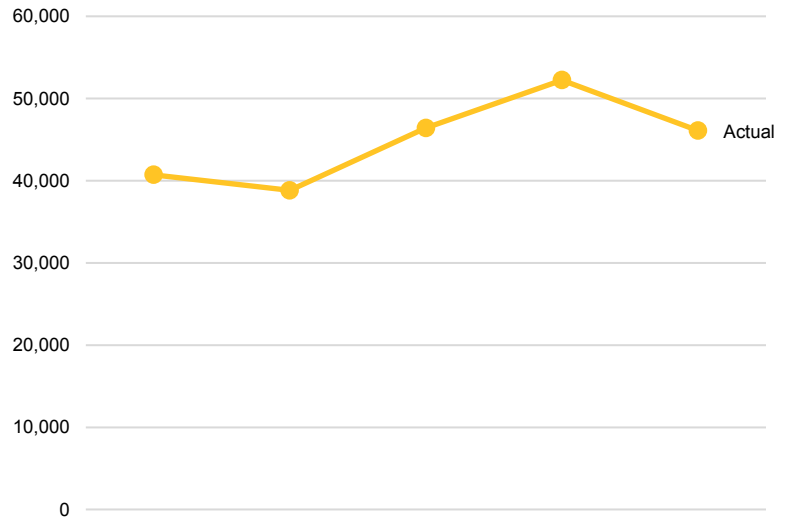


	2009	2010	2011	2012	2013
<b>Actual</b>	158,820	187,128	202,056	227,973	237,766

ABOR Peer Group	Med. Sch. NSF Adj.	2009	2010	2011	2012	2013	Rank
University of Washington - Seattle	X	496,203	660,685	747,743	727,218		1
University of Wisconsin - Madison	X	463,770	502,831	540,419	580,824		2
University of California - Los Angeles	X	486,602	509,236	539,164	564,963		3
Pennsylvania State University - University Park	X	377,322	387,869	397,649	400,423		4
University of Minnesota - Twin Cities	X	311,729	338,971	372,165	367,025		5
University of Illinois - Urbana-Champaign		299,368	277,550	306,900	341,977		6
University of Maryland - College Park		275,549	306,668	338,607	334,714		7
University of Texas - Austin		264,699	297,578	323,527	325,413		8
Ohio State University - Columbus	X	275,033	290,236	325,049	305,262		9
University of Iowa	X	206,317	282,464	290,696	290,266		10
Rutgers the State University of NJ - New Brunswick	X	215,094	282,049	284,787	281,307		11
Michigan State University	X	194,265	221,444	238,325	269,284		12
<b>Arizona State University</b>		<b>158,820</b>	<b>187,128</b>	<b>202,056</b>	<b>227,973</b>	<b>237,766</b>	<b>13</b>
Florida State University	X	181,454	210,685	221,549	227,885		14
Indiana University - Bloomington	X	117,639	129,766	136,266	136,052		15
University of Connecticut - Storrs	X	124,524	116,346	120,551	118,548		16
<b>Median</b>		<b>269,866</b>	<b>286,350</b>	<b>315,214</b>	<b>315,337</b>		

# Enterprise Size

Other Sponsored Project Expenditures (in Thousands)

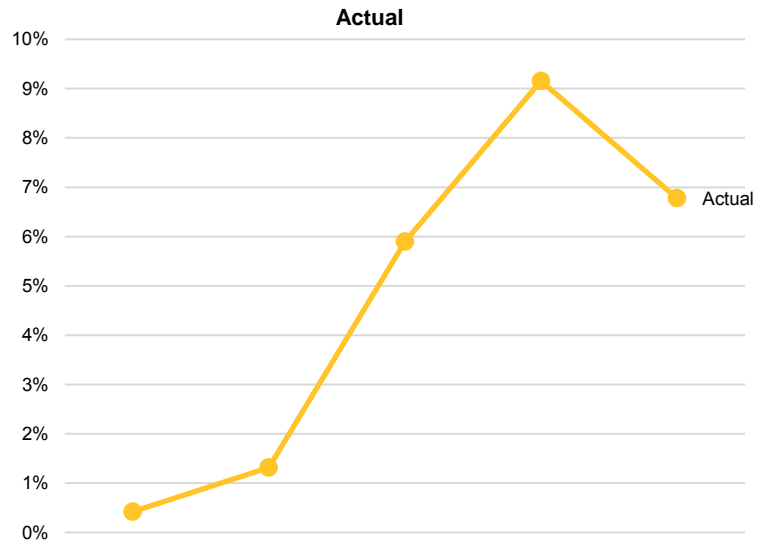


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	2009	2010	2011	2012	2013
Actual	40,705	38,827	46,422	52,235	46,097

# Enterprise Size

Average Growth Rate in Other Sponsored Project Expenditures Over 3 Years



ABOR Enterprise Plan	2009	2010	2011	2012	2013
Actual	0.4%	1.3%	5.9%	9.2%	6.8%

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**Discovery and Scholarly Impact**

# Discovery and Scholarly Impact

## Introduction

At ASU, we embrace our role as a leader of discovery and scholarship as well as a steward in our local community. From designing equipment that explores Mars to developing science curriculum for local students and teachers, ASU research generates real and tangible impact.

Numerous and high impact publications of our faculty members in premier, peer-reviewed journals are a testament to our world-class faculty and students. The citation indices of our faculty members further illustrate the impact they are having on their respective fields. For example, the work of Drs. Sudhir Kumar and Huan Liu have received over 69,000 and 18,000 citations, respectively, as reported by Google Scholar.

Within our local community, ASU is a beacon of knowledge to students and non-students alike, and our presence impacts the quality of life in the Phoenix metro area. We invite the community to engage in discovery and dialogue at public events such as Night of the Open Door, which was attended by over 10,000 people, and events through the Project Humanities initiative, which attracted over 16,000 people. In order to make research more accessible to the general public, ASU partnered with UA and NAU as well as the Arizona Commerce Authority to launch the SciVal Experts tool. The searchable database enables access to a directory of faculty research expertise at Arizona universities.

In the national arena, ASU hosted two events at the National Press Club in Washington, D.C.: “Are We Losing Our Humanity?” hosted by Project Humanities, and “Will U.S. Colleges and Universities Lead or Lag in Education Innovation?” These panels brought together thought leaders including the deputy director of the National Science Foundation and the president of the American Council on Education. Among our students, Davier Rodriguez won the Clinton Global Initiative University Sweet 16 Commitments Challenge for DREAMzone. ASU has also been chosen to host the March 2014 Clinton Global Initiative University.

ASU is increasingly part of the solution to the growing need for STEM-trained professionals in the US. In a new partnership with the Arizona Science Center, we are designing comprehensive outreach activities to attract K-12 students to engage in the STEM fields. We also offer training and education programs in science, technology, engineering, and math for our undergraduate and graduate students at each campus.





## Discovery and Scholarly Impact

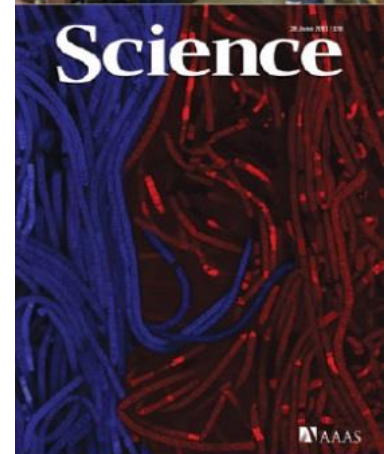
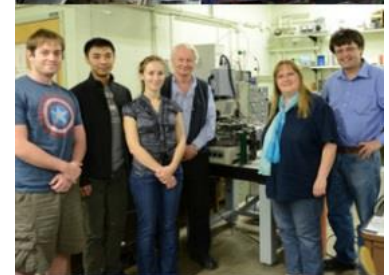
### Selected Accomplishments

**The first nanolaser device that can operate at room temperatures was developed** by a team of researchers led by Dr. Cun-Zheng Ning, a professor in the School of Electrical, Computer and Energy Engineering. This novel creation paves the way for new applications of nanolaser technology, which represents a significant breakthrough in the field.

**The world's largest flexible X-ray detector prototype was successfully manufactured** at the Flexible Electronics and Display Center (FEDC). The device measures 7.9 diagonal inches and was developed in partnership with PARC, a Xerox company.

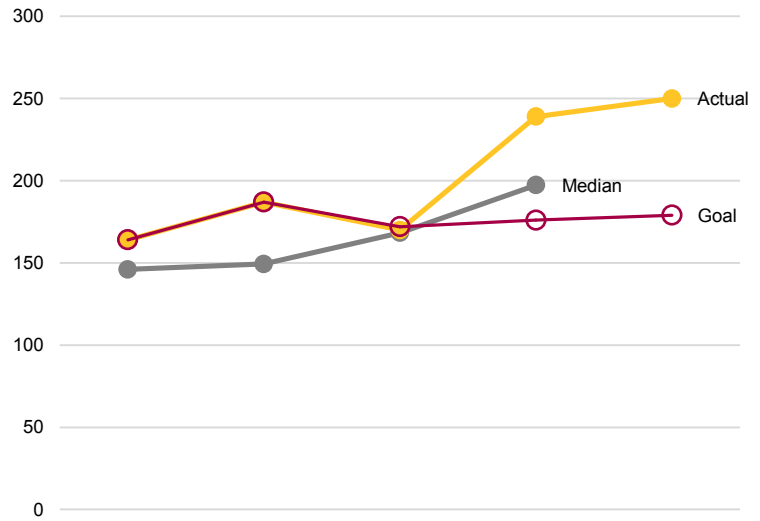
Each year, ASU faculty members publish their scholarly work in top quality venues. Examples include:

- The journal **Science** profiled the use of x-rays to produce a three-dimensional protein structure as **one of the top ten breakthroughs of 2012**. This research is the work of Drs. John Spence, Bruce Doak, Uwe Weierstall, and Petra Fromme, all professors in the College of Liberal Arts and Sciences.
- Research shedding new light on the effects of global warming and the consequences to soil fertility and erosion was **featured as the June 2013 cover story in the journal Science**. The work was led by Dr. Ferran Garcia-Pichel, professor in the School of Life Sciences.
- Dr. Paul Davies, Regents' Professor and director of the Beyond Center, co-authored an article for a special edition of **Physics World** on a radical new way to look at cancer – by tracing its evolutionary roots.
- From the Jaws of Victory: The Triumph and Tragedy of Cesar Chavez and the Farm Worker Movement by Matthew Garcia, professor and director in the School of Historical, Philosophical, and Religious Studies, was **recognized as the Best Book in Labor History with the Philip Taft Book Prize**.
- Several faculty members publish their work in premier journals such as **Nature, Nature Methods, Nature Genetics, and Nature Chemistry** as well as **Science**. For example, Dr. Julie Mustard's work, published in Science, provides evidence that naturally occurring caffeine in plants can affect the learning and memory of honeybees.



# Discovery and Scholarly Impact

Invention Disclosures Transacted

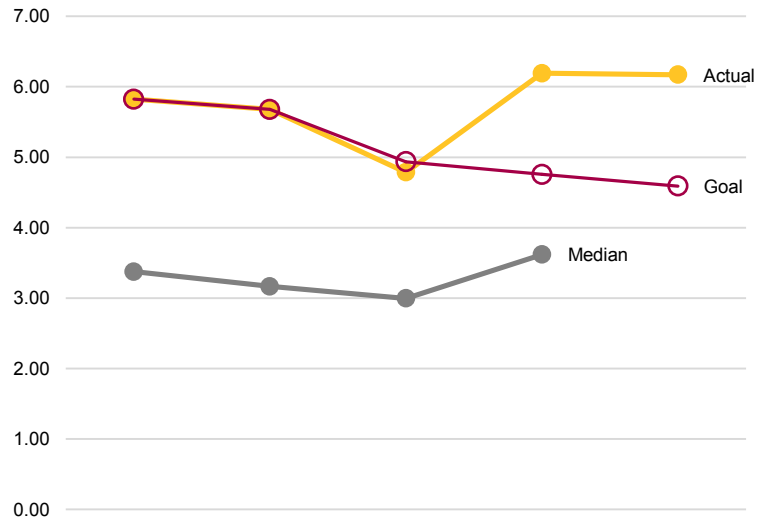


ABOR Enterprise Plan	2009	2010	2011	2012	2013
Actual	164	187	170	239	250
Goal	164	187	172	176	179
Difference	0	0	-2	63	71

ABOR Peer Group	Med. Sch. AUTM Adj.	2009	2010	2011	2012	2013	Rank
University of Washington - Seattle	X	349	354	356	462		1
University of Wisconsin - Madison	X	333	356	357	373		2
University of California - Los Angeles	X	333	379	299	343		3
University of Minnesota - Twin Cities	X	244	255	250	321		4
Ohio State University - Columbus	X	163	173	216	319		5
<b>Arizona State University</b>		<b>164</b>	<b>187</b>	<b>170</b>	<b>239</b>	<b>250</b>	<b>6</b>
University of Illinois - Urbana-Champaign		203	180	182	223		7
Rutgers the State University of NJ - New Brunswick	X	70	126	167	172		8
Michigan State University	X	129	116	110	127		9
Pennsylvania State University - University Park	X	105	117	127	117		10
University of Iowa	X	70	70	68	102		11
Indiana University - Bloomington	X	47	55	62	74		12
Florida State University	X	45	45	64	74		13
University of Connecticut - Storrs	X	50	53	39	46		14
University of Maryland - College Park							
University of Texas - Austin							
<b>Median</b>		<b>146</b>	<b>149</b>	<b>168</b>	<b>197</b>		

# Discovery and Scholarly Impact

Invention Disclosures Transacted per \$10 Million in Total Research Expenditures

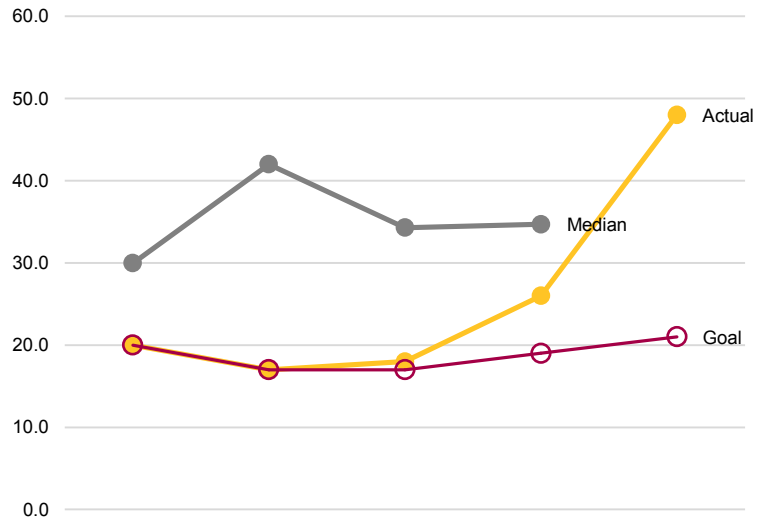


ABOR Enterprise Plan	2009	2010	2011	2012	2013
Actual	5.8	5.7	4.8	6.2	6.2
Goal	5.8	5.7	4.9	4.8	4.6
Difference	0.0	0.0	-0.1	1.4	1.6

ABOR Peer Group	Med. Sch.	NSF Adj.	AUTM Adj.	2009	2010	2011	2012	2013	Rank
Arizona State University				5.8	5.7	4.8	6.2	6.2	1
University of Washington - Seattle	X			4.5	3.5	3.1	4.2		2
Ohio State University - Columbus	X			2.3	2.3	2.6	4.2		3
Indiana University - Bloomington		X	X	3.0	3.1	3.4	4.0		4
Rutgers the State University of NJ - New Brunswick		X	X	2.2	2.9	3.9	3.9		5
University of Minnesota - Twin Cities	X			3.3	3.2	3.0	3.9		6
University of Illinois - Urbana-Champaign				3.6	3.5	3.3	3.8		7
University of California - Los Angeles	X			3.7	4.0	3.0	3.4		8
Florida State University	X			2.3	2.0	2.8	3.3		9
University of Wisconsin - Madison	X			3.5	3.5	3.2	3.2		10
University of Connecticut - Storrs		X	X	3.8	3.8	2.7	3.2		11
Michigan State University	X			3.5	2.7	2.4	2.5		12
University of Iowa	X			2.1	1.6	1.5	2.3		13
Pennsylvania State University - University Park		X	X	1.6	1.7	1.8	1.7		14
University of Maryland - College Park									
University of Texas - Austin									
<b>Median</b>				<b>3.4</b>	<b>3.2</b>	<b>3.0</b>	<b>3.6</b>		

# Discovery and Scholarly Impact

U.S. Patents Issued

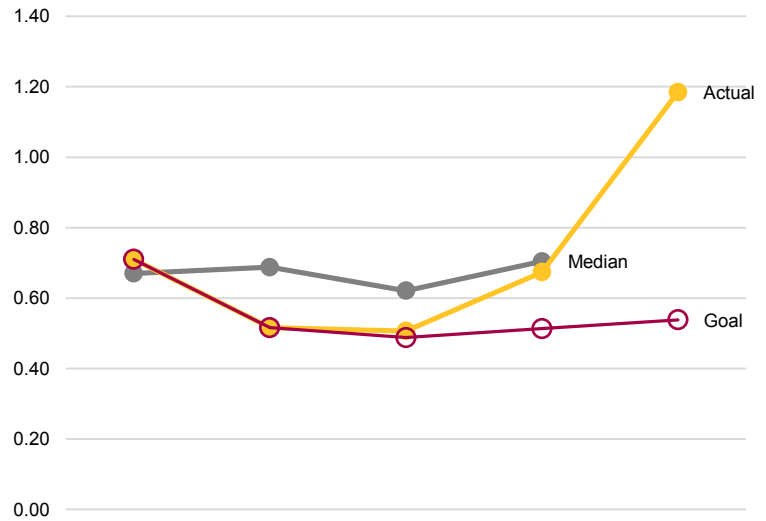


ABOR Enterprise Plan	2009	2010	2011	2012	2013
Actual	20	17	18	26	48
Goal	20	17	17	19	21
Difference	0	0	1	7	27

ABOR Peer Group	Med. Sch. AUTM Adj.	2009	2010	2011	2012	2013	Rank
University of Wisconsin - Madison	X	119	133	156	153		1
University of Illinois - Urbana-Champaign		42	69	68	76		2
University of California - Los Angeles	X	60	47	56	74		3
University of Washington - Seattle	X	40	69	70	61		4
University of Minnesota - Twin Cities	X	37	46	41	59		5
Ohio State University - Columbus	X	20	38	30	41		6
Rutgers the State University of NJ - New Brunswick	X	26	28	27	35		7
Pennsylvania State University - University Park	X	30	48	33	35		8
Michigan State University	X	41	52	38	31		9
University of Iowa	X	30	32	31	31		9
Florida State University	X	10	21	36	27		11
<b>Arizona State University</b>		<b>20</b>	<b>17</b>	<b>18</b>	<b>26</b>	<b>48</b>	<b>12</b>
University of Connecticut - Storrs	X	9	19	10	21		13
Indiana University - Bloomington	X	1	3	6	4		14
University of Maryland - College Park							
University of Texas - Austin							
<b>Median</b>		<b>30</b>	<b>42</b>	<b>34</b>	<b>35</b>		

# Discovery and Scholarly Impact

U.S. Patents Issued per \$10 Million in Total Research Expenditures



ABOR Enterprise Plan	2009	2010	2011	2012	2013
Actual	0.7	0.5	0.5	0.7	1.2
Goal	0.7	0.5	0.5	0.5	0.5
Difference	0.0	0.0	0.0	0.2	0.6

ABOR Peer Group	Med. Sch.	NSF Adj.	AUTM Adj.	2009	2010	2011	2012	2013	Rank
University of Connecticut - Storrs		X	X	0.7	1.3	0.7	1.4		1
University of Wisconsin - Madison	X			1.2	1.3	1.4	1.3		2
University of Illinois - Urbana-Champaign				0.7	1.3	1.2	1.3		3
Florida State University	X			0.5	0.9	1.6	1.2		4
Rutgers the State University of NJ - New Brunswick		X	X	0.8	0.7	0.6	0.8		5
University of California - Los Angeles	X			0.7	0.5	0.6	0.7		6
University of Minnesota - Twin Cities	X			0.5	0.6	0.5	0.7		7
University of Iowa	X			0.9	0.7	0.7	0.7		8
<b>Arizona State University</b>				<b>0.7</b>	<b>0.5</b>	<b>0.5</b>	<b>0.7</b>	<b>1.2</b>	<b>9</b>
Michigan State University	X			1.1	1.2	0.8	0.6		10
University of Washington - Seattle	X			0.5	0.7	0.6	0.6		11
Ohio State University - Columbus	X			0.3	0.5	0.4	0.5		12
Pennsylvania State University - University Park		X	X	0.5	0.7	0.5	0.5		13
Indiana University - Bloomington		X	X	0.0	0.2	0.3	0.2		14
University of Maryland - College Park									
University of Texas - Austin									
<b>Median</b>				<b>0.7</b>	<b>0.7</b>	<b>0.6</b>	<b>0.7</b>		

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**Economic Development**

# Economic Development

## Introduction

Research and innovation at ASU also drive the development of new, game-changing ideas and technologies. Our approach is multi-faceted and includes: cross-disciplinary collaborations within the university, partnerships with corporate sponsors and local economic development organizations such as Arizona Commerce Authority and Greater Phoenix Economic Council, industry consortia such as those hosted by the Flexible Electronics and Display Center as well as novel entrepreneurial programs. Knowledge incubated and created at ASU flows out from the university generating real, positive impact on people's lives and on our local and national economies.

SkySong anchors multiple entrepreneurship and startup programs, but the spirit of innovation thrives on all of our campuses. Our entrepreneurship programs are also focused on the community. New initiatives include (1) the Alexandria Network, which provides workspace and resources in partnership with the Arizona public library system; (2) the Furnace Accelerator program for budding companies, which supported ten tech companies in its first cohort; and (3) mentorship and infrastructure for startup companies as part of the Rapid Startup School program. Our students are uniquely prepared to succeed in today's changing economy, and companies actively position themselves to be a part of our ecosystem of innovation as well as to recruit ASU graduates. Examples include:

- SkySong is home to more than 70 affiliated companies, which have **generated more than 800 new jobs** and **\$460 million in economic impact** for the greater Phoenix area, with a projection of **more than \$9 billion in total economic output** for the Valley over the next 30 years.
- ASU discoveries have led to the **formation of 67 startup companies**. Examples include Fluidic energy, Health *Tell* and Heliae, which collectively employ 215 people in Arizona and more than 370 people worldwide and **attracted more than \$56 million in venture financing investment in 2013**. Companies that license ASU discoveries have raised nearly \$400 million in total venture funding since 2003.
- **ASU has been instrumental in attracting new companies and facilities**, including a new General Motors Innovation Center with over **1,000 jobs**, Zocdoc relocation that will create **600 jobs**, and Stealth Software, which will **hire 200 employees** for its new U.S. headquarters in metro Phoenix.
- **A major expansion of GoDaddy Global Technology Center** at ASU's Research Park. The planned facility will provide 150,000 square feet of creative new space for 1,300 employees including engineers and developers.





## Economic Development

*Selected Accomplishments*

Researchers at the Biodesign Institute announced a **partnership with Life Technologies Corporation** to develop a medical device to rapidly assess an individual's exposure to radiation in the event of a nuclear incident. This is a **continuation of a \$35 million project funded by the Biomedical Advanced Research and Development Authority (BARDA)** within the Office of the Assistant Secretary for Preparedness and Response, U.S. Department of Health and Human Services.

**Development and deployment of the world's first high-cycle life metal air battery** by Fluidic, an ASU spinout company.

**Launch of the company Breezing** based on the revolutionary new metabolism tracker. The device is based on ASU technology and was **launched in to the marketplace using the innovative new crowd funding mechanism.**

As a result of its partnership with ASU, Intel Corporation received the **U.S. Secretary of State's 2012 Award for Corporate Excellence** for the Higher Engineering Education Alliance Program (HEEAP). The program aims to modernize Vietnamese public higher education in engineering. **National Instruments** has also joined the partnership and **will invest \$7 million in education efforts.** HEEAP has enabled more than 150 faculty members at Vietnamese engineering schools to be trained in new instructional methods, both at ASU in in Vietnam.

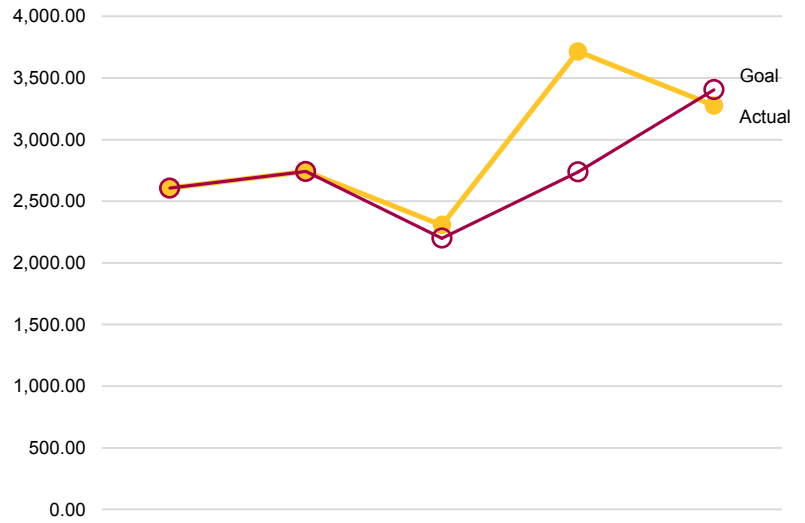
We hosted the **Arizona Solar Summit III: Game Changers** in October. The Summit focused on game changing efforts to move our state toward global solar leadership. Valley excursion tours exhibited pioneering projects and solar sites throughout the Valley. Distinguished Summit speakers included Commissioner of the Arizona State Land Department, Director of the State of Arizona Governor's Office of Energy Policy, and several Valley Mayors including Phoenix Mayor Greg Stanton.

ASU partnered with Global Silicon Valley to present the **2013 Education Innovation Summit** in April. The summit brought together industry leaders, entrepreneurs, investors, educators, activists and others who are passionate about education and advancing the knowledge economy. **Over 160 companies presented** at the Summit and **163 investors were in attendance.** Among the 1,351 participants, **30 foundations, 62 global higher education institutions, and 22 different countries were represented.**



# Economic Development

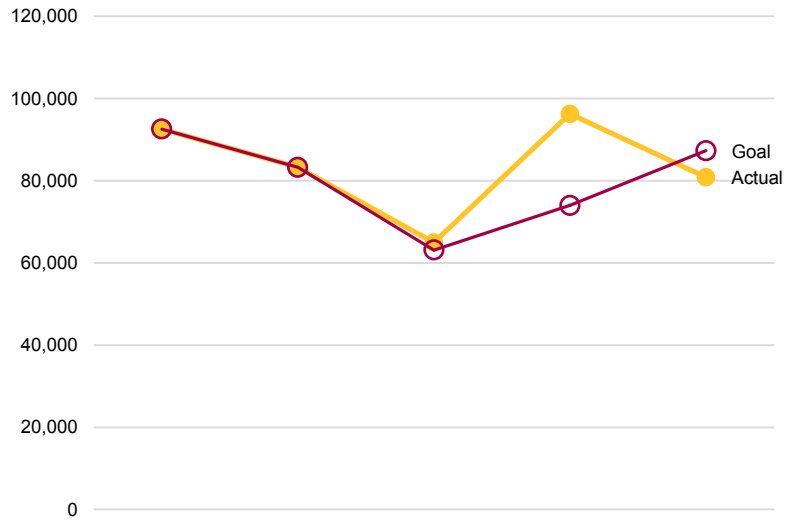
Intellectual Property Income (in Thousands)



ABOR Enterprise Plan	2009	2010	2011	2012	2013
Actual	2,606	2,742	2,307	3,715	3,275
Goal	2,606	2,742	2,200	2,737	3,405
Difference	0	0	107	978	-130

# Economic Development

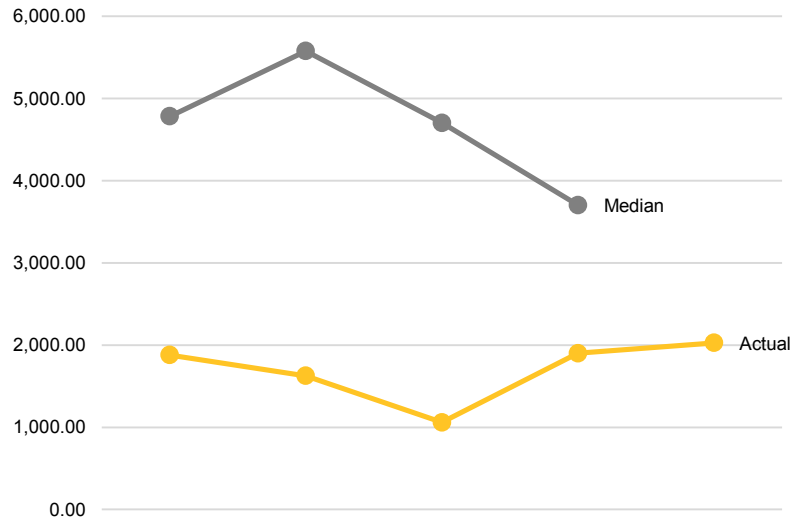
Intellectual Property Income per \$10 Million in Total Research Expenditures



ABOR Enterprise Plan	2009	2010	2011	2012	2013
Actual	92,550	83,252	64,946	96,251	80,840
Goal	92,550	83,252	63,123	73,973	87,308
Difference	0.0	0.0	1,823.3	22,278	-6,467

# Economic Development

Licenses and Options Income (in Thousands)

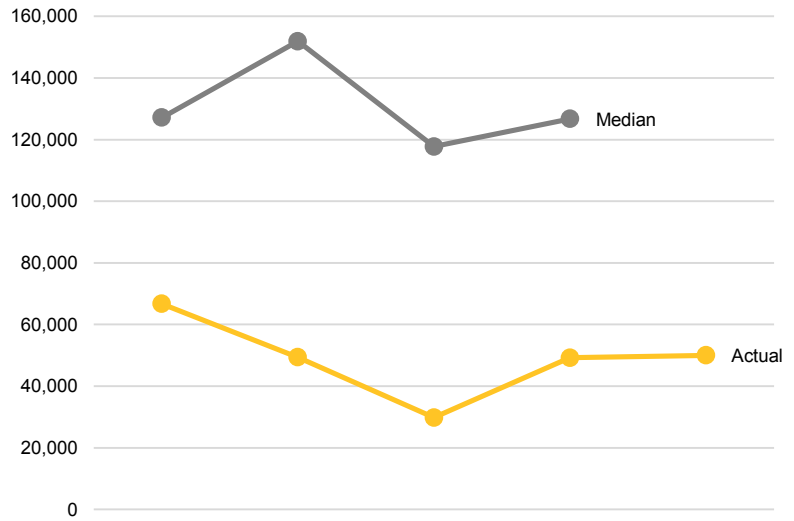


	2009	2010	2011	2012	2013
Actual	1,879	1,626	1,059	1,900	2,027

ABOR Peer Group	Med. Sch. AUTM Adj.	2009	2010	2011	2012	2013	Rank
University of Washington - Seattle	X	87,340	69,032	67,362	76,956		1
University of Minnesota - Twin Cities	X	95,169	83,906	10,079	45,652		2
University of Wisconsin - Madison	X	56,714	54,300	57,730	41,100		3
University of California - Los Angeles	X	22,557	27,485	16,153	17,833		4
University of Iowa	X	42,922	26,991	6,285	7,234		5
Rutgers the State University of NJ - New Brunswick	X	7,405	7,923	5,447	5,512		6
Michigan State University	X	4,449	4,017	3,616	3,704		7
Pennsylvania State University - University Park	X	1,080	1,998	2,594	2,739		8
Indiana University - Bloomington	X	2,119	5,029	3,961	2,607		9
Ohio State University - Columbus	X	1,712	1,907	1,420	2,170		10
<b>Arizona State University</b>		<b>1,879</b>	<b>1,626</b>	<b>1,059</b>	<b>1,900</b>	<b>2,027</b>	<b>11</b>
Florida State University	X	1,192	1,315	1,468	1,133		12
University of Connecticut - Storrs	X	435	521	439	550		13
University of Illinois - Urbana-Champaign		5,116	6,126	6,363			
University of Maryland - College Park							
University of Texas - Austin							
<b>Median</b>		<b>4,783</b>	<b>5,578</b>	<b>4,704</b>	<b>3,704</b>		

# Economic Development

Licenses and Options Income per \$10 Million in Total Research Expenditures

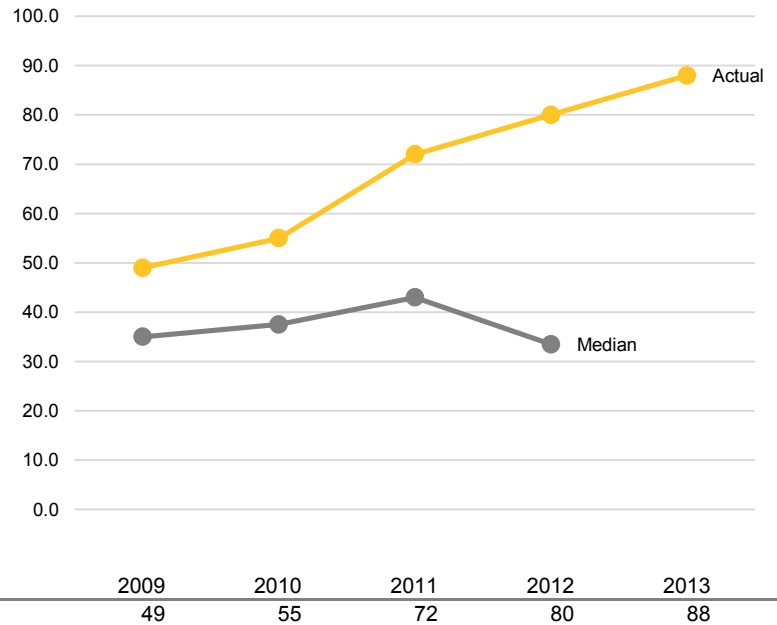


	2009	2010	2011	2012	2013
Actual	66,720	49,362	29,823	49,237	50,023

ABOR Peer Group	Med. Sch. AUTM Adj.	2009	2010	2011	2012	2013	Rank
University of Washington - Seattle	X	1,122,555	674,973	586,506	693,916		1
University of Minnesota - Twin Cities	X	1,284,360	1,067,402	118,932	552,566		2
University of Wisconsin - Madison	X	595,661	527,546	519,322	351,348		3
University of California - Los Angeles	X	253,451	293,331	164,431	177,730		4
University of Iowa	X	1,301,059	607,862	141,587	162,043		5
Indiana University - Bloomington	X	135,034	283,303	215,144	141,288		6
Rutgers the State University of NJ - New Brunswick	X	231,213	184,930	125,989	126,740		7
Michigan State University	X	119,229	93,115	79,596	73,041		8
Florida State University	X	61,075	57,842	63,711	50,274		9
<b>Arizona State University</b>		<b>66,720</b>	<b>49,362</b>	<b>29,823</b>	<b>49,237</b>	<b>50,023</b>	<b>10</b>
Pennsylvania State University - University Park	X	16,289	29,476	37,080	38,800		11
University of Connecticut - Storrs	X	33,273	37,752	30,365	37,580		12
Ohio State University - Columbus	X	23,891	25,252	17,065	28,304		13
University of Illinois - Urbana-Champaign		90,756	118,925	116,601			
University of Maryland - College Park							
University of Texas - Austin							
<b>Median</b>		<b>127,132</b>	<b>151,928</b>	<b>117,766</b>	<b>126,740</b>		

# Economic Development

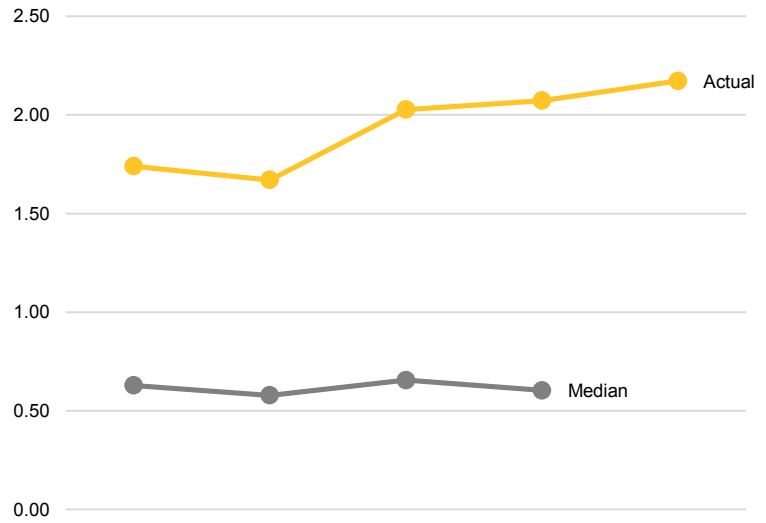
Licenses and Options Executed



		2009	2010	2011	2012	2013	
<b>Actual</b>		49	55	72	80	88	
<b>ABOR Peer Group</b>	<b>Med. Sch. AUTM Adj.</b>	<b>2009</b>	<b>2010</b>	<b>2011</b>	<b>2012</b>	<b>2013</b>	<b>Rank</b>
University of Washington - Seattle	X	231	196	194	209		1
<b>Arizona State University</b>		<b>49</b>	<b>55</b>	<b>72</b>	<b>80</b>	<b>88</b>	<b>2</b>
University of Minnesota - Twin Cities	X	53	73	113	75		3
University of Wisconsin - Madison	X	57	62	62	60		4
Rutgers the State University of NJ - New Brunswick	X	79	73	68	58		5
University of Illinois - Urbana-Champaign		33	40	55	46		6
University of California - Los Angeles	X	37	52	46	34		7
Ohio State University - Columbus	X	27	35	25	33		8
Michigan State University	X	44	31	40	32		9
University of Iowa	X	21	21	24	21		10
Pennsylvania State University - University Park	X	18	21	20	19		11
Indiana University - Bloomington	X	11	10	14	14		12
Florida State University	X	10	6	10	13		13
University of Connecticut - Storrs	X	8	7	4	5		14
University of Maryland - College Park							
University of Texas - Austin							
<b>Median</b>		<b>35</b>	<b>38</b>	<b>43</b>	<b>34</b>		

# Economic Development

Licenses and Options Executed per \$10 Million in Total Research Expenditures

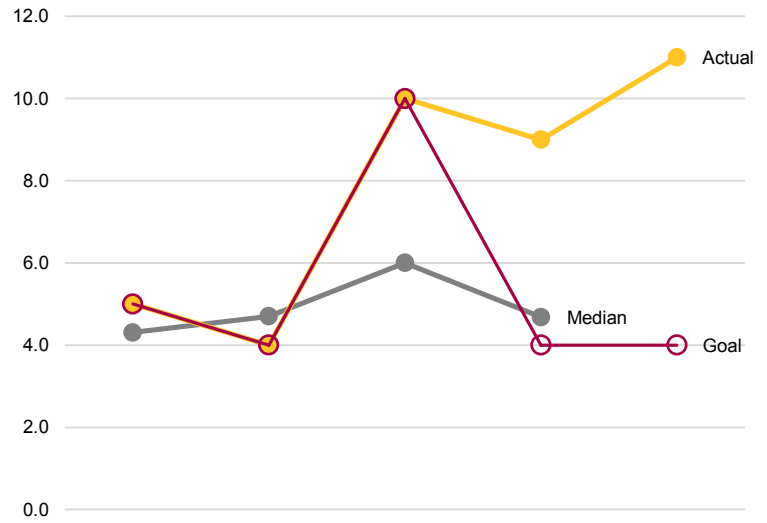


	2009	2010	2011	2012	2013
Actual	1.7	1.7	2.0	2.1	2.2

ABOR Peer Group	Med. Sch.	NSF Adj.	AUTM Adj.	2009	2010	2011	2012	2013	Rank
Arizona State University				1.7	1.7	2.0	2.1	2.2	1
University of Washington - Seattle	X			3.0	1.9	1.7	1.9		2
Rutgers the State University of NJ - New Brunswick		X	X	2.5	1.7	1.6	1.3		3
University of Minnesota - Twin Cities	X			0.7	0.9	1.3	0.9		4
University of Illinois - Urbana-Champaign				0.6	0.8	1.0	0.8		5
Indiana University - Bloomington		X	X	0.7	0.5	0.8	0.8		6
Michigan State University	X			1.2	0.7	0.9	0.6		7
Florida State University	X			0.5	0.3	0.4	0.6		8
University of Wisconsin - Madison	X			0.6	0.6	0.6	0.5		9
University of Iowa	X			0.6	0.5	0.5	0.5		10
Ohio State University - Columbus	X			0.4	0.5	0.3	0.4		11
University of Connecticut - Storrs		X	X	0.6	0.5	0.3	0.4		12
University of California - Los Angeles	X			0.4	0.6	0.5	0.3		13
Pennsylvania State University - University Park		X	X	0.3	0.3	0.3	0.3		14
University of Maryland - College Park									
University of Texas - Austin									
<b>Median</b>				<b>0.6</b>	<b>0.6</b>	<b>0.7</b>	<b>0.6</b>		

# Economic Development

## Startup Companies



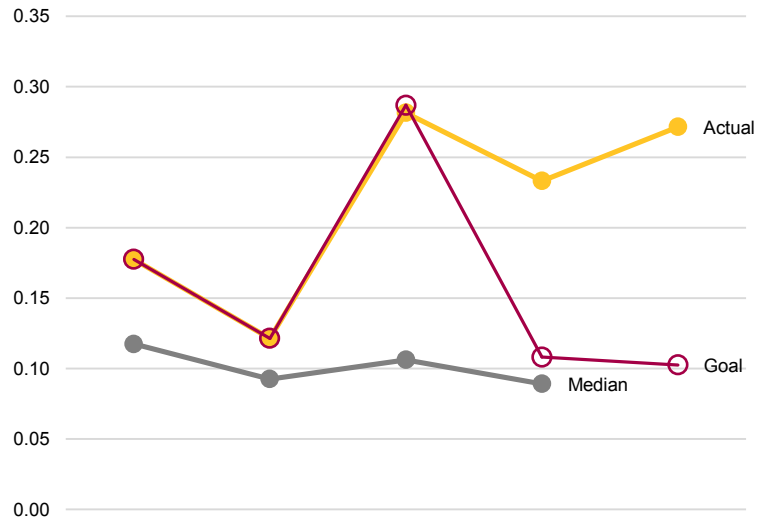
ABOR Enterprise Plan	2009	2010	2011	2012	2013
Actual	5	4	10	9	11
Goal	5	4	10	4	4
Difference	0	0	0	5	7

ABOR Peer Group	Med. Sch. AUTM Adj.	2009	2010	2011	2012	2013	Rank
University of California - Los Angeles	X	22	27	19	13		1
University of Minnesota - Twin Cities	X	3	8	9	12		2
<b>Arizona State University</b>		<b>5</b>	<b>4</b>	<b>10</b>	<b>9</b>	<b>11</b>	<b>3</b>
University of Washington - Seattle	X	10	7	9	9		3
Ohio State University - Columbus	X	7	8	6	5		5
University of Illinois - Urbana-Champaign		6	5	12	5		5
Indiana University - Bloomington	X	2	1	2	5		7
Rutgers the State University of NJ - New Brunswick	X	5	7	7	5		8
Pennsylvania State University - University Park	X	3	4	4	4		9
University of Iowa	X	3	3	2	4		10
University of Wisconsin - Madison	X	1	5	4	4		10
Michigan State University	X		0	1	3		12
University of Connecticut - Storrs	X	4	3		3		13
Florida State University	X	2	2	4	2		14
University of Maryland - College Park							
University of Texas - Austin		22					
<b>Median</b>		<b>4</b>	<b>5</b>	<b>6</b>	<b>5</b>		



# Economic Development

Startup Companies per \$10 Million in Total Research Expenditures

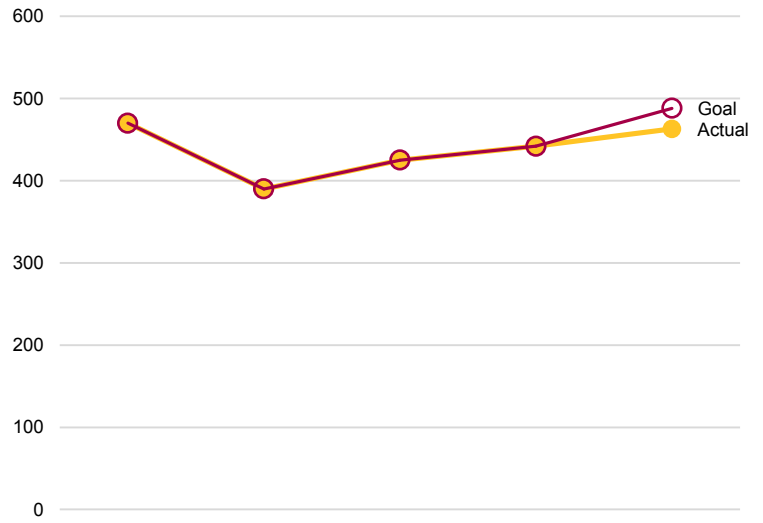


ABOR Enterprise Plan	2009	2010	2011	2012	2013
Actual	0.2	0.1	0.3	0.2	0.3
Goal	0.2	0.1	0.3	0.1	0.1
Difference	0.0	0.0	0.0	0.1	0.2

ABOR Peer Group	Med. Sch.	NSF Adj.	AUTM Adj.	2009	2010	2011	2012	2013	Rank
Indiana University - Bloomington	X	X		0.1	0.1	0.1	0.3		1
<b>Arizona State University</b>				<b>0.2</b>	<b>0.1</b>	<b>0.3</b>	<b>0.2</b>	<b>0.3</b>	<b>2</b>
University of Connecticut - Storrs		X	X	0.3	0.3		0.2		3
University of Minnesota - Twin Cities	X			0.0	0.1	0.1	0.1		4
University of California - Los Angeles	X			0.2	0.3	0.2	0.1		5
Rutgers the State University of NJ - New Brunswick		X	X	0.1	0.2	0.2	0.1		6
University of Iowa	X			0.1	0.1	0.0	0.1		7
Florida State University	X			0.1	0.1	0.2	0.1		8
University of Illinois - Urbana-Champaign				0.1	0.1	0.2	0.1		9
University of Washington - Seattle	X			0.1	0.1	0.1	0.1		10
Ohio State University - Columbus	X			0.1	0.1	0.1	0.1		11
Pennsylvania State University - University Park		X	X	0.0	0.1	0.1	0.1		12
Michigan State University	X				0.0	0.0	0.1		13
University of Wisconsin - Madison	X			0.0	0.0	0.0	0.0		14
University of Maryland - College Park									
University of Texas - Austin				0.4					
<b>Median</b>				<b>0.1</b>	<b>0.1</b>	<b>0.1</b>	<b>0.1</b>		

# Economic Development

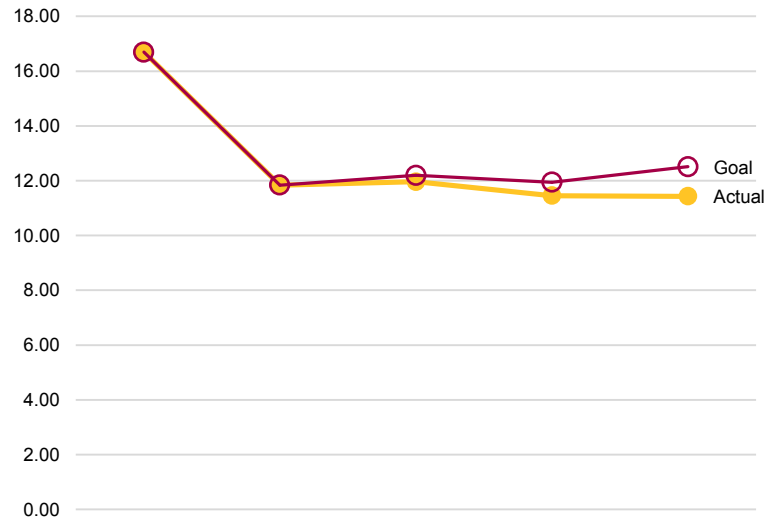
Ph.D. Degrees Conferred



ABOR Enterprise Plan	2009	2010	2011	2012	2013
Actual	470	390	425	442	463
Goal	470	390	425	442	488
Difference	0	0	0	0	-25

# Economic Development

Ph.D. Degrees Conferred per \$10 Million in Total Research Expenditures



ABOR Enterprise Plan	2009	2010	2011	2012	2013
Actual	16.7	11.8	12.0	11.5	11.4
Goal	16.7	11.8	12.2	11.9	12.5
Difference	0.0	0.0	-0.2	-0.5	-1.1

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**Leadership and Recognition**

# Leadership and Recognition

## Introduction

ASU's academic and research pursuits have garnered national and international attention. Examples of our achievements include:

- In recognition of our transformation and exemplary status as the New American University, we are ranked **79<sup>th</sup> among U.S. and international universities, 46<sup>th</sup> among all U.S. universities and 26<sup>th</sup> among all public U.S. universities** by the Academic Rankings of World Universities.
- Several graduate programs were **named among “America’s Best Graduate Schools”** in the 2013 and 2014 editions of the rankings in U.S. News and World Report:
  - The School of Earth and Space Exploration ranks among the top 20 graduate schools in the country.
  - Mary Lou Fulton Teachers College is recognized as 14<sup>th</sup> among public graduate schools of education and 24<sup>th</sup> among all public and private graduate programs in the field of education.
- ASU was named **one of the nation’s “greenest universities”** for the fourth consecutive year by the Princeton Review. This honor not only recognizes our efforts to provide education in sustainability as part of all degree programs but also our implementation of sustainable practices.

Academy inductions represent one of the highest honors bestowed to a researcher. Recognition of our exceptional faculty is reflected by memberships in prestigious academies such as:

- 11 members of the **National Academy of Sciences**
- 10 members of the **American Academy of Arts and Sciences**
- 9 members of the **National Academy of Engineering**
- 5 members of the **National Academy of Public Administration**
- 66 members of the **American Association for the Advancement of Science Fellows**
- 25 members of the **Institute of Electrical and Electronics Engineers**



## Leadership and Recognition

*Selected Accomplishments*

Faculty members inducted to national academies in FY13 include:

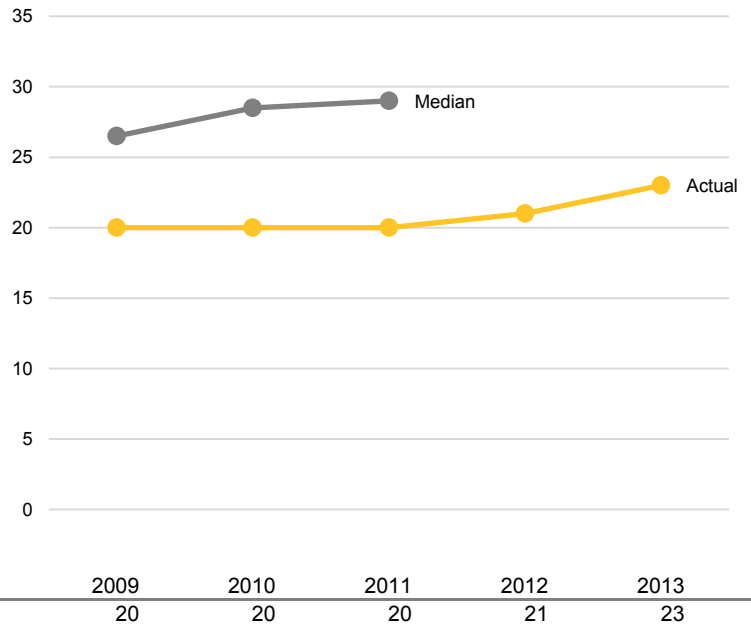
- Dr. Edward Kavazanjian, professor in the School of Sustainable Engineering and the Built Environment, **elected to the National Academy of Engineering.**
- Dr. Jonathan Koppell, dean of the College of Public Programs and director of the School of Public Affairs, **inducted as a fellow of the National Academy of Public Administration.**
- President Michael Crow and Dr. Stuart Newfeld, professor in the School of Life Sciences, **elected as fellows in the American Association for the Advancement of Science**, the world's largest general scientific society.
- Drs. Antonia Papandreou-Suppappola, Cun-Zheng Ning, and Lina Karam, all professors in the Ira A. Fulton Schools of Engineering, **named as fellows in the Institute of Electrical and Electronics Engineers.**
- Drs. Raymond DuBois, director of the Biodesign Institute, and Leland Hartwell, professor at the Biodesign Institute, **selected into the first class of Fellows of the American Association for Cancer Research.**

ASU faculty have also garnered national honors which include:

- Dr. Carlos Castillo-Chavez **reappointed to the U.S. President's Committee on the National Medal of Science**, one of the highest honors bestowed on American scientists.
- Dr. Anne Katherine Jones, assistant professor in the Department of Chemistry and Biochemistry and the Center for Bioenergy and Photosynthesis, **earned a prestigious Department of Energy (DOE) Office of Science Early Career Award.**
- Drs. Kiran Solanki and Robert Wang, assistant professors in the School for Engineering of Matter, Transport and Energy received **the U.S. Air Force Young Investigator award.**
- Dr. John Sabo, associate professor in the School of Life Sciences and director of research development at ASU's Global Institute of Sustainability **named a 2013 Leopold Leadership Fellow.**

# Leadership and Recognition

National Academy Members



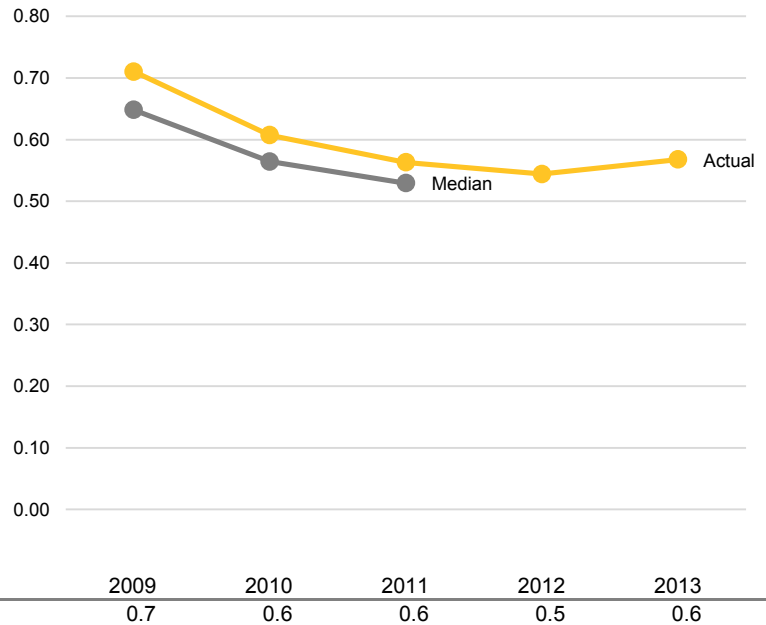
	2009	2010	2011	2012	2013
Actual	20	20	20	21	23

ABOR Peer Group	Med. Sch.	2009	2010	2011	2012	2013	Rank
University of Washington - Seattle	X	101	102	104			1
University of California - Los Angeles	X	85	91	95			2
University of Texas - Austin		65	67	68			3
University of Wisconsin - Madison	X	71	71	67			4
University of Illinois - Urbana-Champaign		55	59	57			5
University of Minnesota - Twin Cities	X	39	41	39			6
Rutgers the State University of NJ - New Brunswick		36	36	35			7
University of Maryland - College Park		27	30	30			8
Ohio State University - Columbus	X	26	27	28			9
Pennsylvania State University - University Park		24	24	23			10
University of Iowa	X	21	22	22			11
<b>Arizona State University</b>		<b>20</b>	<b>20</b>	<b>20</b>	<b>21</b>	<b>23</b>	<b>12</b>
Indiana University - Bloomington		11	10	10			13
Michigan State University	X	7	7	8			14
Florida State University	X	7	7	7			15
University of Connecticut - Storrs		1	1	1			16
<b>Median</b>		<b>27</b>	<b>29</b>	<b>29</b>			



# Leadership and Recognition

National Academy Members per \$10 Million in Total Research Expenditures



	2009	2010	2011	2012	2013
Actual	0.7	0.6	0.6	0.5	0.6

ABOR Peer Group	Med. Sch. NSF Adj.	2009	2010	2011	2012	2013	Rank
University of Texas - Austin		1.3	1.1	1.1			1
University of Illinois - Urbana-Champaign		1.0	1.1	1.0			2
University of California - Los Angeles	X	1.0	1.0	1.0			3
University of Washington - Seattle	X	1.3	1.0	0.9			4
Rutgers the State University of NJ - New Brunswick	X	1.0	0.8	0.7			5
University of Maryland - College Park		0.7	0.7	0.6			6
University of Wisconsin - Madison	X	0.7	0.7	0.6			7
<b>Arizona State University</b>		<b>0.7</b>	<b>0.6</b>	<b>0.6</b>	<b>0.5</b>	<b>0.6</b>	<b>8</b>
University of Iowa	X	0.6	0.5	0.5			9
University of Minnesota - Twin Cities	X	0.5	0.5	0.5			10
Ohio State University - Columbus	X	0.4	0.4	0.3			11
Florida State University	X	0.4	0.3	0.3			12
Pennsylvania State University - University Park	X	0.3	0.3	0.3			13
Indiana University - Bloomington	X	0.2	0.2	0.2			14
Michigan State University	X	0.2	0.2	0.2			15
University of Connecticut - Storrs	X	0.0	0.0	0.0			16
<b>Median</b>		<b>0.6</b>	<b>0.6</b>	<b>0.5</b>			

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## **Technology Transfer**

# Technology Transfer

## Introduction

Arizona Technology Enterprises (AzTE) was formed in 2003 as ASU's exclusive intellectual property (IP) management and technology transfer organization. AzTE comprises industry and university professionals with extensive experience in technology evaluation, IP protection, marketing, capital formation, licensing, and product development. AzTE's professionals have developed deep relationships with ASU's faculty, administration, industry partners, and the investment community.

ASU faculty submitted a record-breaking 250 invention disclosures to AzTE, spun out 11 new start-up companies, and were issued 48 U.S. patents. ASU ranks 33<sup>rd</sup> overall and 4<sup>th</sup> among universities without a medical school for the number of patents issued in 2012. This puts ASU in the league of universities without a medical school such as MIT, Caltech, and Georgia Tech. AzTE also facilitated 88 major agreements licensing ASU technologies for commercial and educational use.

In total, venture development activities have led to the launch of 67 startup companies. Many of these companies are operating in Arizona and employing ASU graduates. Arizona-based startups launched in the past several years now employ more than 370 people worldwide with 215 of those jobs currently in Arizona.

Startup companies that have licensed ASU IP received more than \$68 million in venture capital and other funding in the past fiscal year. In the last decade, these start-up companies and their sublicensees have attracted approximately \$400 million in funding from venture capital firms and other investors, with much of this financing achieved in recent years.

AzTE continually searches for new and strategic ways to support ASU's mission. In June 2013, AzTE took part in *First Look LA*, an investor event hosted by the Los Angeles Venture Association that included ASU, UCLA, USC, Caltech, UC Irvine, UC Santa Barbara, and Saban Research Institute at Children's Hospital Los Angeles. ASU professors pitched five technologies to over 150 investors.

Through the activities of AzTE, we continue to maintain an outstanding level of productivity in technology transfer compared with large U.S. research institutions on relevant performance metrics.



# Technology Transfer

## Statistical Exhibits

Technology Transfer Activities	2009	2010	2011	2012	2013
Invention Disclosures Transacted	164	187	170	239	250
Invention Disclosures Transacted Year/Year Percentage Change		14%	-9%	41%	5%
New Patent Applications	126	99	93	106	168
New Patent Applications Year/Year Percentage Change		-21%	-6%	14%	58%
U.S. Patents Issued	20	17	18	26	48
U.S. Patents Issued Year/Year Percentage Change		-15%	6%	44%	85%
Licenses and Options Executed	49	55	72	80	88
Licenses and Options Executed Year/Year Percentage Change		12%	31%	11%	10%
Other Major Agreements	53	108	126	160	186
Other Major Agreements Year/Year Percentage Change		104%	17%	27%	16%

Licensing and Other Revenue	2009	2010	2011	2012	2013
Licensing Revenue (Including Options)	1,878,749	1,625,716	1,059,372	1,900,333	2,026,689
Licensee Legal Reimbursements	661,986	1,111,111	1,205,679	1,274,577	970,482
Other Revenue	65,367	5,021	41,945	540,000	278,102
Total	2,606,102	2,741,848	2,306,996	3,714,910	3,275,273

Sponsored Research Facilitated	2009	2010	2011	2012	2013
Total	7,215,259	5,623,534	8,945,930	9,601,072	9,790,451

Royalty Distribution	2009	2010	2011	2012	2013
Inventors	-359,299	-281,466	-242,493	-210,800	-576,056
Laboratories and Units	-347,918	-313,358	-208,090	-180,287	-532,439
University	-297,424	-235,699	-138,557	-124,835	-517,940
Undistributed	12,979	548,128	169,983	100,694	2,975

- **Cyclodepsipeptides with Antineoplastic Activity and Methods of Using to Inhibit Cancer**  
**M07-064L, US Patent No. 8,415,294**  
Describes the novel antineoplastic drug Kitastatin 1. Kitastatins are a class of structurally unique and powerful cancer cell growth inhibitors, which display an impressive spectrum of activity against human cancer cell lines, in particular to pancreatic cancer. In a large licensing deal, this technology has been exclusively licensed to Agensys of Santa Monica, for use in producing monoclonal antibody-drug conjugates for the treatment of cancer. This technology was developed by Dr. George “Bob” Pettit, Regents’ Professor in the Department of Chemistry and Biochemistry
- **Gas Dynamic Virtual Nozzle for Generation of Microscopic Droplet Streams**  
**M07-110P, US Patent No. 8,272,576**  
Describes new designs for microfluidic nozzles that can be used in a variety of microfluidic applications, including scientific instrumentation, protein structure analysis, and nanoprinting. Existing nozzles for such applications require small geometries and have a tendency to clog very quickly. The new nozzles make use of a coaxial gas flow that helps focus the droplets exiting the nozzle to a size smaller than the physical geometry of the nozzle itself. This technology was developed by Drs. Bruce Doak and John Spence, professors in the Department of Physics.
- **Tridentate Platinum(II) Complexes**  
**M08-056P, US Patent No. 8,389,725**  
Describes new materials that can be used to produce organic light emitting diodes (OLEDs). These devices are used as back-lighting sources in electronic devices such as cell phones, and large-screen TVs, as well as solid state lighting. This technology is exclusively licensed to Universal Display Corporation. It was developed by Dr. Jian Li, associate professor in the School for Engineering of Matter, Transport and Energy.
- **Methods and Systems for Fluid Examination and Remediation**  
**M10-095L, US Patent No. 8,338,182**  
Describes a novel “downhole” device for in-situ bioremediation of contaminated sediment and groundwater. The device gathers site-specific information on the types of microorganisms present, allowing selection of the proper bioremediation strategy more quickly and less expensively than before. This technology has been exclusively licensed to InSituWell. The technology was developed by Dr. Rolf Halden, Director of the Center for Environmental Security within the ASU Biodesign Institute.

- **Provista Diagnostics**

Provista Diagnostics is a diagnostics laboratory located in Scottsdale, Arizona, specializing in complex assays for detecting the progression of gynecological cancers. Introduced to the promising work of Drs. Joshua LaBaer and Karen Anderson at the Biodesign Institute, the company entered into an exclusive evaluation license for five ASU technologies. Provista Diagnostics is managed by David Reese, an ASU graduate.

- **Presidium**

Presidium is a Canadian company interested in new materials for athletic and safety equipment. Presidium has licensed pressure sensor technology developed by Dr. Jeffrey LaBelle's, Bioengineering Department. The company plans to incorporate this technology into sports equipment to measure the severity of impacts players receive. The company is also licensing a composite material technology from Dr. Tom Attard.

- **Translucent**

Translucent is an Australian company that has exclusively licensed several patents related to improved solar materials. Translucent has also entered into an option agreement for several technologies from Dr. John Kouvetakis' lab related to improved LED lighting materials. Translucent has hired a research scientist from ASU is considering an investment to locate a manufacturing and research lab in Arizona.

- **SiO<sub>2</sub> NanoTech**

SiO<sub>2</sub> NanoTech, an ASU startup, has licensed and developed technology originating in Dr. Nicole Herbots' lab that utilizes surface physics and nanotechnology to control fogging on sportswear visors and goggles, windshields and medical devices.

- **Agensys**

Agensys licensed two groups of cytotoxic natural products from AzTE. Antibody-drug conjugates are a novel class of anti-cancer therapeutic drugs that link the specificity of monoclonal antibodies to the cancer cell killing power of small molecule natural products. These were developed in the laboratory of Dr. George Pettit.

- **Imanin**

IMANIN is a joint ASU/Mayo Clinic company that has licensed technology developed in Dr. Jianming Liang's lab to help identify individuals with risk of cardiovascular disease before they experience a life-threatening coronary event.

# Technology Transfer

Selected Startup Companies

Notable progress of three ASU startups includes:

- **Heliae**

Heliae has commercialized a platform technology that utilizes both sunlight and low-cost carbon feedstocks to optimize output and produce high-value products from algae. Additional funding valued at \$28 million has been secured and will support the company's Gilbert, Arizona facilities. Technologies licensed by Heliae were developed at the Arizona Center for Algae Technology and Innovation.



- **HealthTell**

HealthTell is an ASU biotech spinout that received \$4 million in FY13 funding to commercialize a new test for lung, breast, prostate, and colorectal cancer. At the most recent Arizona Governor's Celebration of Innovation, HealthTell won the "Innovator of the Year" award. The HealthTell diagnostics technology was developed at the ASU Biodesign Institute by Drs. Stephen A. Johnston and Neal Woodbury. In June 2012, ASU received a contract from the U.S. Department of Defense to develop a diagnostic tool to protect military personnel against bioterrorism, utilizing technology developed by HealthTell.



- **Axon**

Axon is a start-up founded by Dr. Michael Kozicki, professor in the School of Electrical, Computer and Energy Engineering. The first commercial product, a next-generation non-volatile memory chip, was introduced in 2012 through its sublicensee, Adesto Technologies. Adesto has more than 30 employees and received over \$20 million in financing in FY13. Adesto recently acquired Atmel's Serial Flash product families and signed a distribution agreement with Digi-Key.





## Technology Transfer

Other Notable Activities

The Entrepreneurship and Innovation activities helps entrepreneurs at ASU and beyond find resources, expand their knowledge and grow ideas. The group has a track record of delivering innovative initiatives with proven outcomes and impacts. Recognition of the group's achievements includes:

- **Ranked among the top 20 university incubators in the world, and tenth in the country**, by the University Business Incubator Index.
- Recognized for **“Most Promising Technology Based Economic Development”** by the State Science and Technology Institute for “creative use of existing resources and strong public-private sector support to spur entrepreneurial activity and build entrepreneurial ecosystems within the Phoenix Metro area and the state of Arizona.”

The Edson Student Entrepreneur Initiative is part of a suite of programs directed by the group. Each year the Edson Initiative selects 20 high-potential student companies to participate in a “pracademic” program that is designed to accelerate companies and nurture student entrepreneurs. The Edson Initiative continues to be successful in attracting top quality students and their ideas. For example, **the 2012 cohort of companies secured \$1.1 million in equity investment and grant awards**. Of the 20 companies, seven are revenue-generating and three are angel-funded. The Edson startup Pollen-Tech **won the inaugural “Best Arizona Student Startup Company” competition**.

Furnace Technology Transfer Accelerator is designed to form, incubate, and launch new companies created from technologies and intellectual property licensed from Arizona's premier research institutions. The most recent Furnace cohort **resulted in 10 new companies and \$250,000 of investment** by Arizona Commerce Authority. Seven of the winning companies were based on ASU technologies, two from the University of Arizona, and one from Dignity Health.

We **proposed a successful Department of Defense “Pracademic Center of Excellence in Technology Transfer (PACE/T2)”** to drive a parallel strategy of research and commercialization for the DOD. PACE/T2 will combine technology transfer methodology with strong collaboration from ASU academic units. This is a joint effort of ASU and AzTE.



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## **Strategic Initiatives**

# Strategic Initiatives

## Summary

ASU's research enterprise is a portfolio of diverse, strategic pursuits and partnerships that tackles emerging challenges. The portfolio includes the three signature focus areas supported by the Technology Research Initiative Fund (TRIF). Our strategic focus includes:

- **Accelerating research in established TRIF focus areas and increasing return on the state's investment.**

In Bio and Health, we are leveraging our capability as a powerhouse of basic science research in medicine and human biology by **further expanding clinical application and partnerships**. The establishment of the off-campus ASU Research Enterprise (ASURE) facility as part of the Security and Defense System Initiative has **uniquely positioned ASU for competitive government contracts** in National Security Systems. **New funding avenues are being pursued** in the Water, Environment and Energy Solutions focus area through strategic partnerships with corporations like AECOM and global organizations such as the United States Agency for International Development.

- **Investing in new research areas to align with changing funding and economic landscapes.**

The new Biodesign Center for Molecular Design and Biomimicry as well as the Space Technology and Science Initiative will not only attract top quality talent but will also result in aligning with new funding and economic opportunities.

- **Strengthening new and existing partnerships that will broaden the impact of ASU research while refining ASU's competitive edge in the global arena.**

Industry partners such as Mayo Clinic and globally based organizations such as USAID offer opportunities to collaborate with organizations committed to making a positive difference and to **extend the reach of ASU use-inspired research**. These partnerships also ensure that the advancement of **ASU research is aligned with the actual needs of society**.



# Strategic Initiatives

## Summary

Achieving each aspect of our strategic focus ensures our continued trajectory of rapid research advancement including achieving \$700 million in total research volume by 2020 and cultivating recognition as a leading institution of higher education. Seeking out and conducting trans-disciplinary, use-inspired, and socially engaged research is instrumental to ASU's efforts to build and diversify its research portfolio. This strategy enables ASU to conduct the necessary planning and execution for creating a high-functioning, influential, and dynamic research enterprise as we fuel a vibrant economy and improve social well-being.



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**Annual Research Report - FY2013**

Northern Arizona University is pleased to provide this summary of our research activity for FY 2013 and to report on our progress toward achieving our 2020 enterprise research goals.



In many ways, FY 2013 was a challenging year, but we faced and addressed our challenges in ways that helped us to build greater research capacity for the coming years. Our challenges included relatively low numbers of tenure track (and therefore research-active) faculty compared with 6 years ago, limited research space, a need to broaden our research scope, and a need to energize the NAU research culture.

We addressed these challenges by hiring additional tenure track faculty with research expectations by launching new research centers that concentrate their research activities to generate more extramural funding, and by envisioning the development of a campus-wide, interdisciplinary, informatics-driven research agenda that will take us in new research directions. All of these efforts, together, are helping to energize NAU's research culture and stimulate innovation. These efforts will also contribute to the economic vitality of the region and state.

In FY 2013, Northern Arizona University for first time established “nationally-recognized research excellence” as one of its institutional strategic goals, aligning with the Arizona Higher Education Enterprise goal to increase research capabilities, outcomes, and impact. This clearly signals a changing culture at NAU that embraces research as integral to the overall goals of the institution. The development of the NAU Informatics and Computing Program (ICP) is a tangible result of this culture shift; through the coordinated efforts of key faculty and committed administrators, a three-stage plan for hiring new research intensive informatics faculty was approved and recruitment began in late Spring. These ICP faculty, along with other new faculty across all disciplines, will expand “big data” expertise and research at the university. The acquisition of a powerful high performance computing cluster to support this new research approach was a key piece of the plan that was implemented in FY13. This high performance computing capacity will not only enhance the work of our established “big data” researchers, but will also help NAU departments—including the new ICP—be more competitive in faculty recruitments.

Also in FY 2013, NAU increased focus on translational health research. Discussions with the Flinn Foundation led to a funded research collaboration with Flagstaff Medical Center on precision medicine (from bed to community), with a larger strategy to build the Northern Arizona end of the biomedical research corridor. Our goal, for which Flinn expressed great enthusiasm, is to build a strong collaborative team with Northern Arizona Healthcare (NAH) and Flagstaff Medical Center. This collaboration began to take shape in FY2013 and is already catalyzing clinical research projects and expanding a network of partners to enhance healthcare research outcomes for Arizona citizens. We expect to sign a Memorandum of Understanding in FY2014 to solidify this new relationship.

Northern Arizona University is making significant progress in its research capacity development and our plans and our current implementation of research initiatives will increase our yearly research expenditures, expand our technology transfer activities, promote a more competitive graduating workforce, and enhance NAU's economic impact on the state.

*William G. Hulse*



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**Enterprise Size**

The Northern Arizona University research enterprise has grown steadily over the past 40 years and is now in the midst of a period of intensive, deliberate growth and change designed to have both immediate and long-term impact—both on the university as well as on the region and state. Along with its sister institutions, NAU has been tasked with approximately doubling research expenditures and significantly enhancing the impact of its research activities through the year 2020 and beyond. Of course, the single most important factor affecting the university’s ability to reach these ambitious goals is its human capital—the faculty, staff and students who ask the questions, who carry out the research and scholarly activities, and who assist the researchers by providing administrative and technical support services. The “business” of creating new knowledge depends upon the ability of these individuals to work synergistically to compete effectively for extramural funds. To this end, in FY2013,



the Office of the Vice President for Research (OVP) implemented a number of programs designed to provide our faculty, staff and student researchers with more of the resources that they need to help them get the job done. For example, in FY2013 the OVP piloted a program that provides accounting support to principal investigators for managing their grant accounts. Additionally, through various research investment funds, including TRIF, the university hired a number of post-doctoral scholars that will help NAU faculty increase

collaborative efforts, bring to NAU expertise that will expand research capacity, and enhance the ability of NAU faculty to compete more effectively for extramural funds in a number of other ways. Through these and other efforts, we hope to catalyze discovery, and raise our research profile.

**Total and Federal Research Expenditures.** Northern Arizona University’s peer institutions range greatly in the size of the research enterprise (as reflected in total research expenditures), from the University of Maine (greater than \$100M) to Bowling Green (less than \$10M). With research expenditures ranging between \$25M and \$30M each year, we tend to fall below the median for our peer group. While we did not reach our goal for research expenditures in FY2013, we did increase research expenditures by 8.5% over FY2012.

**Research Space.** We remain well below the median of our peer group with regard to research space. We continue to invest in renovating and using more efficiently some of the facilities not originally designed for modern research activities (e.g., Engineering). Additionally, we have added new space over the past couple of years (the new Science Laboratory Facility for biological sciences and chemistry) and recognize that we will need to bring more research space online in order to make progress in other 2020 research goals.

**Faculty Numbers and Research Personnel.** Northern Arizona University is ranked toward the bottom of its peer group with respect to numbers of tenured/tenure track faculty members. We recognize that in order to reach our 2020 research goals, we will need to reverse what has been a downward trend in our faculty numbers. Over the past fiscal year, we have implemented programs and policies that recognize the importance of research faculty (non-tenure-track, soft-money) and postdoctoral associates to maintain strength in research and mentor graduate students.

**Post-docs bring cutting-edge expertise to NAU.** In the Spring, more than a dozen new post-doctoral scholars arrived at NAU from places like UCLA, Princeton, Michigan State University, and beyond—recruited under the university's Support for Post-doctoral Associates (SPA) Program. The goal of SPA is to bring new skills and expertise to NAU, increasing research capacity and expanding collaborative opportunities both within NAU and between NAU and other institutions. Post-docs hired



through the SPA program will impact NAU's research capacity in astronomy, biomechanics, forestry, informatics, speech analysis and programming, and other fields. David Wagner, Associate Director of The Center for Microbial Genetics & Genomics, hired Katy Califf (left) from Michigan State University to analyze large genomic datasets that can identify a possible new vaccine and therapeutic targets for melioidosis. "The ability to generate large amounts of genomic data has revolutionized the biomedical sciences. However, handling and analyzing these large datasets is not trivial and requires specialized skills that currently do not exist in my research group," Wagner explained. Califf brings those skills to NAU. "This work has great potential to develop new intellectual property for NAU and should also lead to more external funding," said Wagner. (More about the SPA post-docs in the Strategic Initiatives section of this report.)

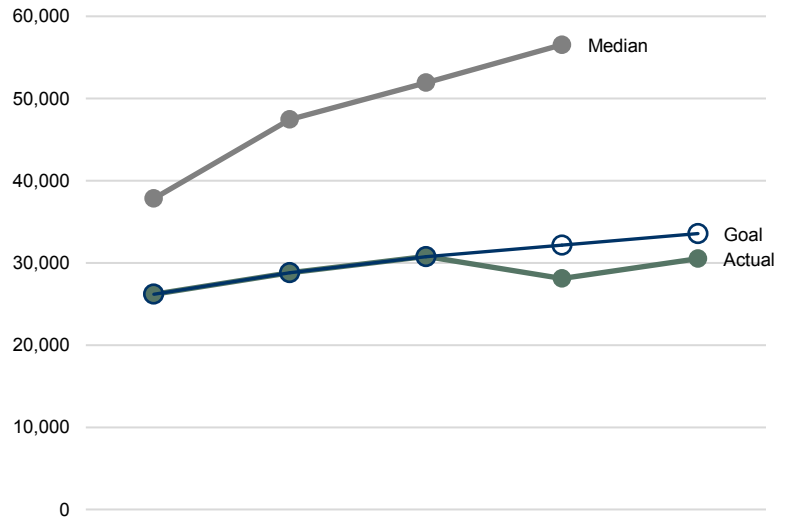
**NAU Launches New Energy Solutions Institute.** Northern Arizona University established the new Institute for Sustainable Energy Solutions (ISES) in FY2013, bringing together the university's energy researchers to expand research capacity in wind, solar and renewable energy. The institute's goal is to increase access to new technologies and shape energy decision-making in both the private and public sectors. The university's support (through the Technology & Research Initiative Fund) allows ISES to "galvanize clean energy research at NAU, engaging our students and addressing problems of worldwide importance," said Tom Acker, director of the institute and professor of mechanical engineering. The university's research in wind, solar and renewable energy will fall under the institute's umbrella. The institute's partners include national laboratories, Native American tribes, renewable energy companies, energy utilities, and non-profit organizations.

**NAU Awarded \$6 million to Lead American Indian Health Research.** The National Institute on Minority Health and Health Disparities awarded a \$6 million grant to create a Center for American Indian Resilience (CAIR) at Northern Arizona University. The five-year project is a collaboration between NAU, The University of Arizona and Diné College that will create partnerships among health researchers and tribal communities identify, study, and teach approaches that take advantage of long-standing Native American cultural practices that promote health. "CAIR research will deepen our scientific knowledge of existing positive health outcomes in tribal communities, and then we will translate this knowledge to practice through public health education and policy," said Priscilla Sanderson, assistant professor of health sciences and applied indigenous studies and Principal Investigator of the grant (above). "Resilience entails the positive traits and personal strategies that allow even those with difficult health conditions to persevere."



# Enterprise Size

Total Research Expenditures (in Thousands)

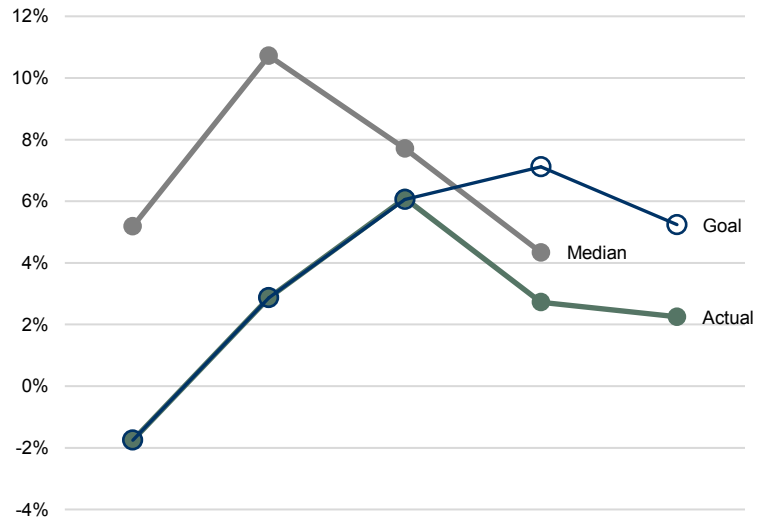


ABOR Enterprise Plan	2009	2010	2011	2012	2013
Actual	26,183	28,803	30,785	28,100	30,516
Goal	26,183	28,803	30,751	32,160	33,569
Difference	0	0	34	-4,060	-3,053

ABOR Peer Group	Med. Sch. NSF Adj.	2009	2010	2011	2012	2013	Rank
Old Dominion University		71,909	97,176	102,192	104,579		1
University of Maine		100,580	111,282	111,600	92,135		2
Georgia State University		60,557	81,015	92,725	91,148		3
George Mason University		78,487	84,120	88,089	90,198		4
Southern Illinois University - Carbondale	X	66,316	69,924	71,130	71,097		5
University of Akron		34,507	52,884	65,536	66,413		6
Wichita State University		65,988	51,524	50,194	61,279		7
Ohio University	X	41,256	50,440	57,643	57,203		8
University of Alabama		36,508	40,762	53,633	55,885		9
University of Nevada - Las Vegas		39,148	44,457	39,526	34,543		10
<b>Northern Arizona University</b>		<b>26,183</b>	<b>28,803</b>	<b>30,785</b>	<b>28,100</b>	<b>30,516</b>	<b>11</b>
Kent State University - Kent		25,050	26,331	27,455	26,507		12
Northern Illinois University		20,644	27,036	21,748	21,823		13
Western Michigan University		13,301	26,391	25,051	21,073		14
University of North Carolina - Greensboro		10,394	22,436	26,121	19,080		15
Bowling Green State University		8,396	8,124	8,999	8,566		16
<b>Median</b>		<b>37,828</b>	<b>47,449</b>	<b>51,914</b>	<b>56,544</b>		

# Enterprise Size

Average Growth Rate in Total Research Expenditures Over 3 Years

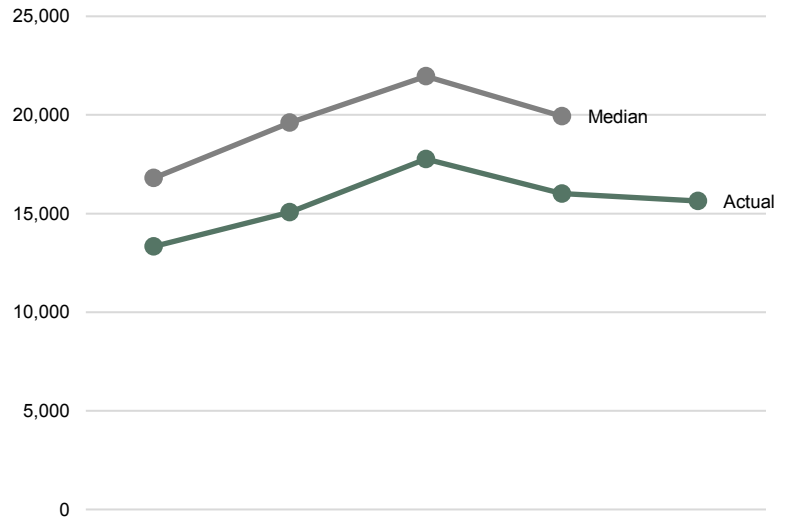


ABOR Enterprise Plan	2009	2010	2011	2012	2013
Actual	-1.8%	2.9%	6.1%	2.7%	2.3%
Goal	-1.8%	2.9%	6.1%	7.1%	5.2%
Difference	0	0	0.0%	-4.4%	-3.0%

ABOR Peer Group	Med. Sch. NSF Adj.	2009	2010	2011	2012	2013	Rank
University of North Carolina - Greensboro		20.5%	58.8%	54.8%	35.1%		1
University of Akron		7.5%	26.8%	34.7%	26.2%		2
Western Michigan University		-9.5%	24.8%	28.1%	25.8%		3
University of Alabama		1.7%	4.4%	18.1%	15.8%		4
Georgia State University		8.9%	21.0%	8.7%	15.5%		5
Old Dominion University		13.3%	23.6%	16.1%	14.2%		6
Ohio University	X	2.9%	9.7%	14.9%	11.9%		7
George Mason University		16.1%	13.3%	6.7%	4.8%		8
Northern Illinois University		9.4%	19.5%	16.5%	3.9%		9
<b>Northern Arizona University</b>		<b>-1.8%</b>	<b>2.9%</b>	<b>6.1%</b>	<b>2.7%</b>	<b>2.3%</b>	<b>10</b>
Southern Illinois University - Carbondale	X	-3.5%	2.7%	2.0%	2.4%		11
Kent State University - Kent		33.9%	11.7%	5.6%	2.0%		12
Bowling Green State University		-4.1%	-2.5%	-4.7%	0.9%		13
Wichita State University		29.2%	5.6%	4.5%	-0.8%		14
University of Maine		2.6%	5.1%	5.6%	-2.2%		15
University of Nevada - Las Vegas		-11.3%	-6.2%	-6.8%	-3.4%		16
<b>Median</b>		<b>5.2%</b>	<b>10.7%</b>	<b>7.7%</b>	<b>4.3%</b>		

# Enterprise Size

Federally Financed Research Expenditures (in Thousands)



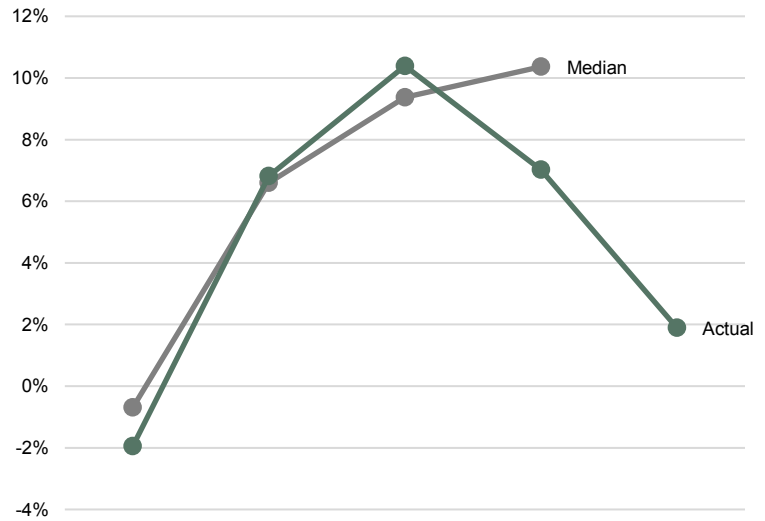
	2009	2010	2011	2012	2013
Actual	13,333	15,070	17,765	16,015	15,638

ABOR Peer Group	Med. Sch. NSF Adj.	2009	2010	2011	2012	2013	Rank
George Mason University		55,678	63,011	65,301	63,786		1
University of Maine		47,280	50,163	59,800	39,661		2
Old Dominion University		27,644	34,687	39,534	38,555		3
Georgia State University		24,038	27,073	28,210	34,075		4
University of Alabama		23,944	26,364	32,999	33,023		5
University of Nevada - Las Vegas		31,270	32,441	30,457	25,068		6
Southern Illinois University - Carbondale	X	19,223	22,209	23,696	22,055		7
Ohio University	X	16,508	18,466	23,051	20,780		8
Wichita State University		12,241	13,751	12,972	19,078		9
University of Akron		10,966	12,107	12,130	16,768		10
University of North Carolina - Greensboro		8,542	19,477	20,868	16,530		11
<b>Northern Arizona University</b>		<b>13,333</b>	<b>15,070</b>	<b>17,765</b>	<b>16,015</b>	<b>15,638</b>	<b>12</b>
Kent State University - Kent		13,282	14,586	15,085	14,882		13
Western Michigan University		8,084	19,738	18,736	14,378		14
Northern Illinois University		17,098	17,334	11,807	12,861		15
Bowling Green State University		4,285	4,963	6,164	7,005		16
<b>Median</b>		<b>16,803</b>	<b>19,608</b>	<b>21,960</b>	<b>19,929</b>		



# Enterprise Size

Average Growth Rate in Federally Financed Research Expenditures Over 3 Years

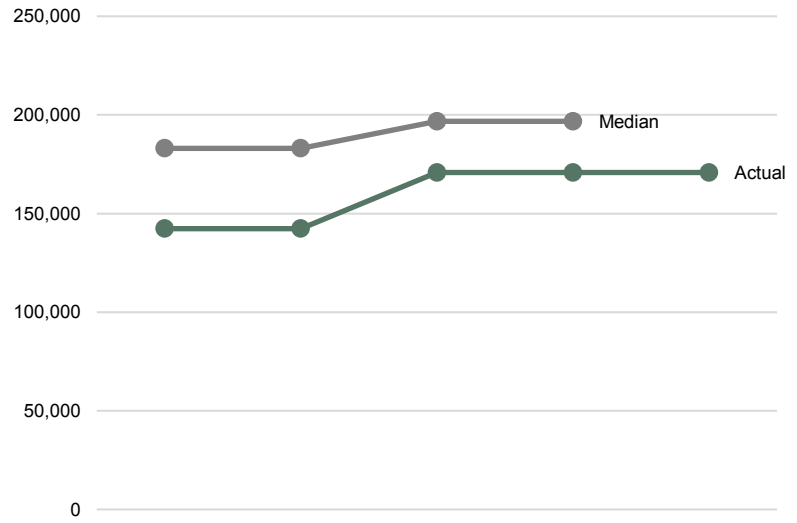


	2009	2010	2011	2012	2013
<b>Actual</b>	-1.9%	6.8%	10.4%	7.0%	1.9%

	Med. Sch. NSF Adj.	2009	2010	2011	2012	2013	Rank
<b>ABOR Peer Group</b>							
Western Michigan University		-10.2%	40.7%	44.4%	38.6%		1
University of North Carolina - Greensboro		18.7%	61.1%	56.7%	38.1%		2
Wichita State University		-7.9%	-7.4%	-0.9%	17.9%		3
Bowling Green State University		-5.7%	-5.9%	4.1%	17.9%		4
University of Akron		-0.3%	3.8%	9.6%	16.3%		5
Georgia State University		-1.1%	3.7%	2.8%	12.5%		6
Old Dominion University		0.4%	11.1%	12.4%	12.3%		7
University of Alabama		2.7%	-1.1%	12.5%	11.8%		8
Ohio University	X	-5.5%	0.1%	9.1%	8.9%		9
<b>Northern Arizona University</b>		<b>-1.9%</b>	<b>6.8%</b>	<b>10.4%</b>	<b>7.0%</b>	<b>1.9%</b>	<b>10</b>
Southern Illinois University - Carbondale	X	-1.1%	8.0%	10.7%	5.1%		11
George Mason University		16.1%	10.6%	9.1%	4.8%		12
Kent State University - Kent		17.8%	14.5%	6.6%	4.0%		13
University of Maine		4.8%	6.4%	13.6%	-2.8%		14
University of Nevada - Las Vegas		-8.5%	-11.8%	-9.0%	-6.7%		15
Northern Illinois University		16.0%	12.6%	5.8%	-7.2%		16
<b>Median</b>		<b>-0.7%</b>	<b>6.6%</b>	<b>9.4%</b>	<b>10.4%</b>		

# Enterprise Size

Net Assignable Square Feet

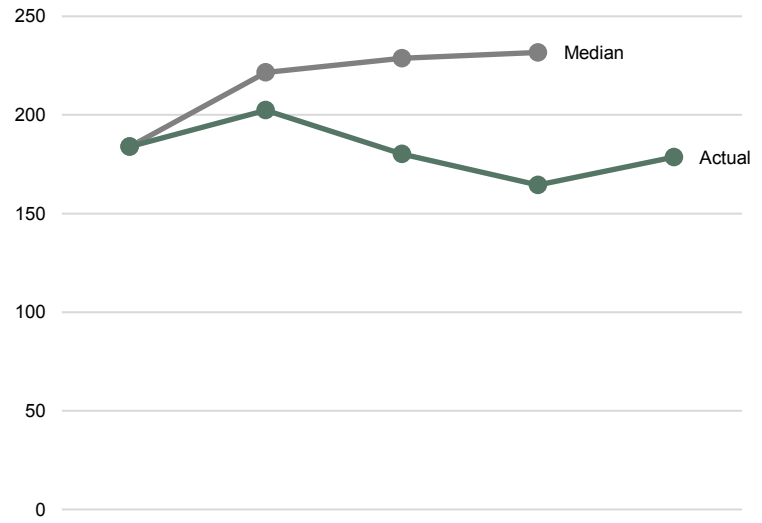


	2009	2010	2011	2012	2013
Actual	142,340	142,340	170,831	170,831	170,831

ABOR Peer Group	Med. Sch. NSF Adj.	2009	2010	2011	2012	2013	Rank
University of Maine		643,390	643,390	625,692	625,692		1
Southern Illinois University - Carbondale	X	328,265	328,265	328,265	328,265		2
Old Dominion University		263,988	263,988	298,718	298,718		3
Wichita State University		220,272	220,272	273,072	273,072		4
Ohio University	X	331,694	331,694	239,382	239,382		5
University of Akron				221,282	221,282		6
Georgia State University		198,532	198,532	214,269	214,269		7
George Mason University		161,103	161,103	200,572	200,572		8
University of Nevada - Las Vegas		181,955	181,955	192,977	192,977		9
University of Alabama		183,990	183,990	192,311	192,311		10
<b>Northern Arizona University</b>		<b>142,340</b>	<b>142,340</b>	<b>170,831</b>	<b>170,831</b>	<b>170,831</b>	<b>11</b>
Bowling Green State University		170,600	170,600	160,592	160,592		12
University of North Carolina - Greensboro		97,658	97,658	125,616	125,616		13
Northern Illinois University		122,986	122,986	122,986	122,986		14
Kent State University - Kent		183,065	183,065	105,565	105,565		15
Western Michigan University		83,055	83,055	83,055	83,055		16
<b>Median</b>		<b>183,065</b>	<b>183,065</b>	<b>196,775</b>	<b>196,774.5</b>		

# Enterprise Size

Total Research Expenditures per Net Assignable Square Foot

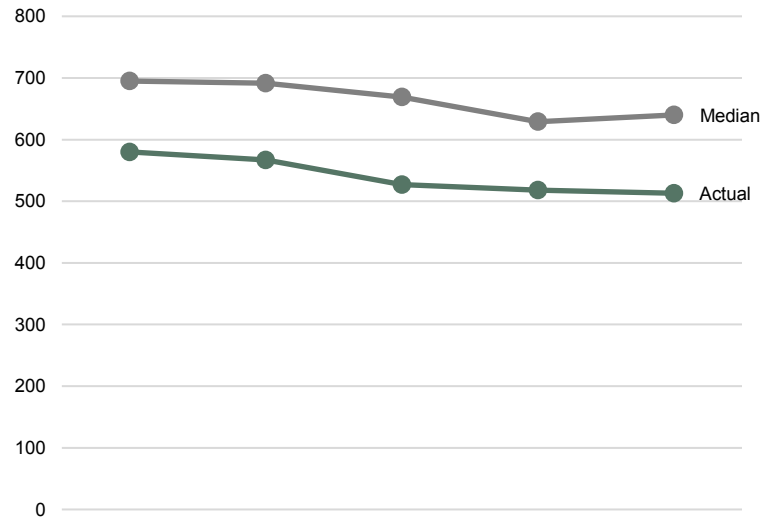


	2009	2010	2011	2012	2013
Actual	184	202	180	164	179

	Med. Sch. NSF Adj.	2009	2010	2011	2012	2013	Rank
<b>ABOR Peer Group</b>							
George Mason University		487	522	439	450		1
Georgia State University		305	408	433	425		2
Old Dominion University		272	368	342	350		3
University of Akron				296	300		4
University of Alabama		198	222	279	291		5
Western Michigan University		160	318	302	254		6
Kent State University - Kent		137	144	260	251		7
Ohio University	X	124	152	241	239		8
Wichita State University		300	234	184	224		9
Southern Illinois University - Carbondale	X	202	213	217	217		10
University of Nevada - Las Vegas		215	244	205	179		11
Northern Illinois University		168	220	177	177		12
<b>Northern Arizona University</b>		<b>184</b>	<b>202</b>	<b>180</b>	<b>164</b>	<b>179</b>	<b>13</b>
University of North Carolina - Greensboro		106	230	208	152		14
University of Maine		156	173	178	147		15
Bowling Green State University		49	48	56	53		16
<b>Median</b>		<b>184</b>	<b>222</b>	<b>229</b>	<b>231.7</b>		

# Enterprise Size

Total Faculty Population

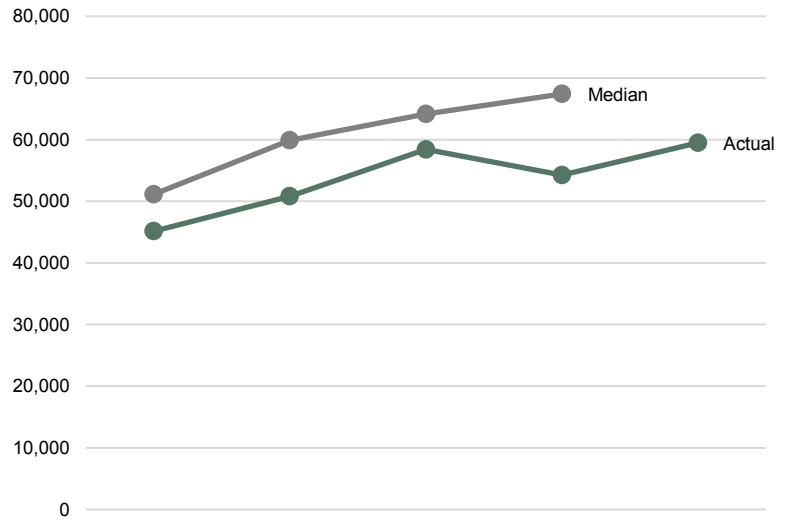


	2009	2010	2011	2012	2013
Actual	580	567	527	518	513

	Med. Sch. NSF Adj.	2009	2010	2011	2012	2013	Rank
<b>ABOR Peer Group</b>							
George Mason University		877	885	882	888	915	1
University of Alabama		803	823	848	845	867	2
Western Michigan University		819	828	829	808	811	3
Southern Illinois University - Carbondale	X	853	860	841	795	789	4
Georgia State University		746	739	736	745	763	5
Ohio University	X	881	898	886	833	728	6
Northern Illinois University		758	758	732	714	699	7
University of Nevada - Las Vegas		706	699	672	616	648	8
Kent State University - Kent		684	684	666	642	632	9
University of Akron		619	636	636	616	619	10
Old Dominion University		528	525	553	567	582	11
Bowling Green State University		557	533	508	527	530	12
University of North Carolina - Greensboro		553	573	593	583	530	12
<b>Northern Arizona University</b>		<b>580</b>	<b>567</b>	<b>527</b>	<b>518</b>	<b>513</b>	<b>14</b>
University of Maine		480	466	449	447	427	15
Wichita State University		401	378	360	361	373	16
<b>Median</b>		<b>695</b>	<b>692</b>	<b>669</b>	<b>629</b>	<b>640</b>	

# Enterprise Size

Total Research Expenditures per Faculty

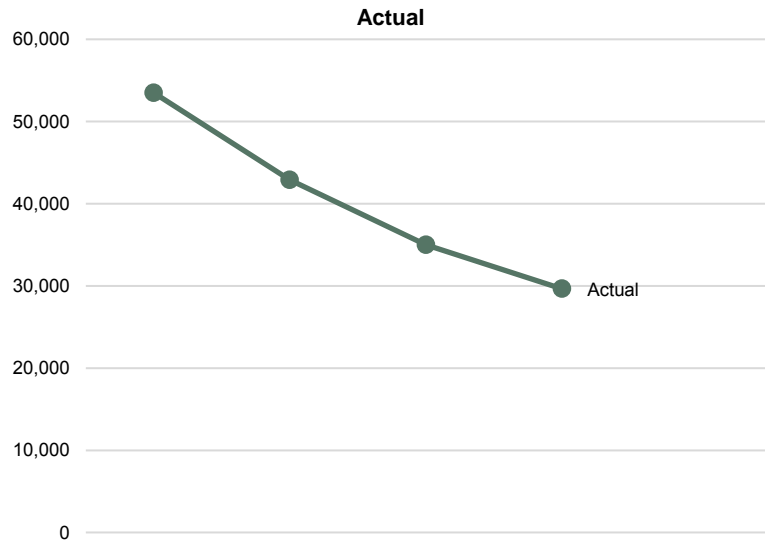


	2009	2010	2011	2012	2013
Actual	45,143	50,799	58,416	54,247	59,485

ABOR Peer Group	Med. Sch. NSF Adj.	2009	2010	2011	2012	2013	Rank
University of Maine		209,542	238,803	248,552	206,119		1
Old Dominion University		136,191	185,097	184,796	184,443		2
Wichita State University		164,559	136,307	139,428	169,748		3
Georgia State University		81,176	109,628	125,985	122,346		4
University of Akron		55,746	83,151	103,044	107,813		5
George Mason University		89,495	95,051	99,874	101,574		6
Southern Illinois University - Carbondale	X	77,744	81,307	84,578	89,430		7
Ohio University	X	46,829	56,169	65,060	68,671		8
University of Alabama		45,465	49,529	63,246	66,136		9
University of Nevada - Las Vegas		55,450	63,601	58,818	56,076		10
<b>Northern Arizona University</b>		<b>45,143</b>	<b>50,799</b>	<b>58,416</b>	<b>54,247</b>	<b>59,485</b>	<b>11</b>
Kent State University - Kent		36,623	38,496	41,224	41,288		12
University of North Carolina - Greensboro		18,796	39,155	44,049	32,727		13
Northern Illinois University		27,235	35,668	29,710	30,564		14
Western Michigan University		16,241	31,873	30,218	26,080		15
Bowling Green State University		15,074	15,242	17,715	16,254		16
<b>Median</b>		<b>51,140</b>	<b>59,885</b>	<b>64,153</b>	<b>67,404</b>		

# Enterprise Size

Other Sponsored Project Expenditures (in Thousands)



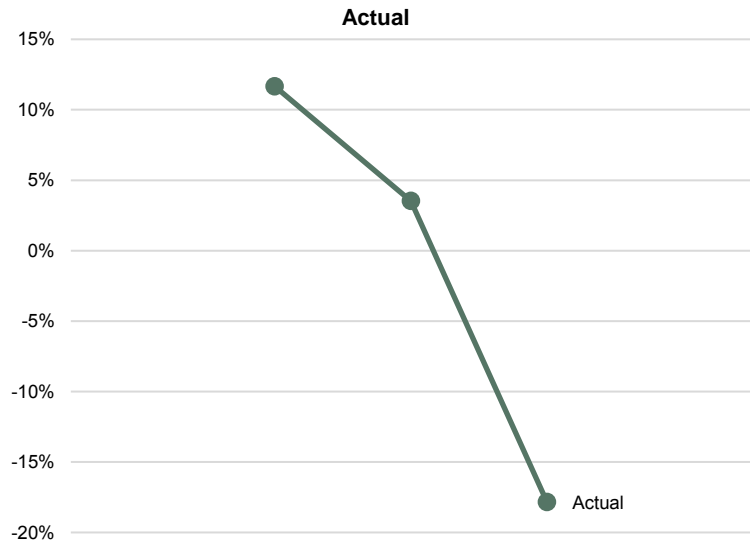
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ABOR Enterprise Plan	2009	2010	2011	2012	2013
Actual	53,486	42,894	34,998	29,645	

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# Enterprise Size

Average Growth Rate in Other Sponsored Project Expenditures Over 3 Years



ABOR Enterprise Plan	2009	2010	2011	2012	2013
Actual		11.7%	3.5%	-17.8%	

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**Discovery and Scholarly Impact**

Discovery and scholarship can be measured in a number of ways. Some indicators are traditionally captured through technology transfer metrics—for example, the number of invention disclosures made or the number of patents issued. At a more basic level, the ability of faculty and students to publish their work in peer-reviewed settings, and the citation of that work by others, directly measures the impact that university researchers are having on the global community.

**Invention Disclosures.** NAU researchers have learned to recognize the commercial potential of their research, and the number of invention disclosures transacted has climbed. The university’s technology transfer “in-reach” program enable us to stay informed about the research interests and activities of our faculty and also serve to educate faculty about how and why they should recognize the potential commercial applications of their work. In FY2013, we saw clear evidence that prior year in-reach efforts are having an impact. We received more disclosures in FY2013 than ever before, and a higher number of these disclosures were received spontaneously. This means that more NAU researchers are understanding how to recognize the commercial potential of their work. We are pleased to report that as a result, we met our goal for invention disclosures transacted in FY2013.

**Patents Issued.** In FY2013, we met our goal for U.S. patents issued. Because we are now seeing patents issued for invention disclosures submitted five years ago, we anticipate that NAU patents will begin issuing on a regular basis, reflecting the regular inflow of invention disclosures—and the improved quality of these disclosures—beginning in FY2009. In addition, NAU *Innovations* is starting to develop and implement more aggressive patent strategies for fast-tracking certain selected patent applications. In doing so we will be able to bring NAU innovations to the marketplace more quickly, giving us an edge needed in the highly competitive global innovation landscape.

**Publication and Citation.** The table above/right shows that NAU is at the top of its peer group in citations across all disciplines through the end of calendar year 2012 (half-way through FY2013). In addition, among its peer group, NAU ranks first in citations in the fields of Ecology and Microbiology, second in the fields of Forestry and Geosciences, and third in the fields of Environmental Sciences and Language & Linguistics. This is especially significant since NAU ranks near the bottom of its peer group in total number of faculty (see Enterprise Size – Total Faculty Population).

*Impact of Publications by NAU and Peers*

Impact (Cites/Docs) on Docs Published 2008-2012	
Institution	
1 No Illinois Univ	9.52
2 Univ Alabama Tuscaloosa	7.41
3 No Arizona Univ	6.96
4 George Mason Univ	6.92
5 Old Dominion Univ	5.80
6 Univ Maine	5.70
7 Kent State Univ	5.48
8 Ohio Univ	5.37
9 Univ Akron	5.32
10 Univ Nevada Las Vegas	5.01
11 Georgia State Univ	4.98
12 Bowling Green State Univ	4.75
13 So Illinois Univ	4.73
14 Wichita State Univ	4.72
15 Univ N Carolina Greensboro	4.42
16 Western Michigan Univ	3.92

**A New Bug.** A newly species of beetle was discovered by a graduate student scientist at Northern Arizona University. Jut Wynne, a biological sciences doctoral candidate and research ecologist with the Colorado Plateau Research Station at NAU, discovered this new species of beetle during a several-year study of caves on Grand Canyon-Parashant National Monument. The newly described beetle, *Eleodes wynnei*, pictured at right, is currently known to occur only in northwestern Arizona and southwestern Utah.



**Flagstaff's Shark.** The thickly-forested Kaibab Formation in northern Arizona was once home to a warm, shallow sea—and to a number of newly discovered shark species. David Elliot, professor of geology at NAU, and James Wittke, a geologic materials analyst in the NAU School of Earth Sciences and Environmental Sustainability, were among four authors of a paper published in *Historical Biology: An International Journal of Paleontology* describing what has been revealed to be the world's most diverse collection of Middle Permian era sharks. Among the new species are *Nanoskalme natans* ("swimming dwarf blade"), *Neosaivodus flagstaffensis* ("new Saivodus from Flagstaff") and *Kaibabvenator swiftae* ("Swift's Kaibab hunter"). "We have identified over 30 shark taxa to date", Elliot said. "This is only the first of a projected series of papers that will make the Permian Kaibab Formation a global standard for these organisms."

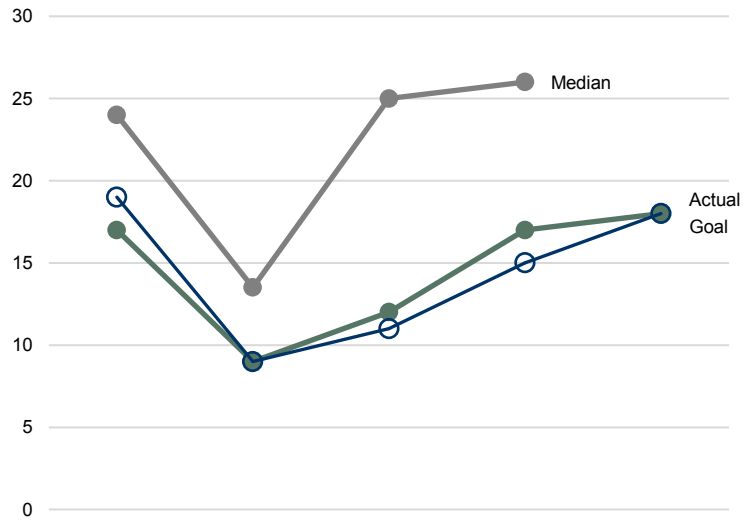
**Rice agriculture linked to global warming through methane production.** Northern Arizona University's Bruce Hungate is among a team of researchers whose study of methane emissions from rice agriculture was published in [Nature Climate Change](#) in FY2013. The researchers studied the published research from 63 different experiments on rice paddies and measured how rising temperatures and extra carbon dioxide in the atmosphere affect both rice yields and the amount of methane released by rice paddies. "Two strong patterns emerged," Hungate said. "First, more CO<sub>2</sub> boosted emissions of methane from rice paddies; and second, higher temperatures caused a decline in rice yields." However, the authors pointed out that there are several ways to reduce methane emissions from rice agriculture. By switching to more heat-tolerant rice cultivars and by adjusting sowing dates, for example, yield declines due to temperature increases can largely be prevented, thereby reducing the effect of warming on methane emissions per yield.

**Project's cropland map of the world to be most detailed ever.** Northern Arizona University assistant research professor Temuulen "Teki" Sankey, a remote sensing ecologist, will work as part of a multi-institute team awarded a five-year, \$3.5 million NASA grant in 2013 to use existing satellite imagery to produce the first-ever global survey of croplands. "This has never been done before at this scale," said Sankey, noting the 30-meter resolution satellite images will allow her and other researchers to identify eight different crops and changes in acreage over the past four decades. Other partners in the project include the U.S. Geological Survey, California State University at Monterey Bay, NASA Ames Research Center, NASA Goddard Space Flight Center, the University of New Hampshire, the University of Wisconsin and Bay Area Environmental Institute. Pictured left: Irrigated crop fields show up as red boxes on this satellite image of the Sonoran Desert.



# Discovery and Scholarly Impact

Invention Disclosures Transacted

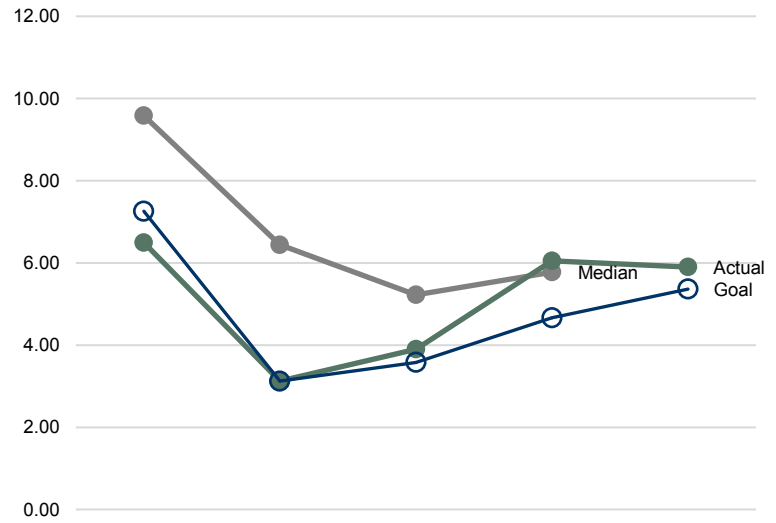


ABOR Enterprise Plan	2009	2010	2011	2012	2013
Actual	17	9	12	17	18
Goal	19	9	11	15	18
Difference	-2	0	1	2	0

ABOR Peer Group	Med. Sch. AUTM Adj.	2009	2010	2011	2012	2013	Rank
University of Akron		58	38	82	63		1
University of Alabama		41	31	30	36		2
Ohio University	X	39			30		3
George Mason University		55	61	46	28		4
University of North Carolina - Greensboro		16	12	30	24		5
Southern Illinois University - Carbondale	X			25	21		6
<b>Northern Arizona University</b>		<b>17</b>	<b>9</b>	<b>12</b>	<b>17</b>	<b>18</b>	<b>7</b>
Northern Illinois University		6	11	7	12		8
Bowling Green State University		12	9	2			
Georgia State University							
Kent State University - Kent		24	15	18			
Old Dominion University							
University of Maine							
University of Nevada - Las Vegas							
Western Michigan University							
Wichita State University							
<b>Median</b>		<b>24</b>	<b>14</b>	<b>25</b>	<b>26</b>		

# Discovery and Scholarly Impact

Invention Disclosures Transacted per \$10 Million in Total Research Expenditures

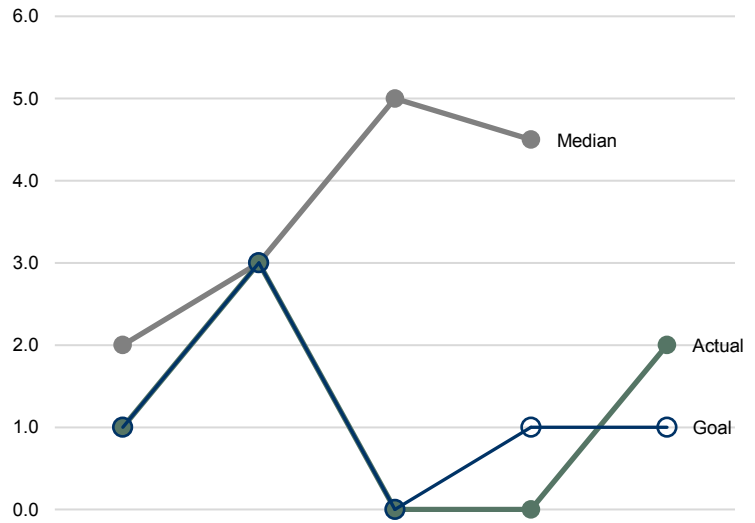


ABOR Enterprise Plan	2009	2010	2011	2012	2013
Actual	6.5	3.1	3.9	6.0	5.9
Goal	7.3	3.1	3.6	4.7	5.4
Difference	-0.8	0.0	0.3	1.4	0.5

ABOR Peer Group	Med. Sch. NSF Adj. AUTM Adj.	2009	2010	2011	2012	2013	Rank
University of North Carolina - Greensboro		15.4	5.3	11.5	12.6		1
University of Akron		16.8	7.2	12.5	9.5		2
University of Alabama		11.2	7.6	5.6	6.4		3
<b>Northern Arizona University</b>		<b>6.5</b>	<b>3.1</b>	<b>3.9</b>	<b>6.0</b>	<b>5.9</b>	<b>4</b>
Northern Illinois University		2.9	4.1	3.2	5.5		5
Ohio University	X	9.5			5.2		6
George Mason University		7.0	7.3	5.2	3.1		7
Southern Illinois University - Carbondale	X			3.5	3.0		8
Bowling Green State University		14.3	11.1	2.2			
Georgia State University							
Kent State University - Kent		9.6	5.7	6.6			
Old Dominion University							
University of Maine							
University of Nevada - Las Vegas							
Western Michigan University							
Wichita State University							
<b>Median</b>		<b>9.6</b>	<b>6.4</b>	<b>5.2</b>	<b>5.8</b>		

# Discovery and Scholarly Impact

U.S. Patents Issued

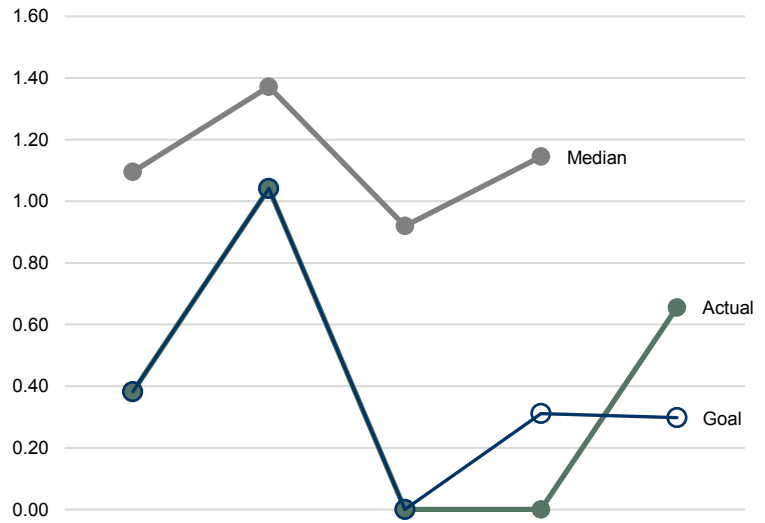


ABOR Enterprise Plan	2009	2010	2011	2012	2013
Actual	1	3	0	0	2
Goal	1	3	0	1	1
Difference	0	0	0	-1	1

ABOR Peer Group	Med. Sch. AUTM Adj.	2009	2010	2011	2012	2013	Rank
George Mason University		7	24	29	22		1
University of Akron		8	9	10	16		2
Ohio University	X	2			9		3
Northern Illinois University		2	1	2	5		4
Southern Illinois University - Carbondale	X			5	4		5
University of Alabama		4	1	3	4		5
University of North Carolina - Greensboro		2	0	0	1		7
<b>Northern Arizona University</b>		<b>1</b>	<b>3</b>	<b>0</b>	<b>0</b>	<b>2</b>	<b>8</b>
Bowling Green State University		1	3	5			
Georgia State University							
Kent State University - Kent		3	8	10			
Old Dominion University							
University of Maine							
University of Nevada - Las Vegas							
Western Michigan University							
Wichita State University							
<b>Median</b>		<b>2</b>	<b>3</b>	<b>5</b>	<b>5</b>		

# Discovery and Scholarly Impact

U.S. Patents Issued per \$10 Million in Total Research Expenditures



ABOR Enterprise Plan	2009	2010	2011	2012	2013
Actual	0.4	1.0	0.0	0.0	0.7
Goal	0.4	1.0	0.0	0.3	0.3
Difference	0.0	0.0	0.0	-0.3	0.4

ABOR Peer Group	Med. Sch. NSF Adj. AUTM Adj.	2009	2010	2011	2012	2013	Rank
George Mason University		0.9	2.9	3.3	2.4		1
University of Akron		2.3	1.7	1.5	2.4		2
Northern Illinois University		1.0	0.4	0.9	2.3		3
Ohio University	X	0.5			1.6		4
University of Alabama		1.1	0.2	0.6	0.7		5
Southern Illinois University - Carbondale	X			0.7	0.6		6
University of North Carolina - Greensboro		1.9	0.0	0.0	0.5		7
<b>Northern Arizona University</b>		<b>0.4</b>	<b>1.0</b>	<b>0.0</b>	<b>0.0</b>	<b>0.7</b>	<b>8</b>
Bowling Green State University		1.2	3.7	5.6			
Georgia State University							
Kent State University - Kent		1.2	3.0	3.6			
Old Dominion University							
University of Maine							
University of Nevada - Las Vegas							
Western Michigan University							
Wichita State University							
<b>Median</b>		<b>1.1</b>	<b>1.4</b>	<b>0.9</b>	<b>1.1</b>		

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## **Economic Development**

Northern Arizona University's impact on the region's economic vitality is significant.

**Public Service.** An important aspect of Northern Arizona University's contribution to economic development in Arizona is the direct impact of public service activities on communities across the state. More than one-quarter of the university's sponsored projects portfolio represents awards for public service projects, and we are focusing on increasing these dollars as much as R&D funding. In FY2013, NAU expended \$16 million through public service activities such as the Otten's Dental



Hygiene Project on the Hopi Reservation, the American Indian Air Quality Training Program, the National Domestic Violence Fatality Review Initiative, and Foster Grandparents and Senior Companion programs. In addition, NAU's commitment to public service is demonstrated through numerous sponsored projects aimed at helping the state's K-12 system through teacher professional development, technology access and other partnerships. For example, in FY2013, NAU received a \$250,000 grant from Arizona Public Service (APS) to launch a new state-wide STEM teacher preparation program. This program, operated in partnership with NAU's Center for

Science Teaching and Learning, allows 12 STEM-focused public schools (K-8) to enhance teacher preparation in science, technology, engineering and math. Another grant for \$281,000 was awarded to NAU for a collaboration with Gilbert Public Schools for the project, "Power Engineering and Physical Science Ideas". This project was funded through the Arizona Department of Education's Mathematics and Science Partnership to boost elementary school science education in Gilbert public schools.

These public service dollars, just like research dollars, contribute to the "bottom line" of the university's direct impact as an economic entity—an impact that is all the more important to the rural regions and small metropolitan areas we serve.

**Intellectual Property Income and Start-up Companies.** The translation of university innovations into commercial products/services and business activity is another important element of the university's economic impact. While licensing activity does not yet reflect increased emphasis on technology transfer since FY2011, NAU did meet its 2020 enterprise goal for intellectual property income in FY2013. In order to enhance our ability to do so going forward, we have implemented a number of programs designed to hasten the transfer of university innovations into the marketplace, thereby generating revenue for the university. For example, Intellectual Property Development (IPD) grants in FY2013 helped a number of investigators prove concepts that form the basis of the novelty of their innovations, while others used these awards to complete the reduction to practice of their inventions—a key step in attracting potential licensees.

By far the most challenging 2020 enterprise goal associated with technology transfer is the licensing of university-developed intellectual property to start-up companies. In FY2013, Northern Arizona University did not meet its goal for this metric. However, lessons learned during our participation in the FY2013 Arizona Furnace technology accelerator will help us be more competitive in FY2014.

**Emulating Biological Actuation.** In August of 2013, NAU received a \$600,000 grant from the National Science Foundation’s “Partnerships for Innovation” program to support the development and commercialization of intellectual property in collaboration with commercial partners iWalk of Boston and Electric Torque Machines of Flagstaff. The project integrates biological inspiration and engineering expertise within a business and economic development context and has the potential to improve the quality of life for millions of disabled Americans. Bioengineering activities include using iWalk’s BiOM prosthesis as a research platform to incorporate a transformative theory—developed at NAU with previous NSF support—for how muscles work into market-accepted innovations in prosthesis actuation and control, with potential broader applications in robotics.

**NAU study estimates financial impact of 2010 Schultz Fire.** Northern Arizona University’s Ecological Restoration Institute and Arizona Rural Policy Institute published a study in 2013 examining the 2010 Schultz Fire and resulting flooding that occurred in the affected areas, estimating the total financial impact of the fire and flooding at between \$133 million and \$147 million. The Schultz Fire



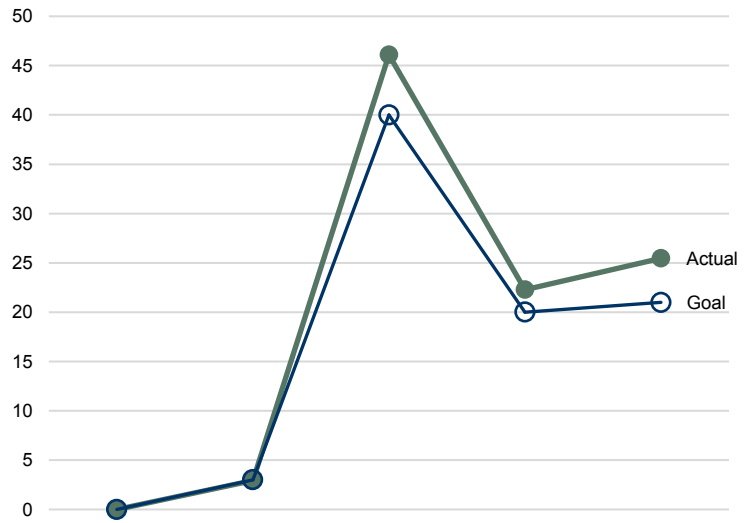
burned 15,000 acres north and west of the city of Flagstaff and resulted in the evacuation of approximately 700 homes. Heavy flooding following the fire inundated property below the burn area and resulted in the death of a 12-year-old girl. The research determined that had the area’s forest undergone thinning of small diameter trees prior to the fire, an investment of

\$15 million, the impact of the fire would have been lessened. “This study demonstrates the value of prevention and the terrible cost of inaction,” said Diane Vosick, director of Policy and Partnerships at the Institute. “It shows that the brunt of forest fire and post-fire flooding can all be avoided by science-supported forest restoration that includes thinning and burning.”

**Grant helps NAU contribute to job creation and environmental cleanup.** Arizona’s environmental and employment outlooks both received a boost in 2013 through a \$200,000 grant from the Environmental Protection Agency. With the funding, NAU’s Institute for Tribal Environmental Professionals will train students for jobs related to cleaning up abandoned uranium mines. The grant targets unemployed residents of the Navajo Nation, particularly those living in areas impacted by uranium mining. “Contributing to environmental workforce development is an important way for NAU to fulfill its mission to the state,” said NAU President John Haeger. Navajo Nation President Ben Shelly said he was pleased with the award. “We have several ongoing cleanup projects and we have a great opportunity to help our own Navajo people get the jobs at these cleanup projects,” Shelly said.

# Economic Development

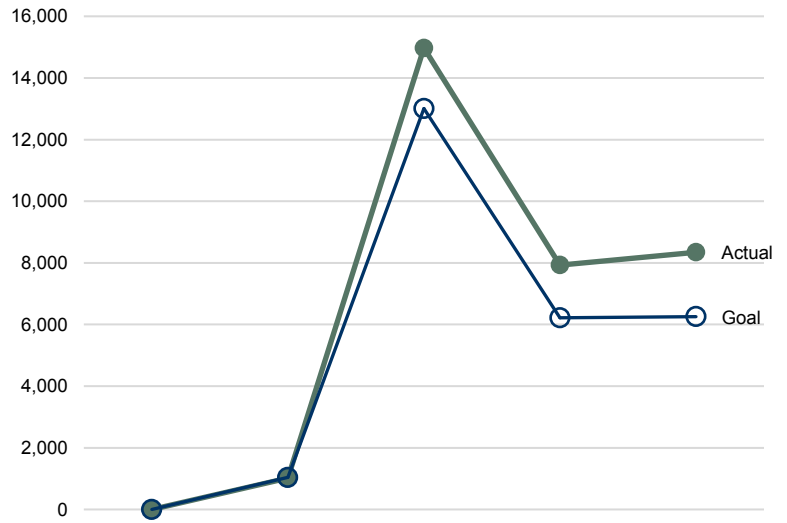
Intellectual Property Income (in Thousands)



ABOR Enterprise Plan	2009	2010	2011	2012	2013
Actual	0	3	46	22	25
Goal	0	3	40	20	21
Difference	0	0	6	2	4

# Economic Development

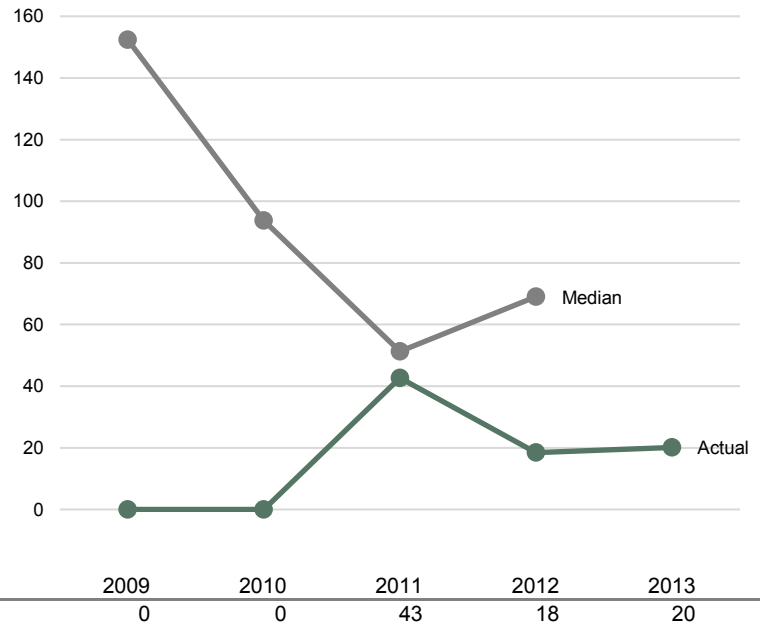
Intellectual Property Income per \$10 Million in Total Research Expenditures



ABOR Enterprise Plan	2009	2010	2011	2012	2013
Actual	0	1,018	14,974	7,928	8,344
Goal	0	1,042	13,008	6,219	6,256
Difference	0	-24	1,966	1,709	2,088

# Economic Development

Licenses and Options Income (in Thousands)

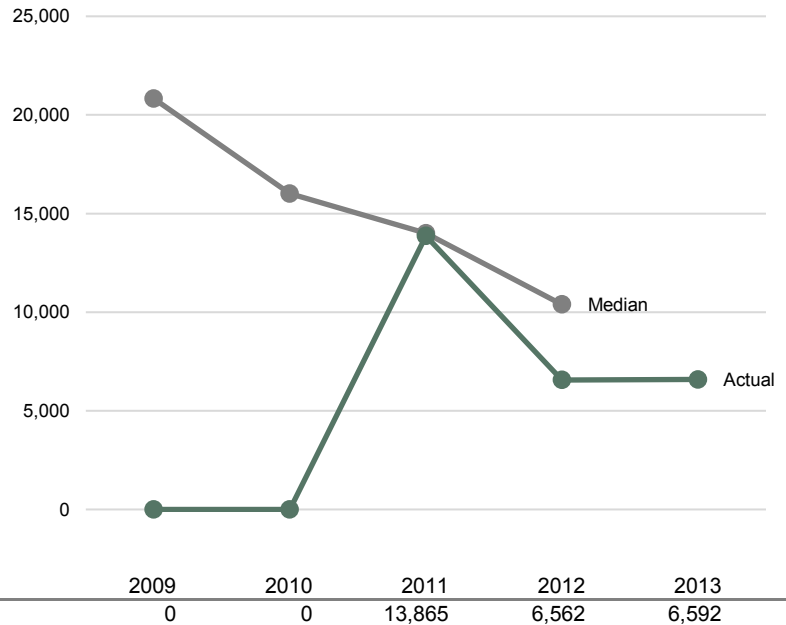


Actual

	Med. Sch. AUTM Adj.	2009	2010	2011	2012	2013	Rank
<b>ABOR Peer Group</b>							
Ohio University	X	6,875			9,400		1
Southern Illinois University - Carbondale	X			677	711		2
University of Akron		455	202	279	336		3
George Mason University		163	110	123	120		4
<b>Northern Arizona University</b>		<b>0</b>	<b>0</b>	<b>43</b>	<b>18</b>	<b>20</b>	<b>5</b>
University of Alabama		5	77	9	18		6
Northern Illinois University		20	10	30	16		7
University of North Carolina - Greensboro		152	121	51	14		8
Bowling Green State University		11	6	2			
Georgia State University							
Kent State University - Kent		339	401	360			
Old Dominion University							
University of Maine							
University of Nevada - Las Vegas							
Western Michigan University							
Wichita State University							
<b>Median</b>		<b>152</b>	<b>94</b>	<b>51</b>	<b>69</b>		

# Economic Development

Licenses and Options Income per \$10 Million in Total Research Expenditures

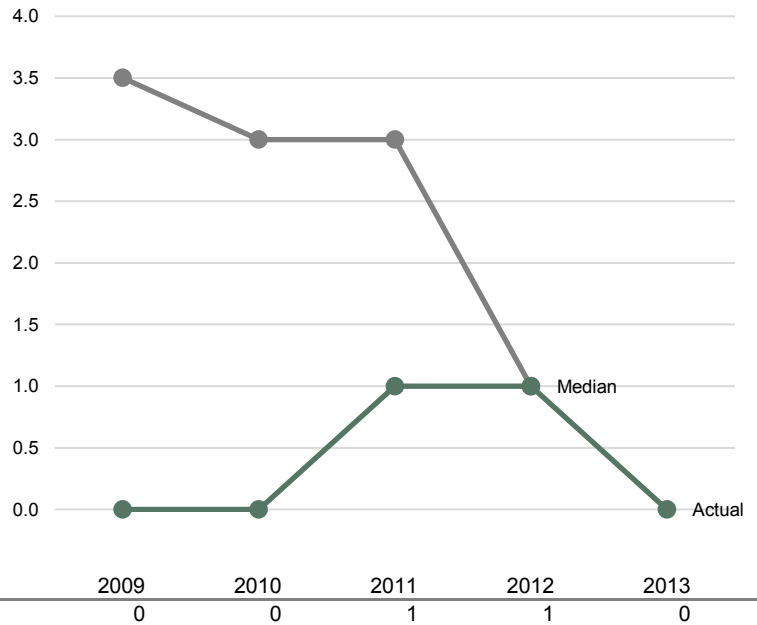


Actual	2009	2010	2011	2012	2013
	0	0	13,865	6,562	6,592

	Med. Sch. NSF Adj. AUTM Adj.	2009	2010	2011	2012	2013	Rank
<b>ABOR Peer Group</b>							
Ohio University	X	1,666,441			1,643,270		1
Southern Illinois University - Carbondale	X			95,207	99,988		2
University of Akron		131,749	38,240	42,518	50,616		3
George Mason University		20,824	13,121	14,005	13,263		4
University of North Carolina - Greensboro		146,579	53,719	19,629	7,517		5
Northern Illinois University		9,446	3,839	13,966	7,273		6
<b>Northern Arizona University</b>		<b>0</b>	<b>0</b>	<b>13,865</b>	<b>6,562</b>	<b>6,592</b>	<b>7</b>
University of Alabama		1,371	18,903	1,602	3,274		8
Bowling Green State University		12,506	7,798	2,545			
Georgia State University							
Kent State University - Kent		135,507	152,380	131,137			
Old Dominion University							
University of Maine							
University of Nevada - Las Vegas							
Western Michigan University							
Wichita State University							
<b>Median</b>		<b>20,824</b>	<b>16,012</b>	<b>14,005</b>	<b>10,390</b>		

# Economic Development

Licenses and Options Executed



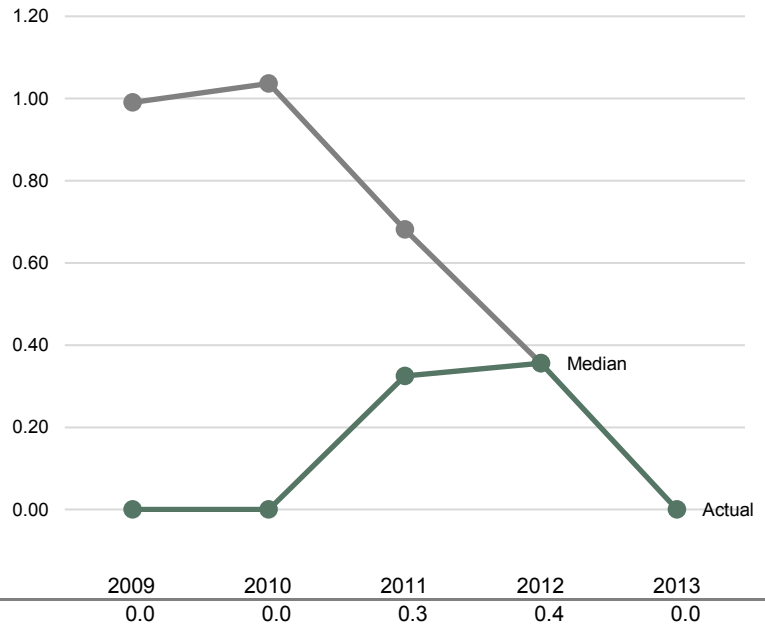
Actual

	Med. Sch. AUTM Adj.	2009	2010	2011	2012	2013	Rank
<b>ABOR Peer Group</b>							
University of Akron		4	10	5	6		1
University of Alabama		3	3	3	4		2
University of North Carolina - Greensboro		8	3	3	2		3
George Mason University		4	6	6	1		4
<b>Northern Arizona University</b>		<b>0</b>	<b>0</b>	<b>1</b>	<b>1</b>	<b>0</b>	<b>4</b>
Northern Illinois University			0	0	0		6
Southern Illinois University - Carbondale	X			5	0		6
Bowling Green State University		3	2	0			
Georgia State University							
Kent State University - Kent		6	8	3			
Ohio University	X	1					
Old Dominion University							
University of Maine							
University of Nevada - Las Vegas							
Western Michigan University							
Wichita State University							
<b>Median</b>		<b>4</b>	<b>3</b>	<b>3</b>	<b>1</b>		



# Economic Development

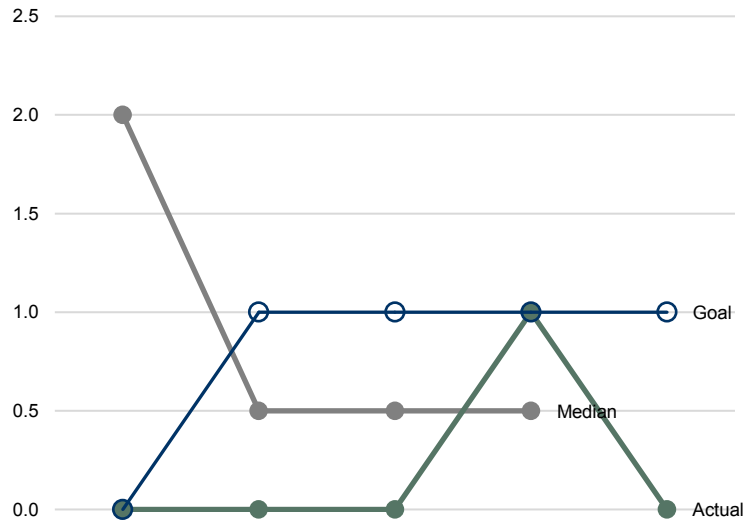
Licenses and Options Executed per \$10 Million in Total Research Expenditures



	Med. Sch. NSF Adj. AUTM Adj.	2009	2010	2011	2012	2013	Rank
<b>ABOR Peer Group</b>							
University of North Carolina - Greensboro		7.7	1.3	1.1	1.0		1
University of Akron		1.2	1.9	0.8	0.9		2
University of Alabama		0.8	0.7	0.6	0.7		3
<b>Northern Arizona University</b>		<b>0.0</b>	<b>0.0</b>	<b>0.3</b>	<b>0.4</b>	<b>0.0</b>	<b>4</b>
George Mason University		0.5	0.7	0.7	0.1		5
Northern Illinois University			0.0	0.0	0.0		6
Southern Illinois University - Carbondale	X			0.7	0.0		6
Bowling Green State University		3.6	2.5	0.0			
Georgia State University							
Kent State University - Kent		2.4	3.0	1.1			
Ohio University	X	0.2					
Old Dominion University							
University of Maine							
University of Nevada - Las Vegas							
Western Michigan University							
Wichita State University							
<b>Median</b>		<b>1.0</b>	<b>1.0</b>	<b>0.7</b>	<b>0.4</b>		

# Economic Development

Startup Companies

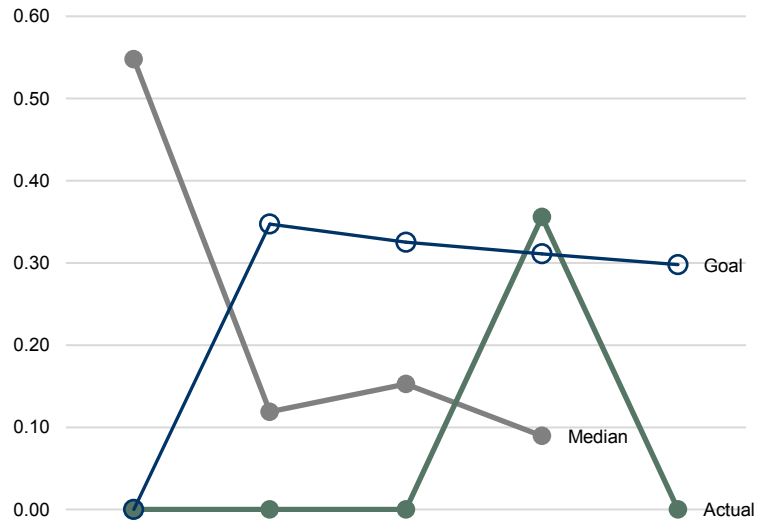


ABOR Enterprise Plan	2009	2010	2011	2012	2013
Actual	0	0	0	1	0
Goal	0	1	1	1	1
Difference	0	-1	-1	0	-1

ABOR Peer Group	Med. Sch. AUTM Adj.	2009	2010	2011	2012	2013	Rank
Ohio University	X				4		1
University of Akron		4	2	2	2		2
<b>Northern Arizona University</b>		<b>0</b>	<b>0</b>	<b>0</b>	<b>1</b>	<b>0</b>	<b>3</b>
University of Alabama		2	0	0	1		3
George Mason University		2	2	4	0		5
Northern Illinois University			0	0	0		5
Southern Illinois University - Carbondale	X				0		5
University of North Carolina - Greensboro		2	1	1	0		5
Bowling Green State University		1	1	0			
Georgia State University							
Kent State University - Kent		1	0	2			
Old Dominion University							
University of Maine							
University of Nevada - Las Vegas							
Western Michigan University							
Wichita State University							
<b>Median</b>		<b>2</b>	<b>1</b>	<b>1</b>	<b>1</b>		

# Economic Development

Startup Companies per \$10 Million in Total Research Expenditures

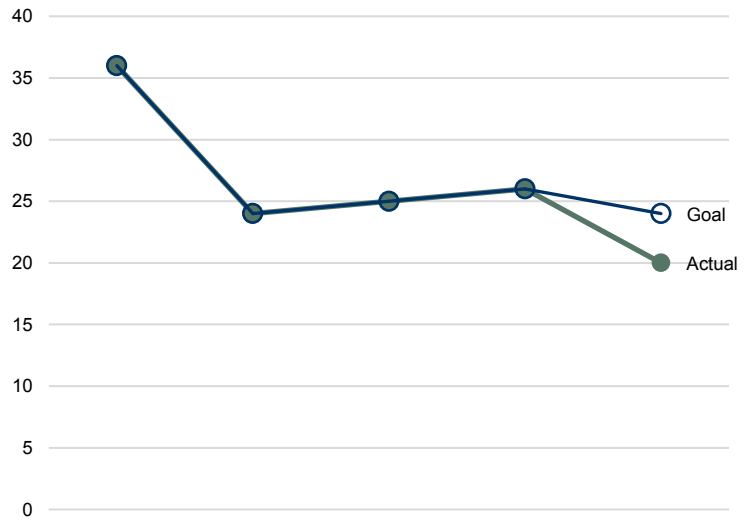


ABOR Enterprise Plan	2009	2010	2011	2012	2013
Actual	0.0	0.0	0.0	0.4	0.0
Goal	0.0	0.3	0.3	0.3	0.3
Difference	0.0	-0.3	-0.3	0.0	-0.3

ABOR Peer Group	Med. Sch. NSF Adj. AUTM Adj.	2009	2010	2011	2012	2013	Rank
Ohio University	X				0.7		1
<b>Northern Arizona University</b>		<b>0.0</b>	<b>0.0</b>	<b>0.0</b>	<b>0.4</b>	<b>0.0</b>	<b>2</b>
University of Akron		1.2	0.4	0.3	0.3		3
University of Alabama		0.5	0.0	0.0	0.2		4
George Mason University		0.3	0.2	0.5	0.0		5
Northern Illinois University			0.0	0.0	0.0		5
Southern Illinois University - Carbondale	X				0.0		5
University of North Carolina - Greensboro		1.9	0.4	0.4	0.0		5
Bowling Green State University		1.2	1.2	0.0			
Georgia State University							
Kent State University - Kent		0.4	0.0	0.7			
Old Dominion University							
University of Maine							
University of Nevada - Las Vegas							
Western Michigan University							
Wichita State University							
<b>Median</b>		<b>0.5</b>	<b>0.1</b>	<b>0.2</b>	<b>0.1</b>		

# Economic Development

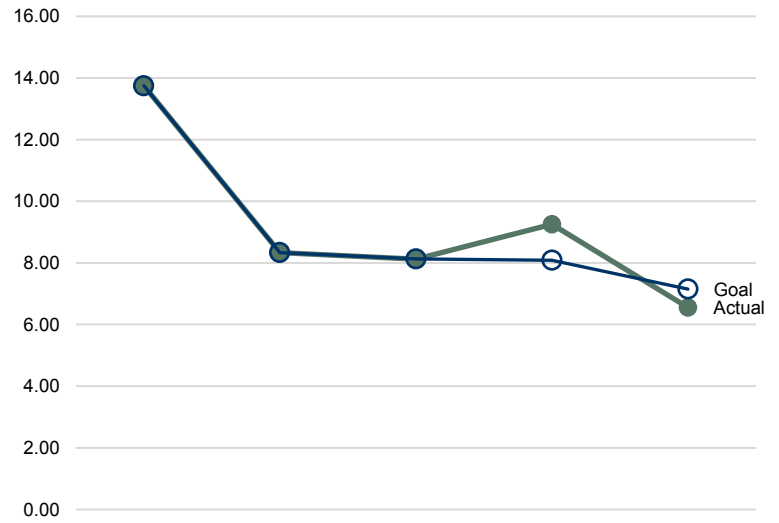
Ph.D. Degrees Conferred



ABOR Enterprise Plan	2009	2010	2011	2012	2013
Actual	36	24	25	26	20
Goal	36	24	25	26	24
Difference	0	0	0	0	-4

# Economic Development

Ph.D. Degrees Conferred per \$10 Million in Total Research Expenditures



ABOR Enterprise Plan	2009	2010	2011	2012	2013
Actual	13.7	8.3	8.1	9.3	6.6
Goal	13.7	8.3	8.1	8.1	7.1
Difference	0.0	0.0	0.0	1.2	-0.6

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## **Leadership and Recognition**

Northern Arizona University seeks to provide regional, national and international leadership through the activities and outcomes of its researchers. The metrics typically used by the nation's largest research institutions rarely provide useful insights for our peer group; ultimately, publication and citation by the research community and awards bestowed upon our researchers are as important as research funds in reflecting the quality and impact of university scholarship.

## **National Academy Members**

As reported last year, we do not currently have members of the National Academies of Science or of Engineering on our faculty. This is the case for most of our peer group as well. Still, the university is home to a number of distinguished and accomplished faculty researchers. National and international recognition of our faculty contributes to our continued success in competing for funding, as well as enhancing the quality of the student experience. Our faculty (even the "stars") virtually all maintain active teaching roles and incorporate many undergraduate students into their research groups; undergraduates frequently report how motivating and helpful it is for their own development to work directly with individuals they know to be "leaders" in the field.



## Leadership and Recognition

*Selected Accomplishments*

### **Keim Named AZBio Bioscience Researcher of the Year**

The Arizona Bioindustry Association awarded Paul Keim, Ph.D., Professor of Biology and Director of the Center for Microbial Genetics and Genomics at NAU and Director of Pathogen Genomics at the Translational Genomics Research Institute (TGen) the Bioscience Researcher of the Year award October 23, 2012 at the 7th Annual AZBio Awards. Dr. Keim was nominated by members of the Arizona Bioscience Community and selected by an independent, statewide panel of leaders for this recognition of his research and innovation in the field of pathogen genomics and microbiology. Dr. Keim's research focuses on the advancement of forensics and genomics analysis of bacterial pathogens. At right: President John Haeger and Provost Laura Huenneke congratulate Regents' Professor Paul Keim (center) on his award.



**Breakfast Event on NAU Energy Innovation.** On April 16, 2013, nearly 60 guests from the Flagstaff area came to NAU to hear about innovative energy research being conducted at Northern Arizona University (NAU).

"Research is a critical part of our mission," noted NAU President John Haeger. "We look for the next places where research can tie into the commercial sector and positively affect the future of northern Arizona." The three speakers at this inaugural event were Tom Acker, who spoke about integrating renewable energy on the grid; Constantin (Cornel) Ciocanel, who described a new super-capacitor that can build power storage into a

system's structure, and Allison Kipple, who discussed creating rugged, efficient appliances, such as refrigerators and water pumps, which operate in off-the-grid systems. Breakfast guests included representatives from business, government, agencies, and the media.

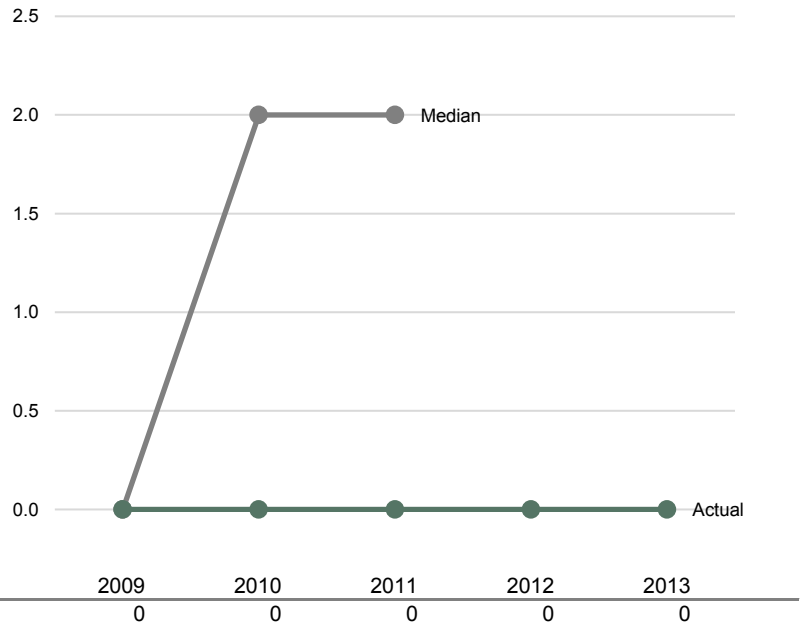
### **Other Notable Accomplishments in FY2013**

- Professor Paul Flikkema, Computer Science and Electrical Engineering, was named a Fulbright-Aalto University (Finland) Distinguished Chair by the Fulbright Scholar Program.
- Shafiu Jibrin, Associate Professor of Mathematics and Statistics (right) was named Fellow of the Arizona-Nevada Academy of Science
- Okim Kang, Assistant Professor of Applied Linguistics, received the TOEFL Outstanding Young Scholar award from the Educational Testing Service.
- Regents' Professor Stan Lindstedt received the August Krogh Award (by the Comparative Physiology Section of the American Physiological Society) at the 2013 Experimental Biology meeting in Boston, MA.



# Leadership and Recognition

National Academy Members

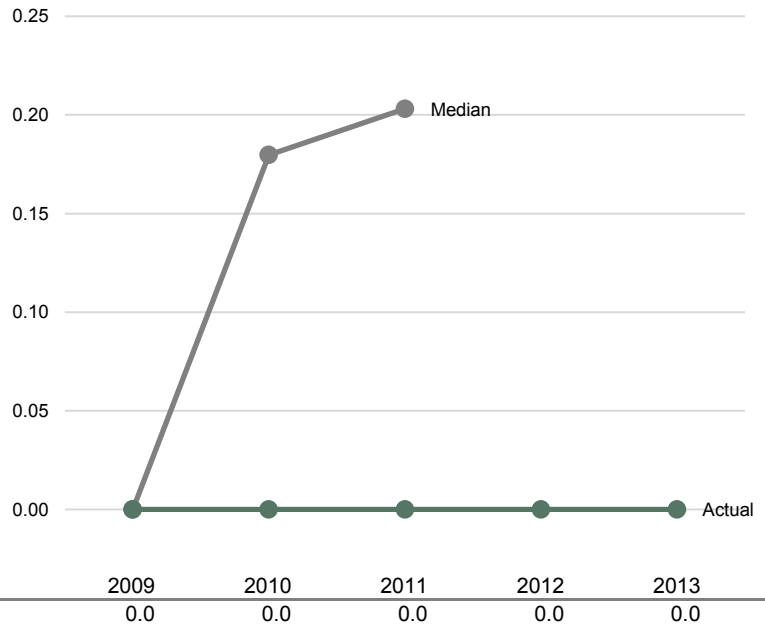


Actual

	Med. Sch.	2009	2010	2011	2012	2013	Rank
<b>ABOR Peer Group</b>							
George Mason University		3	2	2			1
University of Akron		2		2			1
University of Maine		2	2	2			1
<b>Northern Arizona University</b>		<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>4</b>
Bowling Green State University		0					
Georgia State University		0					
Kent State University - Kent		1					
Northern Illinois University		0					
Ohio University	X	0					
Old Dominion University		0					
Southern Illinois University - Carbondale	X	0					
University of Alabama		0					
University of Nevada - Las Vegas		0					
University of North Carolina - Greensboro		0					
Western Michigan University		0					
Wichita State University		0					
<b>Median</b>		<b>0</b>	<b>2</b>	<b>2</b>			

# Leadership and Recognition

National Academy Members per \$10 Million in Total Research Expenditures



Actual

	Med. Sch. NSF Adj.	2009	2010	2011	2012	2013	Rank
<b>ABOR Peer Group</b>							
University of Akron		0.6		0.3			1
George Mason University		0.4	0.2	0.2			2
University of Maine		0.2	0.2	0.2			3
<b>Northern Arizona University</b>		<b>0.0</b>	<b>0.0</b>	<b>0.0</b>	<b>0.0</b>	<b>0.0</b>	<b>4</b>
Bowling Green State University		0.0					
Georgia State University		0.0					
Kent State University - Kent		0.4					
Northern Illinois University		0.0					
Ohio University	X	0.0					
Old Dominion University		0.0					
Southern Illinois University - Carbondale	X	0.0					
University of Alabama		0.0					
University of Nevada - Las Vegas		0.0					
University of North Carolina - Greensboro		0.0					
Western Michigan University		0.0					
Wichita State University		0.0					
<b>Median</b>		<b>0.0</b>	<b>0.2</b>	<b>0.2</b>			

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## **Technology Transfer**

Northern Arizona University encourages its faculty and students to make discoveries and create new knowledge. Customarily, these discoveries are disseminated through articles published in scholarly journals, posters presented at disciplinary conferences, and talks given at scholarly venues. However, another way that NAU disseminates the outcomes of research and scholarship is through technology development and commercialization, or “tech transfer.”

At NAU, technology transfer is more and more becoming an important tool in carrying out our institutional research agenda. As a mechanism for disseminating the outcomes of research, technology transfer at NAU is aimed at helping investigators recognize potential commercial applications for their work, building research partnerships with established companies who may be interested in funding NAU research as well as commercializing university intellectual property, and providing financial support to pursue the development of new ideas. Recognizing the interconnectedness of these efforts with other research enterprise initiatives, in FY2012, the Office of the Vice President for Research established NAU *Innovations*, a branding of the university’s tech transfer operation that combines research and intellectual property development, intellectual property management, and technology commercialization activities. Between FY2012 and FY2013, NAU Innovations added 1.5 staff FTE and is now fully-staffed for the current level of activity at 2.0 staff FTE.



Increases in technology transfer staffing enabled NAU to do more in Technology Transfer in FY2013. NAU Innovations was represented at two major technology conferences in FY2013—TechConnect 2013, held in Washington DC and BIO2013 in Chicago, sponsored by the Biotechnology Industry Organization (BIO), the world’s largest biotechnology trade association. Having a booth at these and similar events is an important aspect of marketing the NAU *Innovations* “brand” as well as for seeking industry research support and potential licensees for specific technologies.

Northern Arizona University’s technology transfer staff is also able to spend more time interacting with researchers through the “in-reach” program—a plan to meet with every faculty member/principal investigator performing funded research at the Mountain Campus. Our in-reach program helps us keep current on the research activities of our faculty and to educate them about the potential commercial applications of their work. In FY2013, these in-reach activities proved very successful, resulting in a significant number of invention disclosures from researchers who had not previously disclosed any intellectual property (more than 20% of the total disclosures submitted). As our in-reach activities become more effective, the number of disclosures received through the in-reach program will decline as more and more researchers learn to recognize the commercial potential of their research outcomes. For example, in FY2013, a higher percentage of disclosures were received spontaneously, and a smaller percentage of disclosures resulted from in-reach efforts, than in FY2012. Overall, however, we received more disclosures than ever before. We love it when a plan comes together!

# Technology Transfer

## Statistical Exhibits



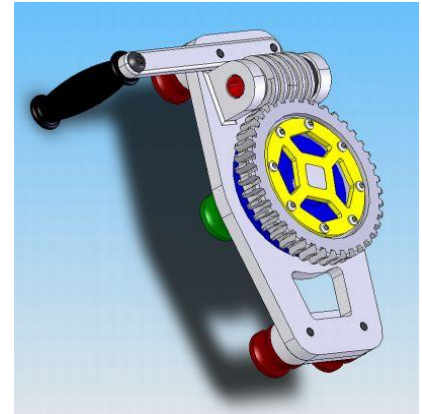
Technology Transfer Activities	2009	2010	2011	2012	2013
Invention Disclosures Transacted	17	9	12	17	18
Invention Disclosures Transacted Year/Year Percentage Change		-47%	33%	42%	6%
New Patent Applications	12	5	5	5	2
New Patent Applications Year/Year Percentage Change		-58%	0%	0%	-60%
U.S. Patents Issued	1	3	0	0	2
U.S. Patents Issued Year/Year Percentage Change		200%	-100%		
Licenses and Options Executed	0	0	1	1	0
Licenses and Options Executed Year/Year Percentage Change				0%	-100%
Other Major Agreements			2	1	1
Other Major Agreements Year/Year Percentage Change				-50%	0%

Licensing and Other Revenue	2009	2010	2011	2012	2013
Licensing Revenue (Including Options)	0	0	42,684	18,439	20,115
Licensee Legal Reimbursements	0	2,931	3,414	3,838	5,347
Other Revenue	0	0	0	0	0
Total	0	2,931	46,098	22,277	25,462

Sponsored Research Facilitated	2009	2010	2011	2012	2013
Total	0	0	0	0	599,804

Royalty Distribution	2009	2010	2011	2012	2013
Inventors	0	0	0	0	0
Laboratories and Units	0	0	0	0	0
University	0	0	0	0	0
Undistributed	0	0	0	0	0

**US 8,444,115 B2** issued May 21, 2013, “Cable Manipulator”. Commercial-grade electrical service is provided to facilities via heavy-duty, large gauge aluminum cable. These cables are currently manipulated manually by utility company linemen. The confined space in which the manipulation occurs, combined with the extreme stiffness of the cable, requires high magnitude forces that may result in soft-tissue repetitive motion injuries to linemen, thereby creating a hazardous work environment. This patent describes an invention which mechanically manipulates commercial-grade electrical cable. Inventors: John Tester (NAU) and Andrew J. Dethlefs (previously an NAU student).



**US 8,318,180 B2** September 27, 2012, “Protective vaccine against Staphylococcus Aureus Biofilms Comprising Cell Wall-Associated Immunogens”, jointly owned with University of Maryland, Baltimore. This patent comprises vaccine formulations effective against Staphylococcus aureus, including MRSA, as well as methods of using the vaccine formulations in the treatment, prevention and prophylaxis of Staphylococcus aureus infections in a human subject. Inventors: Jeff Leid (previously of NAU); Mark Shirtliff and Graeme O’May (University of Maryland).



# Technology Transfer

*Selected Licenses and Options Executed*



# Technology Transfer

*Selected Startup Companies*



### **Northern Arizona University's IP receives National Innovation Award**

NAU's hand-held multi-assay reader, or iTester™, pictured right, received a National Innovation Award at TechConnect, held May 12-17 in Washington, DC. Development of this patent-pending invention was funded through the Technology & Research Initiative Fund (TRIF).



### **NAU teams up with ASU, Dignity Health and others to push out university-developed technologies and catalyze new Arizona start-up companies**

In 2013, NAU participated in the first running of the Arizona Furnace program, a technology-based business accelerator, founded by ASU and funded by the Arizona Commerce Authority and Bioaccel. The Furnace offers selected technologies and IP developed at Arizona research institutions, including Northern Arizona University, for licensing to entrepreneurs with the intent of forming new high-potential start-ups. In its first round, AZ Furnace offered a package worth more than \$50K in cash and services to 10 successful applicants.

# FURNACE



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## **Strategic Initiatives**

### Post-docs bring cutting edge expertise to NAU (Continued from Enterprise Size)

Post-Doc Scholars	Specialty Areas	NAU Mentors	Post-Docs' Ph.D. Institutions
Katy Califf	Bioinformatics	David Wagner	Michigan State University
Foezur Chowdhury	Acoustic Speech Analysis/ Programming	Okim Kang	University of Quebec (Canada)
Fabio Suzart de Albuquerque	Ecology	Paul Beier	Universidad de Alcalá (Spain)
William Flatley	Forestry	Peter Fule	Texas A & M University
David Fortin	Paleoclimatology	Darrell Kaufman, Erik Schiefer	Queen's University (Canada)
Crystal Hepp	Molecular/Cellular Biology	Talima Pearson, Greg Caporaso	Arizona State University
Robert LeMoynes	Biomechanics/ Neuroengineering	Kiisha Nishikawa	University of California (Los Angeles)
Eric Morgan	Wind and Solar Energy	Tom Acker, Paul Flikkema, Brent Nelson	University of Massachusetts
Frances O'Donnell	Ecohydrology	Abe Springer	Princeton University
Paulo Fernando Pentead	Astronomy/Informatics	David Trilling	University of Arizona
Kristen Potter	Acoustics	Richard Hofstetter	University of Arizona
Kees Jan van Groenigen	Environmental Science	Bruce Hungate	Wageningen University (Netherlands)
Chase Williamson	Microbes/Genomics	Jeff Foster	Colorado School of Mines



Richard Hofstetter, NAU Associate Professor in the School of Forestry, said the new Post-doc program may help him get closer to developing a prototype for a patent-pending invention to control insects with acoustic technology. Although Dr. Hofstetter is a forest entomologist and has specialized in wood-infesting insects for more than 20 years, his knowledge and experience using acoustic technologies is limited. Postdoctoral associate Kristen Potter (left) from the University of Arizona brings that expertise to NAU. She will help expand, test, and commercialize the acoustic technology developed by Dr. Hofstetter. "This project directly addresses NAU priorities to promote creativity, innovation, and excellence in research," said Hofstetter. "It will help disseminate new and useful knowledge generated by NAU research for the public benefit, and ultimately it will provide revenue for supporting further NAU research which, in turn, may facilitate the discovery of more inventions and patents."

"To my knowledge, this is something that hasn't been done before in Arizona," says Lesley Cephas, NAU Director of Technology Transfer. "Faculty hire Post-docs all of the time—one at a time. But we're bringing on board 16 Post-docs, relatively simultaneously. Our research community is small enough so that 16 Post-docs should have a tangible impact on NAU's overall research capacity and productivity."

NAU researchers are excited by the possibilities. "After 20 years as a university professor, I have yet to work with a post-doctoral researcher," said Darrell Kaufman, NAU Regent's Professor of Geology. "The time is right to engage a postdoctoral associate to help pursue larger and more sophisticated scientific questions, and to open the door to new research directions and funding opportunities." Kaufman has hired David Fortin (right) from Queen's University in Canada to work with him and Erik Schiefer, NAU Assistant Professor in the Department of Geography, Planning & Recreation, to advance paleoclimatic research. Fortin is developing a modeling and monitoring project for three lake systems—important information for understanding global climate change. Fortin will also help launch NAU's new interdisciplinary Ph.D. program in Earth Sciences & Environmental Sustainability.



Other Post-docs in the program are also increasing NAU's research capacity. As the accompanying table illustrates, they are bringing expertise in the areas of astronomy, biomechanics, ecohydrology, ecology, environmental science, forestry, informatics, microbes and genomics, molecular and cellular biology, speech analysis and programming, and wind and solar energy. For more information about the SPA Program, contact Lesley Cephas.

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**Annual Research Report - FY2013**

I am delighted to bring you this report on the University of Arizona's research activity in fiscal year 2013. In this report we present key highlights of the UA research enterprise as well as specific performance metrics.

Throughout fiscal year 2013, the University of Arizona developed the *Never Settle* strategic academic and business plan. A pillar of this plan is *Innovating*- building on our research strengths to reach a goal of doubling research expenditures, strengthening our infrastructure, enhancing our faculty's creativity and productivity, and facilitating the translation of exciting research developments into products and services that improve the quality of life for Arizonans.

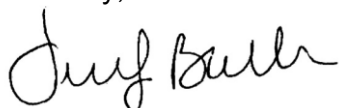
Fiscal year 2013 was one of outstanding achievement. We increased our overall ranking to #29 (#19 in public institutions). Astronomy and Planetary Science continue to be one of the nation's top ranked programs in research expenditures. Our faculty continue to garner prestigious awards, including the National Medal of Technology and Innovation for Gholam Peyman, and the John Simon Guggenheim Memorial Foundation Fellow for Ann Zabudoff. Whether improving health, sustaining our communities, or exploring the cosmos, UA investigators continued to lead with groundbreaking research and innovative technology development. In 2013, UA research and development expenditures totaled \$629M for projects including implementing a new phase of the iPlant cyberinfrastructure, developing high temperature fluids for concentrating solar power systems, training the next generation of cardiovascular scientists, optimizing algal biofuels and bioproducts, and assessing strategies for positive-impact after school programs.



Research undertaken at the University of Arizona furthers and fulfills the mission of the University of Arizona "to provide a comprehensive, high-quality education that engages our students in discovery through research and broad-based scholarship." Every dollar spent on research is returned several-fold in benefits to the university, the community, and future generations. As a result of our strong research programs and expenditures on research, the economic impact of the University of Arizona research enterprise is \$1.2 billion and 8,728 jobs, according to a recent study performed by Tripp Umbach. Research's broader impacts- improving quality of life, extending lifetimes, enriching imaginations, building sustainable communities- are the lasting legacy for Arizonans.

Please enjoy the following pages with additional information on the bold research being undertaken at the University of Arizona.

Sincerely,

A handwritten signature in black ink that reads "Jennifer K. Barton".

Jennifer K. Barton  
Interim Vice President for Research

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**Enterprise Size**

# Enterprise Size

## Introduction

The University of Arizona continued outstanding research and development expenditures, despite a very challenging funding environment. With the budget sequester, 2013 accelerated a precipitous drop in federal research and development funding, with funding down nearly 25% from the peak in 2009. UA is competing very well in this environment, with an increase in ranking from fiscal year 2011 to 2012 (the latest year available) in the National Science Foundation Higher Education Research and Development survey, to 29th among all United States institutions and 19th among public institutions. The total UA research expenditures in fiscal year 2013 was \$629M.

UA continues to excel by building on our strengths and leveraging Technology Research Infrastructure Funds (TRIF). Many of the research areas that have historically been strong at the UA represent strategic target areas to increase our overall performance in external funding, impact, technology transfer and recognition. Seven areas were targeted in the Never Settle plan for doubling research expenditures:

- Water and the Arid Environment
- Space Sciences
- Defense and Security
- Population Health and Health Outcomes
- Healthcare Disparities
- Precision Health
- Neurosciences



T.W. Keating Building  
Credit: John Sartin

Additionally, UA continues to nurture broad-based strengths in:

- Collaborative projects in the arts, humanities, and social sciences
- Regional programs and global collaborations

A robust infrastructure that facilitates cutting-edge research, and a smooth pathway for innovations to reach the marketplace, are also critical for a robust research enterprise. The UA is also focusing on the following enabling resources:

- High-tech shared facilities
- Technology translation through the new Tech Launch Arizona
- Public-private partnerships

Although the total number of faculty is low at UA compared to its ABOR peer institutions, our total research expenditures per faculty is at the median, and showing that our faculty are already very good at attracting and expending research dollars. To achieve our doubling research expenditure goals, the Never Settle plan calls for the hire of 350 high-achieving faculty who will not only bring strong research programs but catalyze existing faculty to enable large and complex projects.

The space available at UA for research is low in absolute terms compared to UA's ABOR-approved peer institutions, yet UA faculty make very efficient use of it, with total UA research expenditures per net assignable square feet exceeding the median. This suggests that UA faculty will be very productive with additional square footage. Fiscal year 2013 saw groundbreaking for the Environment and Natural Resources Building 2, and planning for new Bioresearch and Engineering buildings.

## Enterprise Size

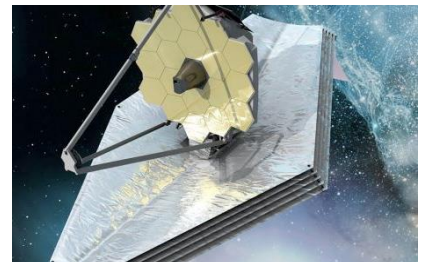
### Selected Accomplishments

- The iPlant Collaborative has been awarded a second 5-year, \$50M project phase from NSF. This program leveraged TRIF funding and the BIO5 Institute to bring together experts from the worlds of biology, bioinformatics and computer science to create a global cyberinfrastructure to process the immense data sets needed to advance life science research. For example, UA plant scientist Eric Lyons created a side-by-side genome comparison tool, making it easier for researchers to identify genes responsible for disease resistance and crop yield.



iPlant Visualization Wall  
Credit: Andrew J Lenards

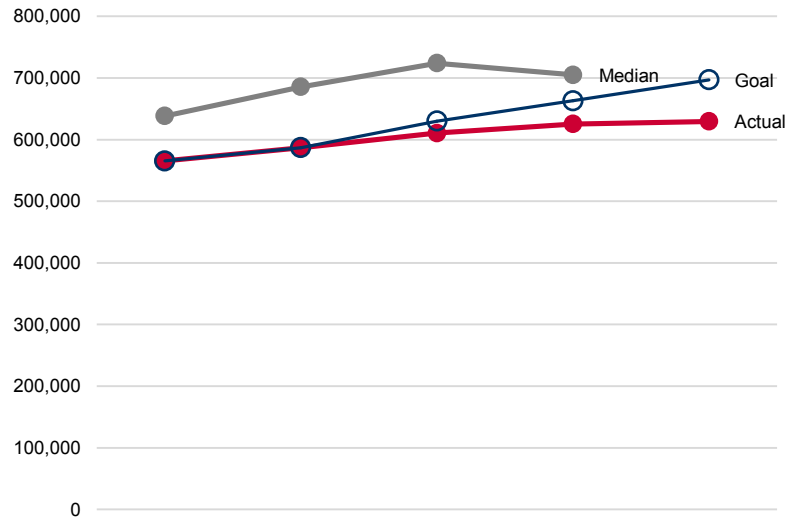
- UA is leading the Regional Algal Feedstock Testbed (RAFT) program, funded by DoE, which will engage industrial, government and academic partners to tackle the problem of large-scale production of algae for fuels, food, and high-value products. The program will develop real time sensors and control strategies, refine cultivation models, and improve system techno-economic models and life cycle assessments.
- Two grants from the National Science Foundation, totaling \$5.4 million, will address significant cybersecurity research and education challenges facing the U.S. The interdisciplinary “Hacker Web” projects integrates a computational framework with algorithms and techniques will allow researchers, policymakers, and industries to better understand the hacker community. AZSecure will support about 40 students over the next five years, who will be immersed in advanced cybersecurity analytics and information assurance for placement in government agencies and industry.
- The University of Arizona Early Phase Chemoprevention Consortium led by UA Cancer Center researchers Sherry Chow and Dr. David Alberts has been awarded \$9.6M by the NIH to conduct early-phase clinical trials to evaluate the safety, clinical activity and biological effects of novel cancer preventive agents. This new award will encourage collaboration among clinicians and researchers across the UA College of Medicine. A previous award funded early-phase clinical trials of compounds in breast, cervical, prostate, melanoma and esophageal cancer prevention.
- Under a partnership between UA and Lockheed Martin, the instrument that will form the heart of NASA's James Webb Space Telescope has been assembled and delivered to NASA Goddard Space Flight Center. The UA and Lockheed Martin are responsible for the NIRCam instrument optical, mechanical, structural, thermal and electronic precision mechanisms. As the space telescope's prime instrument, NIRCam will peer deeper into space and time than any other instrument before.
- Sean Limesand has received an award from the Bill & Melinda Gates Foundation Achieving Healthy Growth program within the Grand Challenges in Global Health initiative for his research on the fetal response to stress hormones in the womb. The Limesand team plans to determine if intervention to correct adrenaline dysregulation can improve muscle growth and metabolism, lowering the risk for metabolic disorders.



Rendering of JWST  
with NIRCam

# Enterprise Size

Total Research Expenditures (in Thousands)



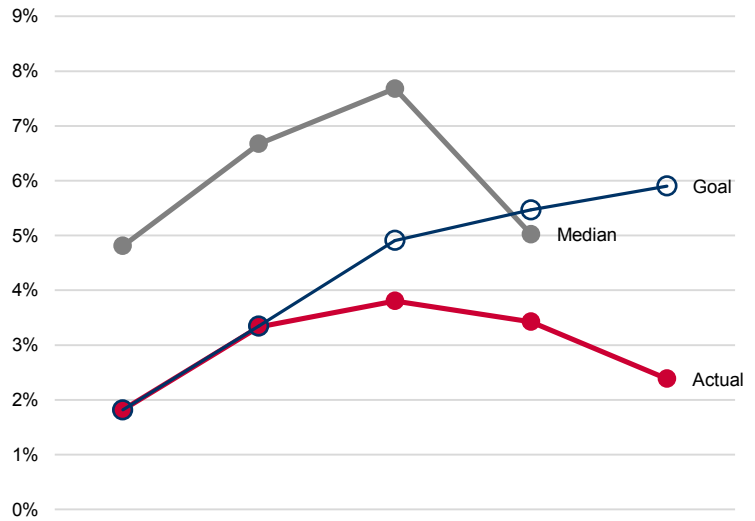
ABOR Enterprise Plan	2009	2010	2011	2012	2013
Actual	565,292	586,647	610,565	625,365	629,466
Goal	565,292	586,932	630,000	663,000	697,000
Difference	0	-285	-19,435	-37,635	-67,534

ABOR Peer Group	Med. Sch. NSF Adj.	2009	2010	2011	2012	2013	Rank
University of Wisconsin - Madison	X	952,119	1,029,295	1,111,642	1,169,779		1
University of Washington	X	778,046	1,022,740	1,148,533	1,109,008		2
University of California - Los Angeles	X	889,995	936,995	982,357	1,003,375		3
University of North Carolina - Chapel Hill	X	646,011	755,284	869,174	884,791		4
University of Minnesota	X	740,980	786,074	847,419	826,173		5
Pennsylvania State University, All Campuses	X	753,358	770,449	794,846	797,679		6
The Ohio State University	X	716,461	755,194	832,126	766,513		7
University of California - Davis	X	681,618	679,915	707,896	713,292		8
University of Florida	X	592,082	681,548	739,931	696,985		9
Texas A&M University		630,655	689,624	705,720	693,421		10
<b>The University of Arizona</b>	<b>X</b>	<b>565,292</b>	<b>586,647</b>	<b>610,565</b>	<b>625,365</b>	<b>629,466</b>	<b>11</b>
University of Texas - Austin		506,369	589,502	632,171	621,538		12
University of Illinois - Urbana - Champaign		563,710	515,133	545,669	583,754		13
Michigan State University	X	373,184	431,373	454,248	507,061		14
University of Maryland - College Park		409,190	451,415	495,382	502,406		15
University of Iowa	X	329,901	444,034	443,893	446,429		16
<b>Median</b>		<b>638,333</b>	<b>685,586</b>	<b>723,914</b>	<b>705,139</b>		



# Enterprise Size

Average Growth Rate in Total Research Expenditures Over 3 Years

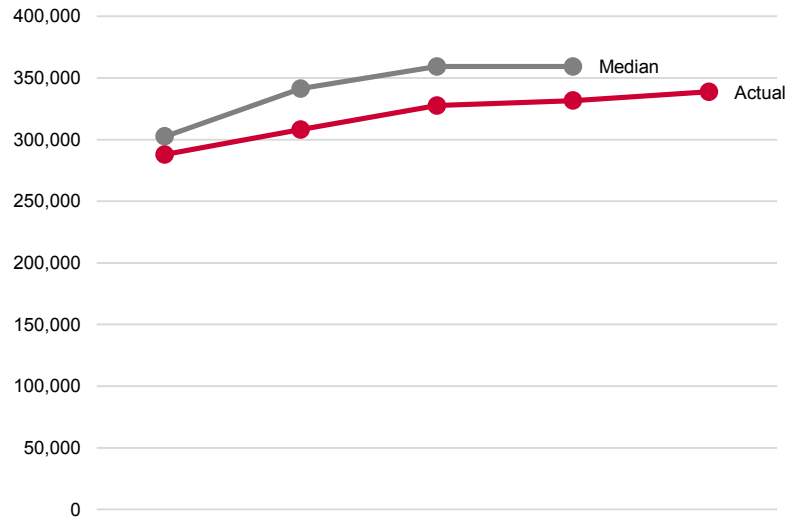


ABOR Enterprise Plan	2009	2010	2011	2012	2013
Actual	1.8%	3.3%	3.8%	3.4%	2.4%
Goal	1.8%	3.3%	4.9%	5.5%	5.9%
Difference	0	0	-1.1%	-2.0%	-3.5%

ABOR Peer Group	Med. Sch. NSF Adj.	2009	2010	2011	2012	2013	Rank
University of Washington	X	0.0%	11.4%	15.1%	13.4%		1
University of Iowa	X	-0.6%	9.3%	15.6%	11.7%		2
University of North Carolina - Chapel Hill	X	13.5%	16.7%	18.3%	11.3%		3
Michigan State University	X	1.4%	6.4%	8.5%	10.8%		4
University of Texas - Austin		5.5%	9.8%	8.8%	7.3%		5
University of Maryland - College Park		5.0%	7.9%	7.9%	7.2%		6
University of Wisconsin - Madison	X	4.6%	7.0%	8.0%	7.1%		7
University of Florida	X	1.6%	5.0%	8.3%	6.0%		8
University of California - Los Angeles	X	3.1%	4.4%	4.1%	4.1%		9
University of Minnesota	X	7.6%	8.0%	7.5%	3.8%		10
<b>The University of Arizona</b>	<b>X</b>	<b>1.8%</b>	<b>3.3%</b>	<b>3.8%</b>	<b>3.4%</b>	<b>2.4%</b>	<b>11</b>
Texas A&M University		8.6%	8.2%	6.7%	3.3%		12
The Ohio State University	X	3.3%	1.6%	5.9%	2.6%		13
Pennsylvania State University, All Campuses	X	5.4%	5.7%	4.3%	1.9%		14
University of California - Davis	X	6.0%	4.3%	3.3%	1.5%		15
University of Illinois - Urbana - Champaign		5.9%	3.2%	3.3%	1.4%		16
<b>Median</b>		<b>4.8%</b>	<b>6.7%</b>	<b>7.7%</b>	<b>5.0%</b>		

# Enterprise Size

Federally Financed Research Expenditures (in Thousands)

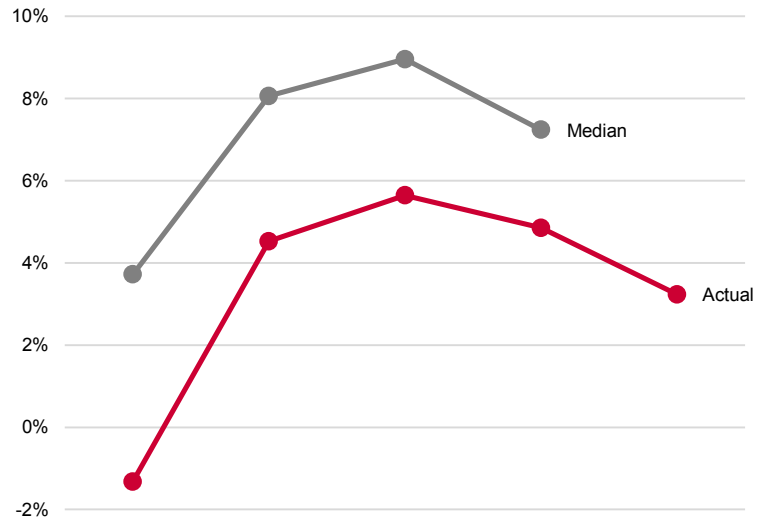


	2009	2010	2011	2012	2013
<b>Actual</b>	287,889	308,157	327,565	331,578	338,790

ABOR Peer Group	Med. Sch. NSF Adj.	2009	2010	2011	2012	2013	Rank
University of Washington	X	619,353	829,885	948,976	909,652		1
University of North Carolina - Chapel Hill	X	431,837	545,993	600,843	606,348		2
University of Wisconsin - Madison	X	507,898	545,189	593,633	580,661		3
University of California - Los Angeles	X	467,505	538,521	563,560	539,054		4
Pennsylvania State University, All Campuses	X	439,193	464,750	468,705	531,421		5
University of Minnesota	X	390,602	426,359	489,480	485,462		6
The Ohio State University	X	339,820	399,942	493,130	445,635		7
University of Illinois - Urbana - Champaign		288,013	303,852	323,454	359,989		8
University of California - Davis	X	295,924	332,325	362,976	358,577		9
University of Texas - Austin		309,125	350,308	355,437	354,873		10
University of Maryland - College Park		246,985	297,896	338,780	340,180		11
<b>The University of Arizona</b>	<b>X</b>	<b>287,889</b>	<b>308,157</b>	<b>327,565</b>	<b>331,578</b>	<b>338,790</b>	<b>12</b>
University of Florida	X	232,737	279,649	306,349	305,067		13
University of Iowa	X	252,336	282,465	283,627	269,734		14
Texas A&M University		261,491	288,173	291,812	269,460		15
Michigan State University	X	164,198	214,134	240,837	268,952		16
<b>Median</b>		<b>302,525</b>	<b>341,317</b>	<b>359,207</b>	<b>359,283</b>		

# Enterprise Size

Average Growth Rate in Federally Financed Research Expenditures Over 3 Years

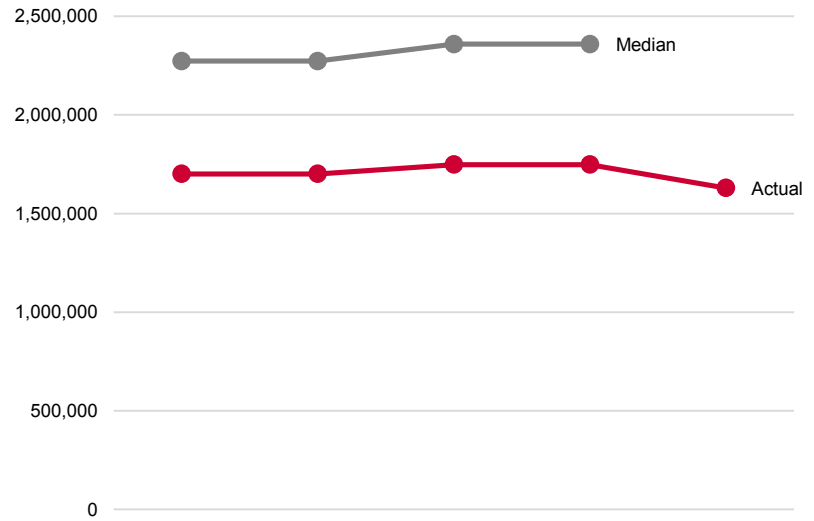


	2009	2010	2011	2012	2013
Actual	-1.3%	4.5%	5.6%	4.9%	3.2%

ABOR Peer Group	Med. Sch. NSF Adj.	2009	2010	2011	2012	2013	Rank
Michigan State University	X	-0.7%	9.2%	16.8%	18.2%		1
University of Washington	X	-1.6%	11.3%	16.4%	14.7%		2
University of North Carolina - Chapel Hill	X	9.6%	16.6%	17.4%	12.5%		3
University of Maryland - College Park		5.6%	11.0%	12.9%	11.6%		4
The Ohio State University	X	2.5%	8.7%	14.1%	10.5%		5
University of Florida	X	-2.1%	5.6%	10.2%	9.8%		6
University of Illinois - Urbana - Champaign		3.0%	6.2%	6.6%	7.7%		7
University of Minnesota	X	6.2%	8.1%	10.4%	7.7%		8
University of California - Davis	X	6.1%	9.0%	10.5%	6.8%		9
Pennsylvania State University, All Campuses	X	6.2%	7.8%	4.9%	6.7%		10
University of California - Los Angeles	X	-1.1%	3.6%	6.3%	5.2%		11
University of Texas - Austin		4.4%	6.9%	3.4%	4.9%		12
<b>The University of Arizona</b>	<b>X</b>	<b>-1.3%</b>	<b>4.5%</b>	<b>5.6%</b>	<b>4.9%</b>	<b>3.2%</b>	<b>13</b>
University of Wisconsin - Madison	X	1.2%	5.2%	7.8%	4.7%		14
University of Iowa	X	5.3%	8.3%	7.4%	2.5%		15
Texas A&M University		8.2%	8.1%	6.0%	1.3%		16
<b>Median</b>		<b>3.7%</b>	<b>8.1%</b>	<b>9.0%</b>	<b>7.2%</b>		

# Enterprise Size

Net Assignable Square Feet

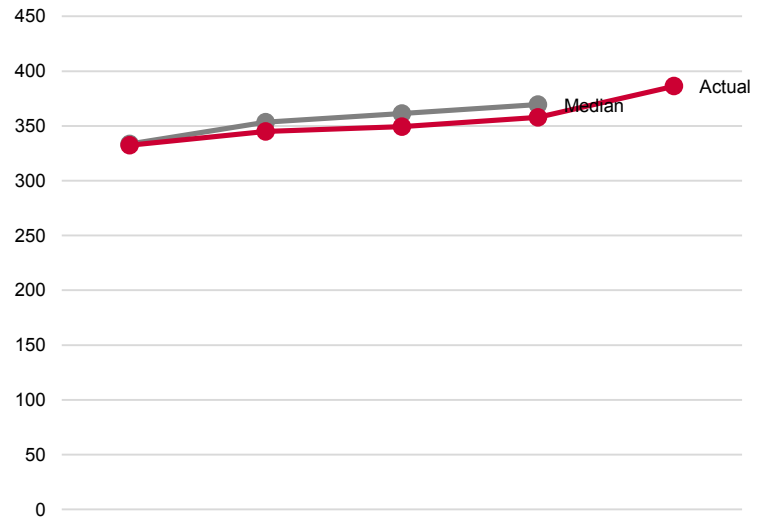


	2009	2010	2011	2012	2013
<b>Actual</b>	1,700,749	1,700,749	1,748,035	1,748,035	1,629,762

ABOR Peer Group	Med. Sch. NSF Adj.	2009	2010	2011	2012	2013	Rank
University of Illinois - Urbana - Champaign		4,561,500	4,561,500	4,631,400	4,631,400		1
University of Minnesota	X	3,684,378	3,684,378	3,531,048	3,531,048		2
University of Florida	X	3,081,524	3,081,524	3,038,164	3,038,164		3
University of Wisconsin - Madison	X	2,844,272	2,844,272	2,935,571	2,935,571		4
Pennsylvania State University, All Campuses	X	2,997,579	2,997,579	2,929,245	2,929,245		5
University of California - Davis	X	2,660,052	2,660,052	2,927,180	2,927,180		6
University of California - Los Angeles	X	2,496,563	2,496,563	2,632,450	2,632,450		7
Texas A&M University		2,222,041	2,222,041	2,443,234	2,443,234		8
Michigan State University	X	2,324,423	2,324,423	2,274,375	2,274,375		9
University of Washington	X	1,795,359	1,795,359	1,874,449	1,874,449		10
<b>The University of Arizona</b>	<b>X</b>	<b>1,700,749</b>	<b>1,700,749</b>	<b>1,748,035</b>	<b>1,748,035</b>	<b>1,629,762</b>	<b>11</b>
University of Texas - Austin		1,480,462	1,480,462	1,478,523	1,478,523		12
The Ohio State University	X	1,487,468	1,487,468	1,447,310	1,447,310		13
University of North Carolina - Chapel Hill	X	1,662,923	1,662,923	1,223,219	1,223,219		14
University of Maryland - College Park		712,085	712,085	769,581	769,581		15
University of Iowa	X	616,700	616,700	659,913	659,913		16
<b>Median</b>		<b>2,273,232</b>	<b>2,273,232</b>	<b>2,358,805</b>	<b>2,358,804.5</b>		

# Enterprise Size

Total Research Expenditures per Net Assignable Square Foot

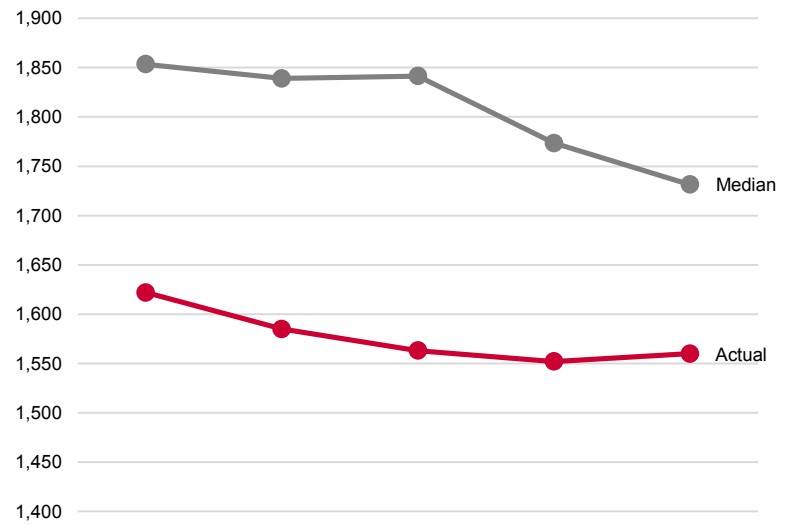


	2009	2010	2011	2012	2013
Actual	332	345	349	358	386

	Med. Sch. NSF Adj.	2009	2010	2011	2012	2013	Rank
<b>ABOR Peer Group</b>							
University of North Carolina - Chapel Hill	X	388	454	711	723		1
University of Iowa	X	535	720	673	676		2
University of Maryland - College Park		575	634	644	653		3
University of Washington	X	433	570	613	592		4
The Ohio State University	X	482	508	575	530		5
University of Texas - Austin		342	398	428	420		6
University of Wisconsin - Madison	X	335	362	379	398		7
University of California - Los Angeles	X	356	375	373	381		8
<b>The University of Arizona</b>	<b>X</b>	<b>332</b>	<b>345</b>	<b>349</b>	<b>358</b>	<b>386</b>	<b>9</b>
Texas A&M University		284	310	289	284		10
Pennsylvania State University, All Campuses	X	251	257	271	272		11
University of California - Davis	X	256	256	242	244		12
University of Minnesota	X	201	213	240	234		13
University of Florida	X	192	221	244	229		14
Michigan State University	X	161	186	200	223		15
University of Illinois - Urbana - Champaign		124	113	118	126		16
<b>Median</b>		<b>334</b>	<b>353</b>	<b>361</b>	<b>369.5</b>		

# Enterprise Size

Total Faculty Population

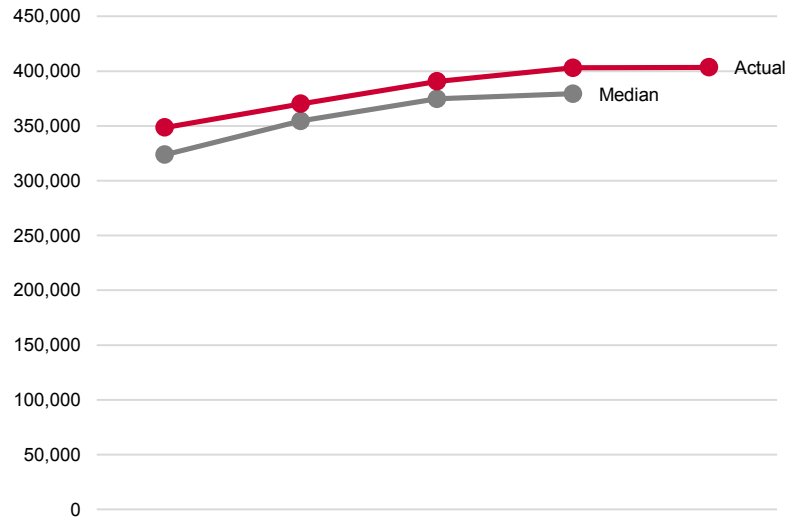


	2009	2010	2011	2012	2013
Actual	1,622	1,585	1,563	1,552	1,560

ABOR Peer Group	Med. Sch. NSF Adj.	2009	2010	2011	2012	2013	Rank
University of Florida	X	2,775	2,696	2,701	2,647	2,493	1
The Ohio State University	X	2,605	2,602	2,560	2,511	2,489	2
University of Minnesota	X	2,377	2,319	2,277	2,251	2,412	3
University of Wisconsin - Madison	X	2,053	2,047	2,057	2,014	2,067	4
University of North Carolina - Chapel Hill	X	1,804	1,833	1,861	1,876	1,948	5
University of Texas - Austin		1,913	1,981	1,954	1,910	1,910	6
University of California - Los Angeles	X	1,829	1,840	1,822	1,776	1,747	7
Michigan State University	X	1,921	1,948	1,906	1,883	1,732	8
Pennsylvania State University, All Campuses	X	1,757	1,748	1,759	1,763	1,731	9
Texas A&M University		1,878	1,838	1,871	1,771	1,710	10
University of Illinois - Urbana - Champaign		1,883	1,856	1,778	1,707	1,710	10
University of Iowa	X	1,599	1,572	1,527	1,538	1,576	12
<b>The University of Arizona</b>	<b>X</b>	<b>1,622</b>	<b>1,585</b>	<b>1,563</b>	<b>1,552</b>	<b>1,560</b>	<b>13</b>
University of Washington	X	1,568	1,548	1,536	1,525	1,487	14
University of Maryland - College Park		1,485	1,472	1,463	1,501	1,483	15
University of California - Davis	X	1,466	1,498	1,467	1,421	1,423	16
Median		1,854	1,839	1,842	1,774	1,732	

# Enterprise Size

Total Research Expenditures per Faculty

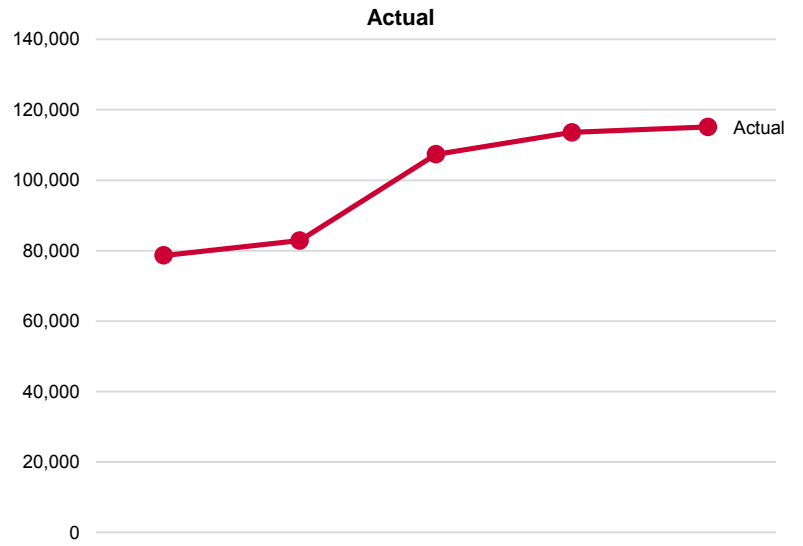


	2009	2010	2011	2012	2013
<b>Actual</b>	<b>348,515</b>	<b>370,124</b>	<b>390,637</b>	<b>402,941</b>	<b>403,504</b>

ABOR Peer Group	Med. Sch. NSF Adj.	2009	2010	2011	2012	2013	Rank
University of Washington	X	496,203	660,685	747,743	727,218		1
University of Wisconsin - Madison	X	463,770	502,831	540,419	580,824		2
University of California - Los Angeles	X	486,602	509,236	539,164	564,963		3
University of California - Davis	X	464,951	453,882	482,547	501,965		4
University of North Carolina - Chapel Hill	X	358,099	412,048	467,047	471,637		5
Pennsylvania State University, All Campuses	X	428,775	440,760	451,874	452,455		6
<b>The University of Arizona</b>	<b>X</b>	<b>348,515</b>	<b>370,124</b>	<b>390,637</b>	<b>402,941</b>	<b>403,504</b>	<b>7</b>
Texas A&M University		335,812	375,203	377,189	391,542		8
University of Minnesota	X	311,729	338,971	372,165	367,025		9
University of Illinois - Urbana - Champaign		299,368	277,550	306,900	341,977		10
University of Maryland - College Park		275,549	306,668	338,607	334,714		11
University of Texas - Austin		264,699	297,578	323,527	325,413		12
The Ohio State University	X	275,033	290,236	325,049	305,262		13
University of Iowa	X	206,317	282,464	290,696	290,266		14
Michigan State University	X	194,265	221,444	238,325	269,284		15
University of Florida	X	213,363	252,800	273,947	263,311		16
<b>Median</b>		<b>323,771</b>	<b>354,548</b>	<b>374,677</b>	<b>379,283</b>		

# Enterprise Size

Other Sponsored Project Expenditures (in Thousands)

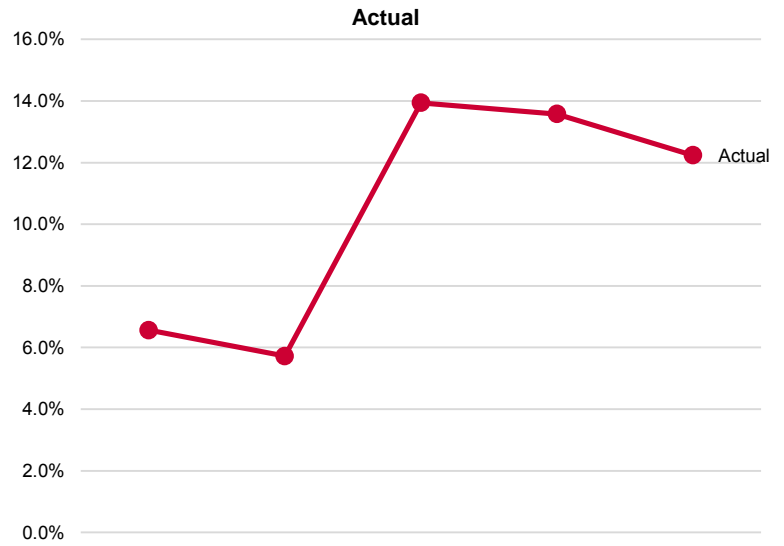


ABOR Enterprise Plan	2009	2010	2011	2012	2013
Actual	78,629	82,855	107,365	113,559	115,105



# Enterprise Size

Average Growth Rate in Other Sponsored Project Expenditures Over 3 Years



ABOR Enterprise Plan	2009	2010	2011	2012	2013
Actual	6.6%	5.7%	13.9%	13.6%	12.2%

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**Discovery and Scholarly Impact**

UA is committed to not only generating new knowledge, but also sharing discoveries with Arizona and the world where they will improve well-being. Further, this activity is a conversation- a two-way street. UA scholars and researchers engage in a partnership with industry, foundations, governmental organizations, and citizen to assess needs, generate novel ideas and solutions, develop technology, and assess effectiveness.

As a first step, to be effective, **discoveries must be communicated** to wide public, professional, and research audiences. Faculty members have always communicated their research results in professional publications. According to Thomson Reuters Web of Science, University of Arizona investigators published approximately 4,400 articles in fiscal year 2013 in high impact journals. The National Taiwan University Performance Ranking of Scientific Papers places UA #44 in the world, and #33 in the US, normalized for faculty size.

Beyond publication of results, **inventions must be put to practical and beneficial use** through technology transfer and commercialization. As stated in the *Never Settle* plan, UA will advance research that innovates, engages students to increase recruitment and retention, and partners with our local and global community to address social, cultural, and economic needs. Translation of technology, whether it is bench-to bedside, bench-to-field, or bench-to-marketplace, continues to be a major goal. New efforts in research development, enhancing biomedical clinical trials infrastructure, continuing emphasis on cooperative extension, and the new Technology Transfer Arizona facilitate this goal.

One benchmark of our success in impacting the greater community is the number of **invention disclosures and patents** made by our researchers. Disclosures totaled 144 in fiscal year 2013, and the number of patents issued was 21. The number of patents applied for was 108, representing a 10% increase over FY 2012. Additional information about disclosures and patents is included in the Technology Transfer section.

UA is also **fostering interaction with communities** to provide more direct societal benefits. This is accomplished through a comprehensive program of knowledge dissemination and public programs aimed at health, environmental and regional stewardship, community and economic development, life-long learning, and access to arts and culture. UA offerings range from an Arizona Telemedicine program to introduce middle school students to medical science coursework and life-long responsibility for their health, to engaging citizen scientists with programs such as Tumamoc Hill, where hikers are helping researchers track changes in plant life. Gary Nabhan, a research scientist at the UA's Southwest Center, is overseeing the project where dozens of participants fill in sheets with observations on buds, flowers, fruits and sightings of pollinators at three elevation zones on the 700-foot hill. Hugely popular series such as the Humanities Seminars and the 2013 Science Lecture Series "Genomics Now" continue to draw members of the community to UA.



Tumamoc Hill citizen science.  
Credit azstarnet.com

# Discovery and Scholarly Impact

## Selected Accomplishments

- Three UA faculty members have been conferred with the prestigious rank of Regents' Professor: Neal Armstrong, Xiaohui Fan and Hsinchun Chen. Chemistry and Optical Sciences professor Armstrong is considered one of the leading global scientists and scholars in the field of advanced solar cell technologies. UA astronomy professor Fan investigates objects dating back billions of years as well as younger objects to determine what actions occurred to shape the universe. Eller College of Management professor Chen determine how to best utilize "big data" for societal benefits, including such as building massive, easily accessible digital libraries and being able to identify and curtail cyber attacks.
- UA launched the STEM Learning Center, a nexus where researchers, educators, parents, students, businesses and industry, community organizations and regional policy leaders will join forces to improve an economic and civic future around the STEM fields, from primary school to graduate school.
- To foster translation of novel techniques from the medical imaging researcher to the patient, a partnership between UA, University of Arizona Health Network, and Siemens Medical Systems has been created. Scanning protocols created by UA researchers on a 3T Magnetic Resonance Imaging (MRI) unit located in the UA Biomedical Research Labs can be directly translated across the street to an identical unit at the University of Arizona Medical Center, providing patients with state of the art care.
- Two Foundations are supporting the efforts of UA researchers to improve the lives of young people. The Ford Foundation is supporting the Crossroads Collaborative, which engages youth in creative processes and discussion about local practices and policies, while demonstrating how youth can be engaged, informed, and able to make choices about their lives. The Virginia G. Piper Charitable Trust is granting more than \$1 million to fund a University of Arizona project aimed at improving after-school programs in Maricopa County. The project will assess programs and provide rigorous methods of improving program quality.
- A UA team led by Kacey Ernst has been awarded more than \$2 million by the NIH to track populations of the mosquito *Aedes aegypti*, a dangerous carrier of the virus that causes dengue, along a geographic line from Guaymas in southern Sonora, Mexico to Tucson. Their work will investigate social, environmental, and climate factors that affect transmission.



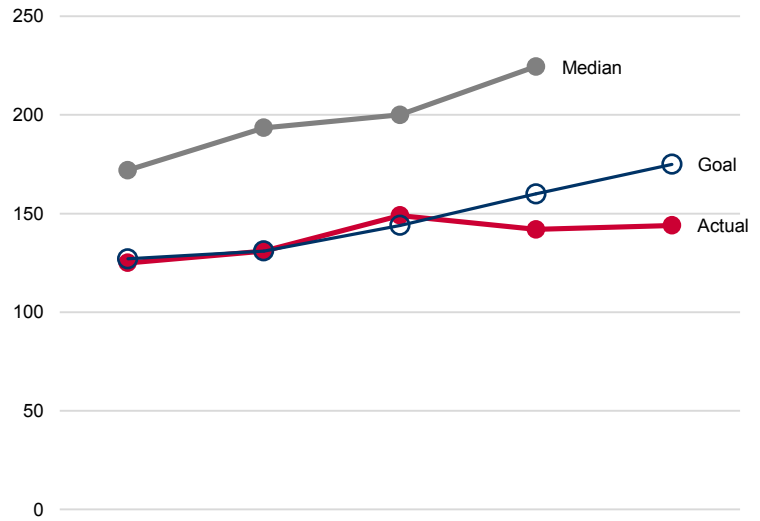
Research 3T MRI



Capturing mosquitos

# Discovery and Scholarly Impact

Invention Disclosures Transacted

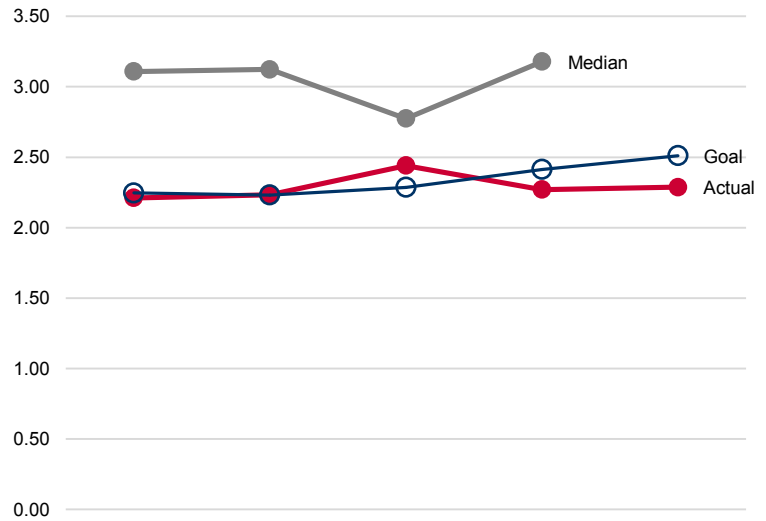


ABOR Enterprise Plan	2009	2010	2011	2012	2013
Actual	125	131	149	142	144
Goal	127	131	144	160	175
Difference	-2	0	5	-18	-31

ABOR Peer Group	Med. Sch. AUTM Adj.	2009	2010	2011	2012	2013	Rank
University of Washington	X	349	354	356	462		1
University of Wisconsin - Madison	X	333	356	357	373		2
University of Florida	X	304	295	322	345		3
University of California - Los Angeles	X	333	379	299	343		4
University of Minnesota	X	244	255	250	321		5
The Ohio State University	X	163	173	216	319		6
University of California - Davis	X	172	245	184	226		7
University of Illinois - Urbana - Champaign			180	182	223		8
Texas A&M University		196	207	284	212		9
University of North Carolina - Chapel Hill	X	137	125	142	160		10
<b>The University of Arizona</b>	<b>X</b>	<b>125</b>	<b>131</b>	<b>149</b>	<b>142</b>	<b>144</b>	<b>11</b>
Pennsylvania State University, All Campuses	X	119	133	144	132		12
Michigan State University	X	129	116	110	127		13
University of Iowa	X	70	70	68	102		14
University of Maryland - College Park							
University of Texas - Austin							
<b>Median</b>		<b>172</b>	<b>194</b>	<b>200</b>	<b>225</b>		

# Discovery and Scholarly Impact

Invention Disclosures Transacted per \$10 Million in Total Research Expenditures

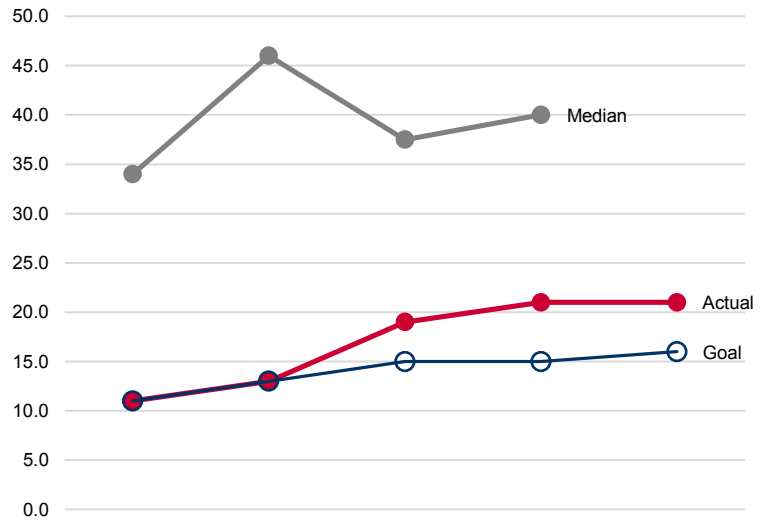


ABOR Enterprise Plan	2009	2010	2011	2012	2013
Actual	2.2	2.2	2.4	2.3	2.3
Goal	2.2	2.2	2.3	2.4	2.5
Difference	0.0	0.0	0.2	-0.1	-0.2

ABOR Peer Group	Med. Sch. NSF Adj. AUTM Adj.	2009	2010	2011	2012	2013	Rank
University of Florida	X	5.1	4.3	4.4	4.9		1
University of Washington	X	4.5	3.5	3.1	4.2		2
The Ohio State University	X	2.3	2.3	2.6	4.2		3
University of Minnesota	X	3.3	3.2	3.0	3.9		4
University of Illinois - Urbana - Champaign			3.5	3.3	3.8		5
University of California - Los Angeles	X	3.7	4.0	3.0	3.4		6
University of Wisconsin - Madison	X	3.5	3.5	3.2	3.2		7
University of California - Davis	X	2.5	3.6	2.6	3.2		8
Texas A&M University		3.1	3.0	4.0	3.1		9
Michigan State University	X	3.5	2.7	2.4	2.5		10
University of Iowa	X	2.1	1.6	1.5	2.3		11
<b>The University of Arizona</b>	<b>X</b>	<b>2.2</b>	<b>2.2</b>	<b>2.4</b>	<b>2.3</b>	<b>2.3</b>	<b>12</b>
University of North Carolina - Chapel Hill	X	2.1	1.7	1.6	1.8		13
Pennsylvania State University, All Campuses	X	1.6	1.7	1.8	1.7		14
University of Maryland - College Park							
University of Texas - Austin							
<b>Median</b>		<b>3.1</b>	<b>3.1</b>	<b>2.8</b>	<b>3.2</b>		

# Discovery and Scholarly Impact

U.S. Patents Issued



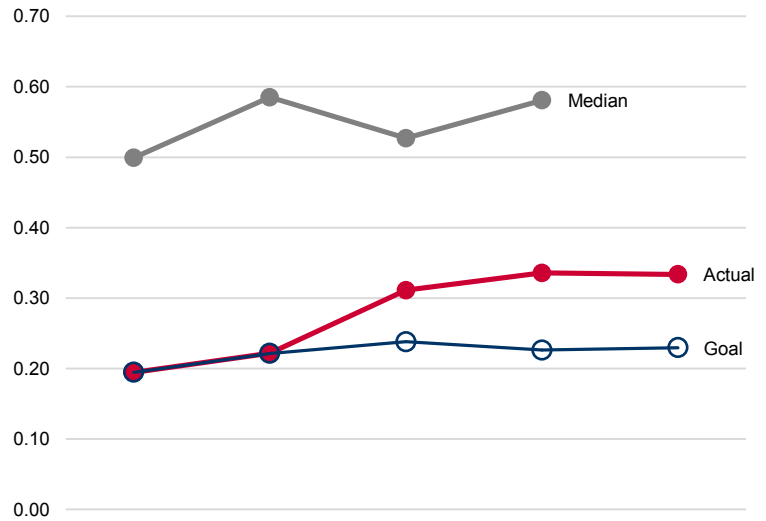
ABOR Enterprise Plan	2009	2010	2011	2012	2013
Actual	11	13	19	21	21
Goal	11	13	15	15	16
Difference	0	0	4	6	5

ABOR Peer Group	Med. Sch. AUTM Adj.	2009	2010	2011	2012	2013	Rank
University of Wisconsin - Madison	X	119	133	156	153		1
University of Illinois - Urbana - Champaign				68	76		2
University of California - Los Angeles	X	60	47	56	74		3
University of Washington	X	40	69	70	61		4
University of Florida	X	73	59	86	60		5
University of Minnesota	X	37	46	41	59		6
The Ohio State University	X	20	38	30	41		7
Pennsylvania State University, All Campuses	X	34	54	37	39		8
Michigan State University	X	41	52	38	31		9
University of Iowa	X	30	32	31	31		9
University of North Carolina - Chapel Hill	X	19	27	33	31		9
Texas A&M University		20	33	18	29		12
University of California - Davis	X	24	29	23	26		13
<b>The University of Arizona</b>	<b>X</b>	<b>11</b>	<b>13</b>	<b>19</b>	<b>21</b>	<b>21</b>	<b>14</b>
University of Maryland - College Park							
University of Texas - Austin							
<b>Median</b>		<b>34</b>	<b>46</b>	<b>38</b>	<b>40</b>		



# Discovery and Scholarly Impact

U.S. Patents Issued per \$10 Million in Total Research Expenditures



ABOR Enterprise Plan	2009	2010	2011	2012	2013
Actual	0.2	0.2	0.3	0.3	0.3
Goal	0.2	0.2	0.2	0.2	0.2
Difference	0.0	0.0	0.1	0.1	0.1

ABOR Peer Group	Med. Sch. NSF Adj. AUTM Adj.	2009	2010	2011	2012	2013	Rank
University of Wisconsin - Madison	X	1.2	1.3	1.4	1.3		1
University of Illinois - Urbana - Champaign				1.2	1.3		2
University of Florida	X	1.2	0.9	1.2	0.9		3
University of California - Los Angeles	X	0.7	0.5	0.6	0.7		4
University of Minnesota	X	0.5	0.6	0.5	0.7		5
University of Iowa	X	0.9	0.7	0.7	0.7		6
Michigan State University	X	1.1	1.2	0.8	0.6		7
University of Washington	X	0.5	0.7	0.6	0.6		8
The Ohio State University	X	0.3	0.5	0.4	0.5		9
Pennsylvania State University, All Campuses	X	0.5	0.7	0.5	0.5		10
Texas A&M University		0.3	0.5	0.3	0.4		11
University of California - Davis	X	0.4	0.4	0.3	0.4		12
University of North Carolina - Chapel Hill	X	0.3	0.4	0.4	0.4		13
<b>The University of Arizona</b>	<b>X</b>	<b>0.2</b>	<b>0.2</b>	<b>0.3</b>	<b>0.3</b>	<b>0.3</b>	<b>14</b>
University of Maryland - College Park							
University of Texas - Austin							
<b>Median</b>		<b>0.5</b>	<b>0.6</b>	<b>0.5</b>	<b>0.6</b>		

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**Economic Development**

The University of Arizona serves as a **major economic driver** for Tucson and Arizona. The University's research strengths drive economic development activities through leading edge research initiatives, new inventions, technology commercialization, and innovative public-private partnerships. The Office of the Senior Vice President for Research (OSVPR) and Tech Launch Arizona (TLA) work together to create a smooth innovation pipeline from discovery to development to economic and citizen benefit.

In a significant and **national-leading modification** of promotion and tenure processes/ guidelines, UA now fully recognizes the critical role of of partnering and economic development during faculty reviews. Community engagement, industry partnership, and technology transfer activities fulfill a central role in the UA's overall mission of creating a positive impact on the Tucson and Arizona economies, and is reflected as a critical component of the *Never Settle* Strategic Plan,

**Tech Parks Arizona** (TPA), a unit within TLA, is a significant economic engine for Tucson, Pima County, and the state of Arizona. TPA helps to attract new businesses and grow existing ones, launch new companies, commercialize new technologies and create high-paying jobs. Annually, TPA's economic impact is more than \$2.47 billion in Pima County, a number that is on top of the \$1.2 billion impact of research conducted at UA.

- TPA is home to 45 tenant companies that employ 5,961 people, with a total impact of 12,739 direct, indirect, and induced jobs.
- The average annual salary for TPA employees is \$70,854, compared to the Pima County average of \$41,304.
- TPA generated approximately \$42.5 million in tax revenues for state, county, and city governments.



UA Tech Park, looking northwest.

UA is driving **workforce development activities** to create the pool of highly-skilled employees at multiple education levels needed to serve the growth of current industry and attract new companies to the region. As one example, TPA is partnering with Pima County, Tucson Regional Economic Opportunities, Arizona Commerce Authority and others to develop a regional advanced technology manufacturing hub and workforce training center. In another, UA has enhanced its Professional Science Masters program, which equips students with both strong science/engineering know-how and business/ management skills in preparation for professional career opportunities to serve Arizona needs. Specialties include Applied Biosciences, Medical Physics, and the Lowell Program in Economic Geology

UA continues to **innovate in pre- and post-doctoral training**, preparing the next generation of scholars and leaders. New programs provide the training necessary for a variety of careers, including government, research communications, industry, as well as academic positions, thus creating a diverse workforce that is prepared to succeed in a collaborative environment regardless of chosen career. An example is the Carson scholars, who receive communications training for stakeholder outreach as well as awareness of policy and governance needs in science.

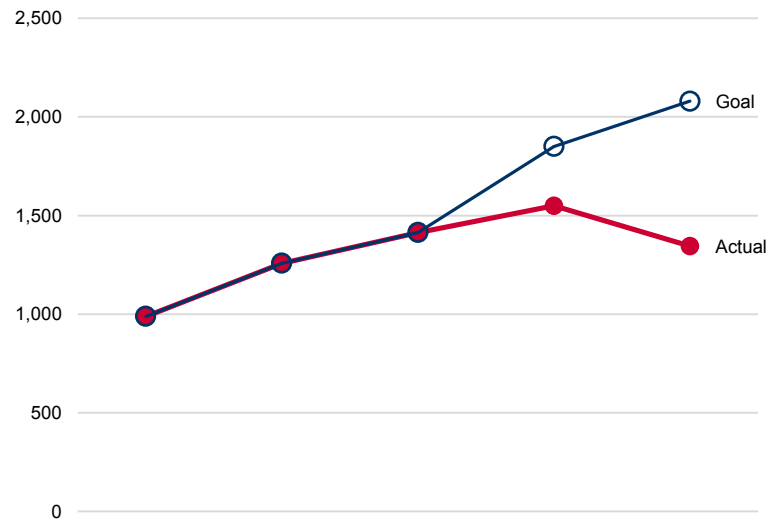
- During FY 2013, UA and the City of Tucson (Mayor and City Council) initiated a city-funded **Commercialization Network Alliance** designed to build network capacity within the Tucson and Southern Arizona related communities.
- TLA established a **domain expert network** called the Wheelhouse Network. This group connects UA investigators and their inventions with specific interested, informed, and committed individuals who are drawn on to advance technology opportunities. From a base of 150 at the end of fiscal year 2013, on the way to a 750+ member network, Wheelhouse Network helps assess, understand, and position technologies based on commercial and social relevance. Members include alumni, entrepreneurs, investors, and civic leaders. Each of 46 separate technologies averaged 3.5 distinct domain expert interactions.
- The **Border Technology Evaluation Center** (BorderTEC) located at TPA accomplished two milestones during FY 2013. First, the Tech Park successfully recruited DRS Technologies, a subsidiary of Finmeccania, a leading provider of Border and Force Protection Systems in the domestic and international marketplace. It opened the Border Security Systems Integration Laboratory (SIL) at the TPA, which is attracting both national and international attention in the defense and homeland security sector. A Border Technology Showcase highlighting UA's National Center for Excellence in Border Security and Immigration (BORDERS), and an integrated fixed tower system being developed by DRS Technologies, drew federal and state homeland security officials, representatives of regional law enforcement agencies, executives of border technology companies, workforce development experts and university researchers.
- **410 Ph.D. degrees were awarded** for 2012/2013 to UA students. An additional 409 other doctoral degrees (e.g. medicine, law, pharmacy) were awarded. UA launched the Grad Center, an initiative to enhance recruiting and support structures for graduate students.
- U.S. News and World Report gave **top-10 national rankings** to the following UA graduate programs:
  - #1 in Geology (and #7 in the overall category of Earth Sciences)
  - #4 in Information Systems (up from #5 in 2012)
  - #5 in Speech-Language Pathology (same ranking)
  - #5 in Social Psychology (up from #6 in 2012)
  - #6 in Analytical Chemistry (same ranking)
  - #6 in Rehabilitation Counseling (same ranking)
  - #7 in Atomic, Molecular, and Optical Physics (same ranking)
  - #9 in Ecology and Evolutionary Biology (same ranking)
  - #9 in Latin American History (moved into top 10)
  - #10 in Pharmacy (same ranking)
  - #10 in Geochemistry (same ranking)



DRS Border Tower,  
Credit: Mike Cristy, Arizona Daily

# Economic Development

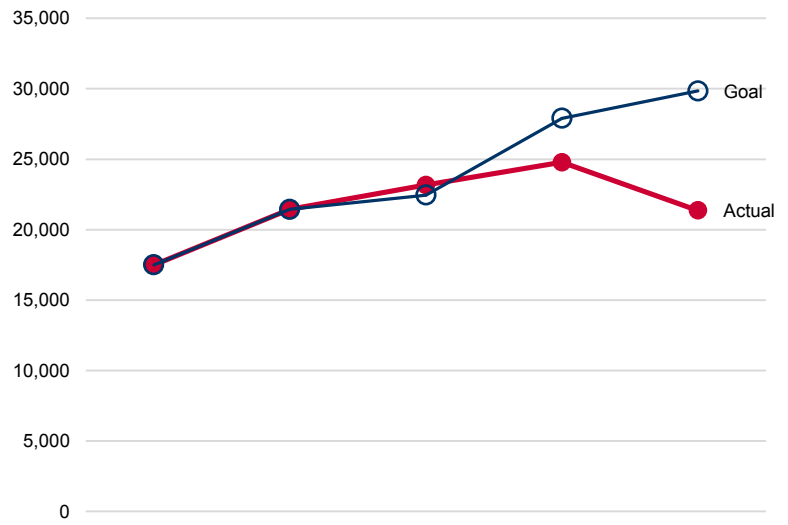
Intellectual Property Income (in Thousands)



ABOR Enterprise Plan	2009	2010	2011	2012	2013
Actual	989	1,258	1,414	1,550	1,345
Goal	989	1,258	1,414	1,850	2,080
Difference	0	0	0	-300	-735

# Economic Development

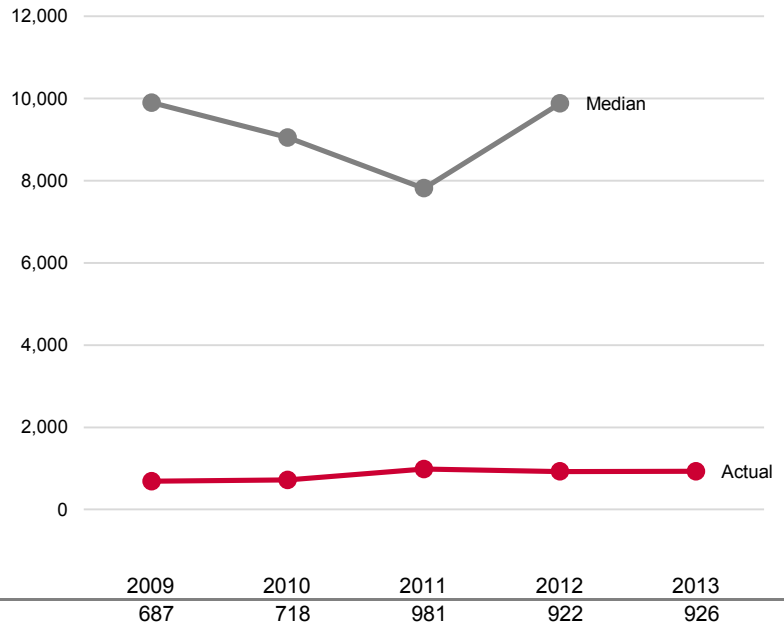
Intellectual Property Income per \$10 Million in Total Research Expenditures



ABOR Enterprise Plan	2009	2010	2011	2012	2013
Actual	17,497	21,450	23,164	24,778	21,364
Goal	17,497	21,439	22,449	27,903	29,842
Difference	0	10	715	-3,125	-8,479

# Economic Development

Licenses and Options Income (in Thousands)

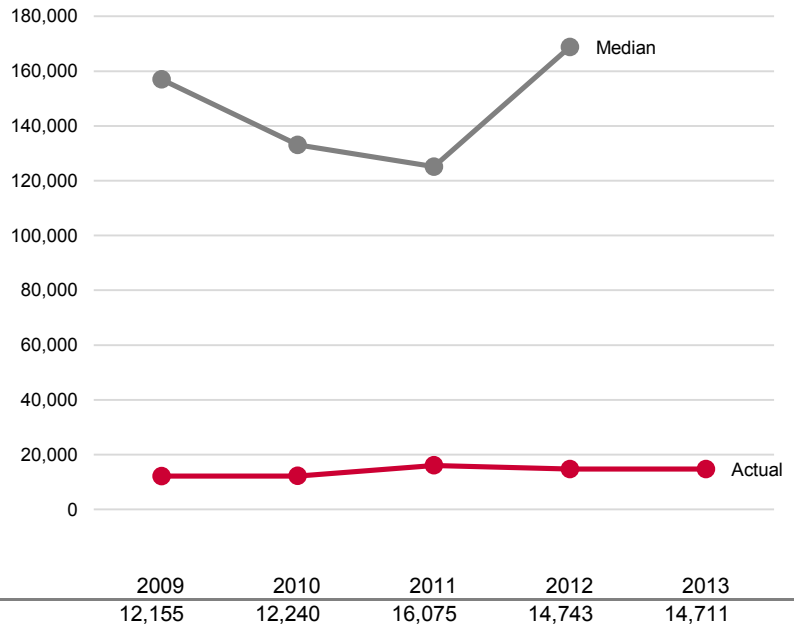


		2009	2010	2011	2012	2013	
Actual		687	718	981	922	926	
<b>ABOR Peer Group</b>	<b>Med. Sch. AUTM Adj.</b>	<b>2,009</b>	<b>2,010</b>	<b>2,011</b>	<b>2,012</b>	<b>2,013</b>	<b>Rank</b>
University of Washington	X	87,340	69,032	67,362	76,956		1
University of Minnesota	X	95,169	83,906	10,079	45,652		2
University of Wisconsin - Madison	X	56,714	54,300	57,730	41,100		3
University of Florida	X	53,880	29,235	29,494	33,922		4
University of California - Los Angeles	X	22,557	27,485	16,153	17,833		5
Texas A&M University		9,898	8,621	9,264	13,074		6
University of California - Davis	X	9,845	9,048	10,233	12,525		7
University of Iowa	X	42,922	26,991	6,285	7,234		8
University of Illinois - Urbana - Champaign				6,363	6,410		9
Michigan State University	X	4,449	4,017	3,616	3,704		10
Pennsylvania State University, All Campuses	X	1,227	2,271	2,947	3,095		11
University of North Carolina - Chapel Hill	X	3,064	2,598	1,483	2,414		12
The Ohio State University	X	1,712	1,907	1,420	2,170		13
<b>The University of Arizona</b>	<b>X</b>	<b>687</b>	<b>718</b>	<b>981</b>	<b>922</b>	<b>926</b>	<b>14</b>
University of Maryland - College Park							
University of Texas - Austin							
<b>Median</b>		<b>9,898</b>	<b>9,048</b>	<b>7,813</b>	<b>9,880</b>		



# Economic Development

Licenses and Options Income per \$10 Million in Total Research Expenditures

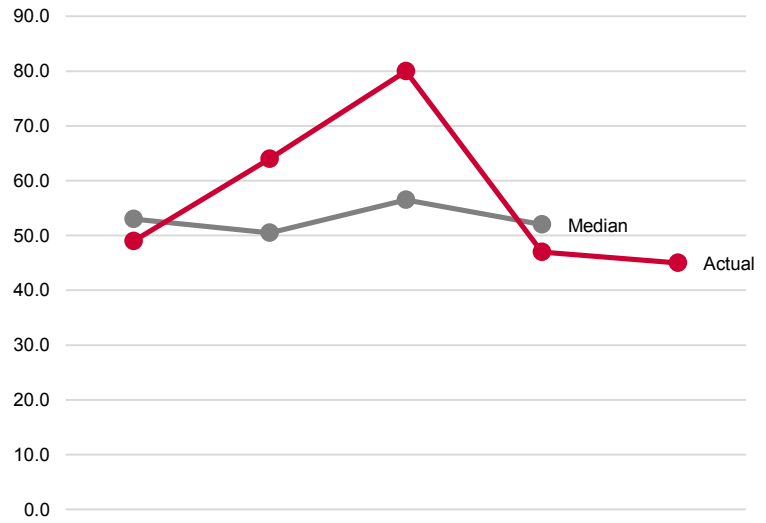


	2009	2010	2011	2012	2013
Actual	12,155	12,240	16,075	14,743	14,711

ABOR Peer Group	Med. Sch. NSF Adj. AUTM Adj.	2009	2010	2011	2012	2013	Rank
University of Washington	X	1,122,555	674,971	586,506	693,916		1
University of Minnesota	X	1,284,360	1,067,406	118,932	552,566		2
University of Florida	X	910,017	428,950	398,598	486,700		3
University of Wisconsin - Madison	X	595,661	527,546	519,322	351,348		4
Texas A&M University		156,941	125,010	131,271	188,538		5
University of California - Los Angeles	X	253,451	293,331	164,431	177,730		6
University of California - Davis	X	144,436	133,075	144,555	175,594		7
University of Iowa	X	1,301,059	607,859	141,587	162,043		8
University of Illinois - Urbana - Champaign				116,601	109,813		9
Michigan State University	X	119,229	93,121	79,596	73,041		10
Pennsylvania State University, All Campuses	X	16,289	29,476	37,080	38,800		11
The Ohio State University	X	23,891	25,252	17,065	28,304		12
University of North Carolina - Chapel Hill	X	47,429	34,398	17,057	27,286		13
<b>The University of Arizona</b>	<b>X</b>	<b>12,155</b>	<b>12,240</b>	<b>16,075</b>	<b>14,743</b>	<b>14,711</b>	<b>14</b>
University of Maryland - College Park							
University of Texas - Austin							
<b>Median</b>		<b>156,941</b>	<b>133,075</b>	<b>125,101</b>	<b>168,819</b>		

# Economic Development

Licenses and Options Executed

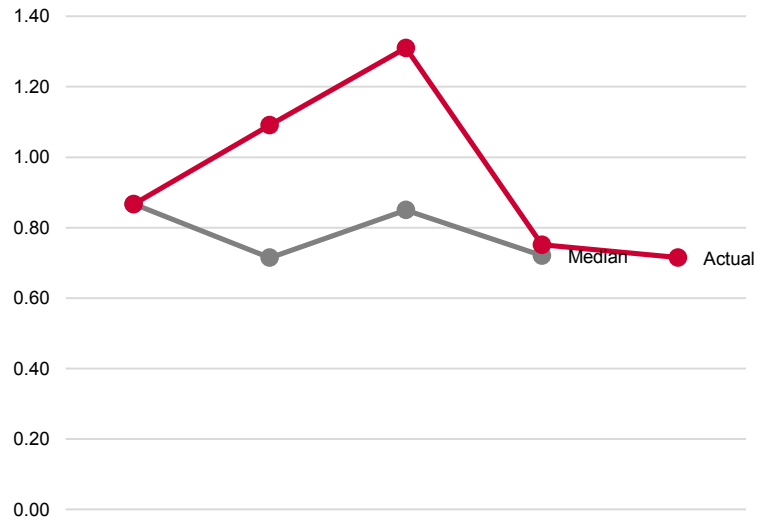


	2009	2010	2011	2012	2013
Actual	49	64	80	47	45

	Med. Sch. AUTM Adj.	2009	2010	2011	2012	2013	Rank
<b>ABOR Peer Group</b>							
University of Washington	X	231	196	194	209		1
University of Florida	X	115	92	131	129		2
University of Minnesota	X	53	73	113	75		3
Texas A&M University		63	49	67	71		4
University of North Carolina - Chapel Hill	X	72	39	45	61		5
University of Wisconsin - Madison	X	57	62	62	60		6
University of California - Davis	X	74	67	58	57		7
<b>The University of Arizona</b>	<b>X</b>	<b>49</b>	<b>64</b>	<b>80</b>	<b>47</b>	<b>45</b>	<b>8</b>
University of Illinois - Urbana - Champaign			40	55	46		9
University of California - Los Angeles	X	37	52	46	34		10
The Ohio State University	X	27	35	25	33		11
Michigan State University	X	44	31	40	32		12
Pennsylvania State University, All Campuses	X	21	24	23	21		13
University of Iowa	X	21	21	24	21		13
University of Maryland - College Park							
University of Texas - Austin							
<b>Median</b>		<b>53</b>	<b>51</b>	<b>57</b>	<b>52</b>		

# Economic Development

Licenses and Options Executed per \$10 Million in Total Research Expenditures

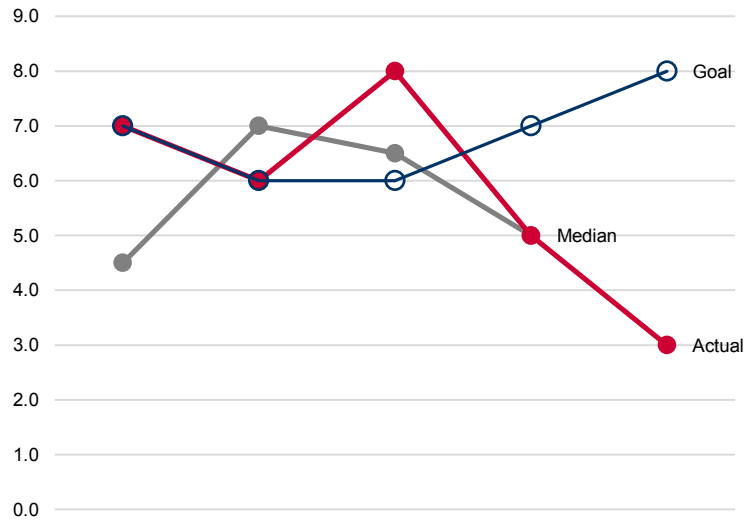


	2009	2010	2011	2012	2013
<b>Actual</b>	<b>0.9</b>	<b>1.1</b>	<b>1.3</b>	<b>0.8</b>	<b>0.7</b>

	Med. Sch. NSF Adj. AUTM Adj.	2009	2010	2011	2012	2013	Rank
<b>ABOR Peer Group</b>							
University of Washington	X	3.0	1.9	1.7	1.9		1
University of Florida	X	1.9	1.3	1.8	1.9		2
Texas A&M University		1.0	0.7	0.9	1.0		3
University of Minnesota	X	0.7	0.9	1.3	0.9		4
University of California - Davis	X	1.1	1.0	0.8	0.8		5
University of Illinois - Urbana - Champaign			0.8	1.0	0.8		6
<b>The University of Arizona</b>	<b>X</b>	<b>0.9</b>	<b>1.1</b>	<b>1.3</b>	<b>0.8</b>	<b>0.7</b>	<b>7</b>
University of North Carolina - Chapel Hill	X	1.1	0.5	0.5	0.7		8
Michigan State University	X	1.2	0.7	0.9	0.6		9
University of Wisconsin - Madison	X	0.6	0.6	0.6	0.5		10
University of Iowa	X	0.6	0.5	0.5	0.5		11
The Ohio State University	X	0.4	0.5	0.3	0.4		12
University of California - Los Angeles	X	0.4	0.6	0.5	0.3		13
Pennsylvania State University, All Campuses	X	0.3	0.3	0.3	0.3		14
University of Maryland - College Park							
University of Texas - Austin							
<b>Median</b>		<b>0.9</b>	<b>0.7</b>	<b>0.8</b>	<b>0.7</b>		

# Economic Development

Startup Companies

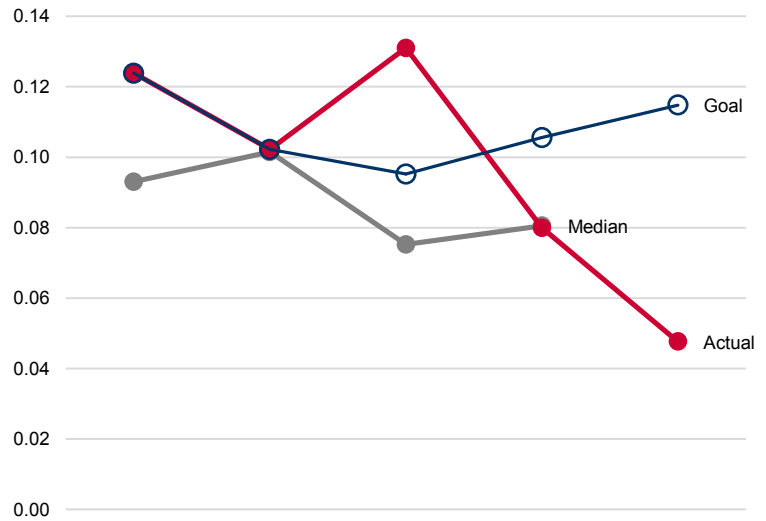


ABOR Enterprise Plan	2009	2010	2011	2012	2013
Actual	7	6	8	5	3
Goal	7	6	6	7	8
Difference	0	0	2	-2	-5

ABOR Peer Group	Med. Sch. AUTM Adj.	2009	2010	2011	2012	2013	Rank
University of Florida	X	10	9	12	15		1
University of California - Los Angeles	X	22	27	19	13		2
University of Minnesota	X	3	8	9	12		3
University of North Carolina - Chapel Hill	X	1	5	7	9		4
University of Washington	X	10	7	9	9		4
Pennsylvania State University, All Campuses	X	3	5	5	5		6
Texas A&M University		6	7	4	5		6
The Ohio State University	X	7	8	6	5		6
<b>The University of Arizona</b>	<b>X</b>	<b>7</b>	<b>6</b>	<b>8</b>	<b>5</b>	<b>3</b>	<b>6</b>
University of Illinois - Urbana - Champaign			5	12	5		6
University of Iowa	X	3	3	2	4		11
University of Wisconsin - Madison	X	1	5	4	4		11
Michigan State University	X			1	3		13
University of California - Davis	X	2	9	5	2		14
University of Maryland - College Park							
University of Texas - Austin							
<b>Median</b>		<b>5</b>	<b>7</b>	<b>7</b>	<b>5</b>		

# Economic Development

Startup Companies per \$10 Million in Total Research Expenditures

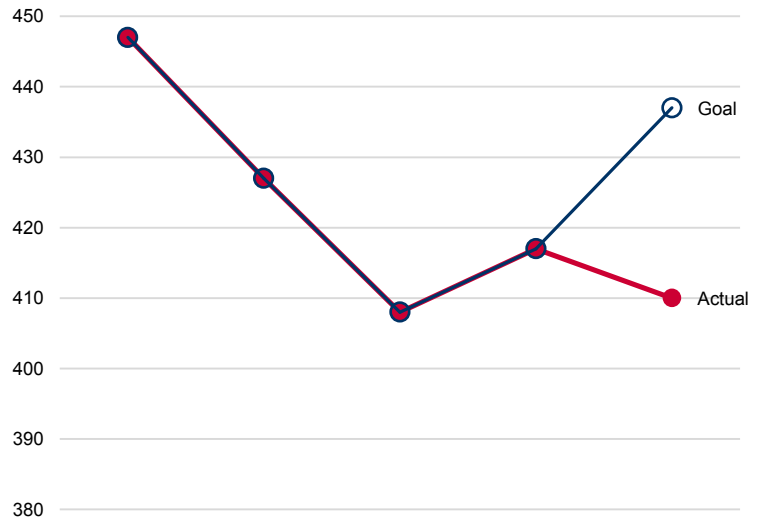


ABOR Enterprise Plan	2009	2010	2011	2012	2013
Actual	0.1	0.1	0.1	0.1	0.0
Goal	0.1	0.1	0.1	0.1	0.1
Difference	0.0	0.0	0.0	0.0	-0.1

ABOR Peer Group	Med. Sch. NSF Adj. AUTM Adj.	2009	2010	2011	2012	2013	Rank
University of Florida	X	0.2	0.1	0.2	0.2		1
University of Minnesota	X	0.0	0.1	0.1	0.1		2
University of California - Los Angeles	X	0.2	0.3	0.2	0.1		3
University of North Carolina - Chapel Hill	X	0.0	0.1	0.1	0.1		4
University of Iowa	X	0.1	0.1	0.0	0.1		5
University of Illinois - Urbana - Champaign			0.1	0.2	0.1		6
University of Washington	X	0.1	0.1	0.1	0.1		7
<b>The University of Arizona</b>	<b>X</b>	<b>0.1</b>	<b>0.1</b>	<b>0.1</b>	<b>0.1</b>	<b>0.0</b>	<b>8</b>
Texas A&M University		0.1	0.1	0.1	0.1		9
The Ohio State University	X	0.1	0.1	0.1	0.1		10
Pennsylvania State University, All Campuses	X	0.0	0.1	0.1	0.1		11
Michigan State University	X			0.0	0.1		12
University of Wisconsin - Madison	X	0.0	0.0	0.0	0.0		13
University of California - Davis	X	0.0	0.1	0.1	0.0		14
University of Maryland - College Park							
University of Texas - Austin							
<b>Median</b>		<b>0.1</b>	<b>0.1</b>	<b>0.1</b>	<b>0.1</b>		

# Economic Development

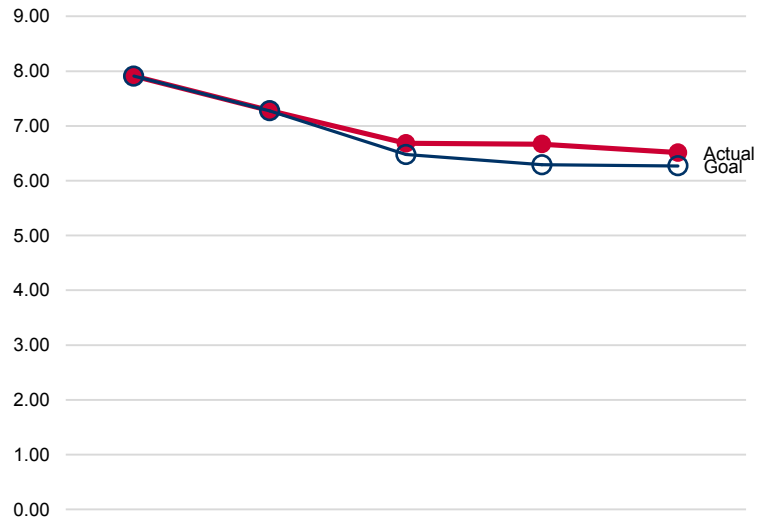
Ph.D. Degrees Conferred



ABOR Enterprise Plan	2009	2010	2011	2012	2013
Actual	447	427	408	417	410
Goal	447	427	408	417	437
Difference	0	0	0	0	-27

# Economic Development

Ph.D. Degrees Conferred per \$10 Million in Total Research Expenditures



ABOR Enterprise Plan	2009	2010	2011	2012	2013
Actual	7.9	7.3	6.7	6.7	6.5
Goal	7.9	7.3	6.5	6.3	6.3
Difference	0.0	0.0	0.2	0.4	0.2

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**Leadership and Recognition**

Recognition for leadership and innovation in knowledge discovery are among the highest accolades that a university can receive. International and national academic awards honor achievements that change how we view and make sense of the world. The UA Research Office actively promotes faculty members and students for recognition at the national and international levels.



Dolores Hill and OSIRIS-REx principal Dante Lauretta carefully handle an asteroid.

University of Arizona researcher, Dolores Hill, co-lead of the OSIRIS-REx Target Asteroids! program, has been recognized as one of 12 White House Champions of Change recipients. Hill and her 11 counterparts were selected from a pool of about 1,000 nominations. The group was honored at a ceremony at the White House. The award honors individuals and organizations that have demonstrated exemplary leadership in engaging the broader, non-expert community in science, technology, engineering or mathematics (STEM) research. As part of NASA's OSIRIS-REx asteroid sample return mission, which is led by the UA, the Target Asteroids! program involves amateur astronomers in observations of near-Earth

asteroids to provide scientists with important information about these objects. Data amateur astronomers generate are intended to aid the mission, which is slated to visit a near-Earth asteroid in 2018 and return a sample to Earth in 2023. The announcement of Hill's award came just as the Association of American Universities named the UA one of only eight U.S. institutions supported by a \$4.7 million grant-funded initiative designed to greatly enhance STEM education.

The University of Arizona has been ranked as the top environmental university in the U.S. and 2nd in the world based on several measures of productivity for research publications in environmental science, according to a report published in the journal *Science of the Total Environment*. The researchers based their study on the Thomson Reuters Web of Science® database to analyze not only the number of top-cited articles published by an institution, but also to assess scientific publications resulting from collaborations and to follow the lifespan and history of a particular article, all of which are indicators of significance of a research report in the scientific community. Environmental science and policy at the UA spans a wide range of disciplines, institutes, departments and colleges including the Institute of the Environment, part of the TRIF-supported initiative in Water Energy and Environmental Solutions.



Biosphere 2  
Credit: Gregg M. Erickson

## Leadership and Recognition

*Selected Accomplishments*

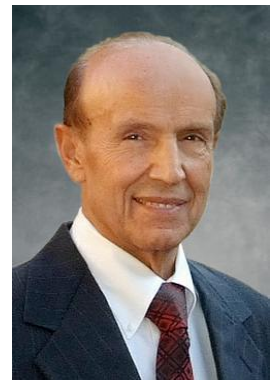
- **Ana Zabludoff**, Professor of Astronomy, has been selected as a John Simon **Guggenheim Memorial Foundation Fellow**. Guggenheim Fellowships are intended for men and women who have already demonstrated exceptional capacity for productive scholarship. Dr. Zabludoff's research is broadly distributed over extragalactic astronomy and observational cosmology.



- **Leslie Boyer**, founding director of the VIPER (Venom Immunochemistry, Pharmacology and Emergency Response) Institute at the UA College of Medicine – Tucson, has been named a **Hero of Rare Diseases** by the Food and Drug Administration's Office of Orphan Products Development. Dr. Boyer is one of 30 Heroes selected by the FDA. The FDA made the awards to highlight clinical, research, advocacy and regulatory contributions over the last three decades. The FDA's designation recognizes efforts that raise awareness with the public about rare diseases, the challenges encountered by those affected, the importance of research to develop diagnostics and treatments and the impact of these diseases on patients' lives.



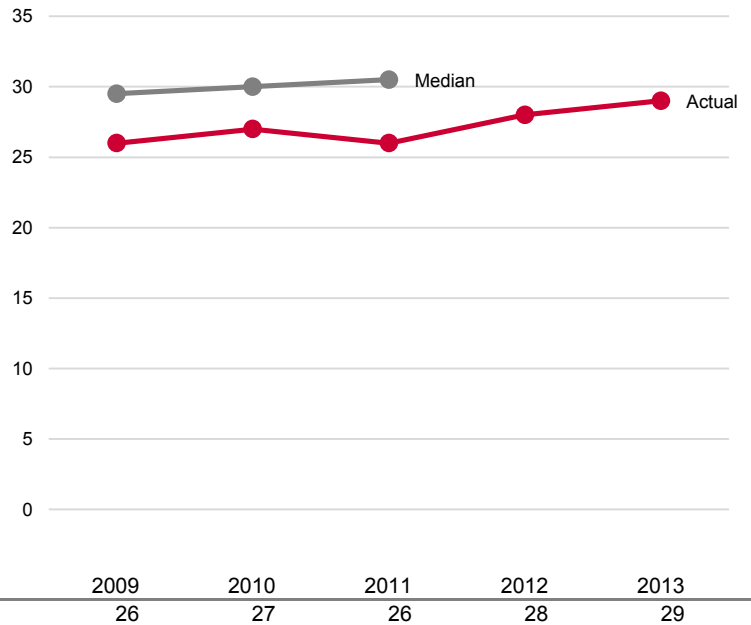
- **Gholam A. Peyman**, a faculty member at the University of Arizona College of Medicine – Phoenix, and Professor of Optical Sciences and Engineering at UA, was named as one of the 12 eminent researcher recipients of the **National Medal of Technology and Innovation**. Dr. Peyman is an ophthalmologist and vitreoretinal surgeon. His most widely-known invention is LASIK eye surgery, a vision correction procedure designed to allow people to see clearly without glasses. Dr. Peyman's inventions cover a broad range of novel medical devices, intra-ocular drug delivery, surgical techniques, laser and optical instruments, as well as new methods of diagnosis and treatment. He has won numerous honors and awards, including being inducted into the Hall of Fame of Ophthalmology.



- UA faculty regularly obtain top awards in their disciplinary fields or are recognized with Career Awards. **Feryal Ozel**, an associate professor of astronomy and physics at the University of Arizona is the recipient of this year's **Maria Goeppert Mayer Award** from the American Physics Society. The award recognizes outstanding achievement by a woman physicist in the early years of her career. **Shirley Papuga**, assistant professor in the School of Natural Resources and the Environment, and **Jonathan Sprinkle**, assistant professor in electrical and computer engineering, received the 2013 **National Science Foundation Career Award**, the agency's most prestigious honor for junior faculty members. The awards are granted to scientists who demonstrate outstanding research, excellent education and have a particular skill at integrating both aspects.
- **UA graduate students** continued to garner awards in FY 2013. Thirty five UA students received **NSF Predoctoral Fellowships**, one of the most competitive and prestigious fellowships in the country, bringing the total to 50 new and continuing NSF Fellows who are currently attending UA. This is the **highest number of NSF graduate fellowships ever** at UA. **Jared Males**, Postdoctoral Fellow in Astronomy, has received a NASA Carl Sagan Fellowship (one of five awarded) to investigate exoplanetary habitability.

# Leadership and Recognition

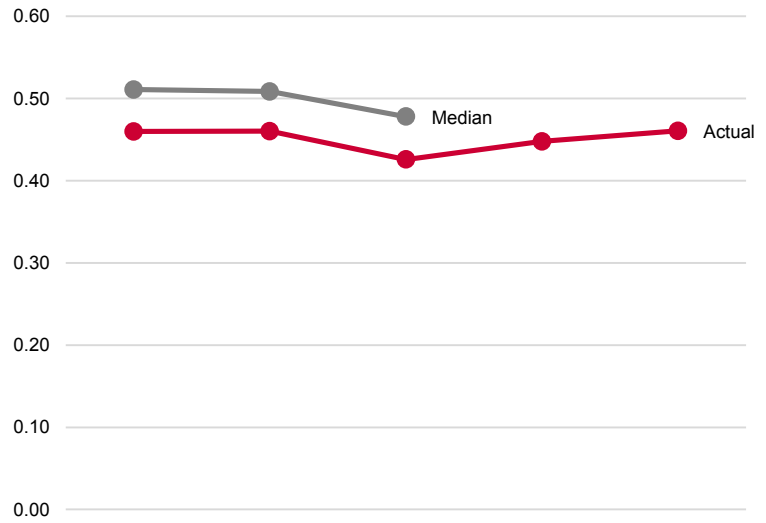
National Academy Members



		2009	2010	2011	2012	2013	
<b>Actual</b>		26	27	26	28	29	
	<b>Med. Sch.</b>						
<b>ABOR Peer Group</b>							<b>Rank</b>
University of Washington	X	101	102	104			1
University of California - Los Angeles	X	85	91	95			2
University of Texas - Austin		65	67	68			3
University of Wisconsin - Madison	X	71	71	67			4
University of Illinois - Urbana - Champaign		55	59	57			5
University of California - Davis	X	32	36	39			6
University of Minnesota	X	39	41	39			6
University of North Carolina - Chapel Hill	X	32	30	31			8
University of Maryland - College Park		27	30	30			9
The Ohio State University	X	26	27	28			10
<b>The University of Arizona</b>	<b>X</b>	<b>26</b>	<b>27</b>	<b>26</b>	<b>28</b>	<b>29</b>	<b>11</b>
Pennsylvania State University, All Campuses	X	24	24	23			12
University of Florida	X	23	23	23			12
Texas A&M University		22	22	22			14
University of Iowa	X	21	22	22			14
Michigan State University	X	7	7	8			16
<b>Median</b>		<b>30</b>	<b>30</b>	<b>31</b>			

# Leadership and Recognition

National Academy Members per \$10 Million in Total Research Expenditures



	2009	2010	2011	2012	2013
Actual	0.5	0.5	0.4	0.4	0.5

ABOR Peer Group	Med. Sch. NSF Adj.	2009	2010	2011	2012	2013	Rank
University of Texas - Austin		1.3	1.1	1.1			1
University of Illinois - Urbana - Champaign		1.0	1.1	1.0			2
University of California - Los Angeles	X	1.0	1.0	1.0			3
University of Washington	X	1.3	1.0	0.9			4
University of Maryland - College Park		0.7	0.7	0.6			5
University of Wisconsin - Madison	X	0.7	0.7	0.6			6
University of California - Davis	X	0.5	0.5	0.6			7
University of Iowa	X	0.6	0.5	0.5			8
University of Minnesota	X	0.5	0.5	0.5			9
<b>The University of Arizona</b>	<b>X</b>	<b>0.5</b>	<b>0.5</b>	<b>0.4</b>	<b>0.4</b>	<b>0.5</b>	<b>10</b>
University of North Carolina - Chapel Hill	X	0.5	0.4	0.4			11
The Ohio State University	X	0.4	0.4	0.3			12
Texas A&M University		0.3	0.3	0.3			13
University of Florida	X	0.4	0.3	0.3			14
Pennsylvania State University, All Campuses	X	0.3	0.3	0.3			15
Michigan State University	X	0.2	0.2	0.2			16
<b>Median</b>		<b>0.5</b>	<b>0.5</b>	<b>0.5</b>			

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**Technology Transfer**

With the appointment of David N. Allen as Executive Director of Tech Launch Arizona in September 2012, the University of Arizona (UA) entered a new era of technology commercialization. Dr. Allen is a seasoned leader with over 30 years of experience in technology commercialization related research, instruction and practice. TLA is a cabinet-level unit reporting to the President.

Released April 1, 2013, TLA's strategic plan – The TLA Roadmap – defines the UA's five-year plan to transform technology commercialization, documenting a comprehensive strategy for success with specific, measurable, achievable goals.

In FY 2013, TLA integrated four separate University offices under a centralized leadership structure. Under TLA's leadership:

- The Office of Technology Transfer became **Tech Transfer Arizona**
- The Office of Corporate and Business Relations became **Corporate Relations Arizona**
- The Office of University Research Parks became **Tech Parks Arizona**
- Commercialization Networks and Operations became **Wheelhouse Arizona**

Under this model, TLA coordinates the entire commercialization continuum, from identification of high-value research projects, through intellectual property protection and prototype development, to licensing and company launch, incubation and acceleration.

**Team Growth and Leadership:** A number of experienced and talented hires were brought in to build the team during FY 2013:

Name	Title	Start Date
David N. Allen	VP of Tech Launch Arizona	9/4/2012
Sherry Hoskinson	Director, Wheelhouse	11/12/2012
Lewis Humphreys	Marketing and Communications Manager	1/7/2013
Douglas Hockstad	Director, Tech Transfer Arizona	2/25/2013
Jennifer Watson	Associate of Technology Commercialization	6/17/2013
Janet Kisinger	Intellectual Property Manager	6/24/2013
Robert Sleeper	Licensing Manager, College of Engineering Embed	6/24/2013

### Accomplishments, Transactions, Revenues and Distributions

- 45 licensing and option deals, 22 of which are exclusive licenses and options.
- 144 invention disclosures and 108 patent applications.
- 3 new Arizona-based companies formed around UA technologies; created a new structure, process, and support paradigm to significantly increase the number of start-ups formed around UA technology in the future.
- 45 confidentiality agreements
- 23 requests to license UA technologies to start-up companies
- 4 inter-institutional agreements to share responsibility on co-owned technologies
- \$1.34 million in revenues from licensing activity and legal reimbursements
- Over 55% median ratio of TTA legal expenditures to legal reimbursements (in comparison to 33% median ratio for peer institutions)



# Technology Transfer

## Statistical Exhibits



Technology Transfer Activities	2009	2010	2011	2012	2013
Invention Disclosures Transacted	125	131	149	142	144
Invention Disclosures Transacted Year/Year Percentage Change		5%	14%	-5%	1%
New Patent Applications	99	67	104	98	108
New Patent Applications Year/Year Percentage Change		-32%	55%	-6%	10%
U.S. Patents Issued	11	13	19	21	21
U.S. Patents Issued Year/Year Percentage Change		18%	46%	11%	0%
Licenses and Options Executed	49	64	80	47	45
Licenses and Options Executed Year/Year Percentage Change		31%	25%	-41%	-4%
Other Major Agreements	20	13	8	13	6
Other Major Agreements Year/Year Percentage Change		-35%	-38%	63%	-54%
<b>Licensing and Other Revenue</b>	<b>2009</b>	<b>2010</b>	<b>2011</b>	<b>2012</b>	<b>2013</b>
Licensing Revenue (Including Options)	\$687,110	\$718,027	\$981,495	\$921,965	\$926,023
Licensee Legal Reimbursements	\$301,988	\$540,324	\$432,790	\$627,572	\$418,743
Other Revenue	\$0	\$0	\$0	\$0	\$0
<b>Total</b>	<b>\$989,098</b>	<b>\$1,258,351</b>	<b>\$1,414,285</b>	<b>\$1,549,537</b>	<b>\$1,344,766</b>
<b>Sponsored Research Facilitated</b>	<b>2009</b>	<b>2010</b>	<b>2011</b>	<b>2012</b>	<b>2013</b>
<b>Total</b>	<b>\$1,857,451</b>	<b>\$4,701,776</b>	<b>\$5,918,193</b>	<b>\$5,100,000</b>	<b>\$1,677,000</b>
<b>Royalty Distribution</b>	<b>2009</b>	<b>2010</b>	<b>2011</b>	<b>2012</b>	<b>2013</b>
Inventors	-\$225,842	-\$248,107	-\$346,698	-\$322,687	-\$271,071
Laboratories and Units	-\$171,589	-\$188,505	-\$231,132	-\$276,590	-\$233,554
University	-\$157,873	-\$173,437	-\$192,609	-\$184,779	-\$155,016
Undistributed	\$131,807	\$107,977	\$211,056	\$137,909	\$266,382

In FY 2013, UA filed 108 new patent applications, representing a 10% increase from the previous fiscal year, and had 21 patents issued. The following are two examples of the U.S. patents filed or granted in FY 2013:

- **U.S. Patent issued No. 8,366,820**

- **“Curable Composition, Paste, and Oxidatively Carbonated Composition”**

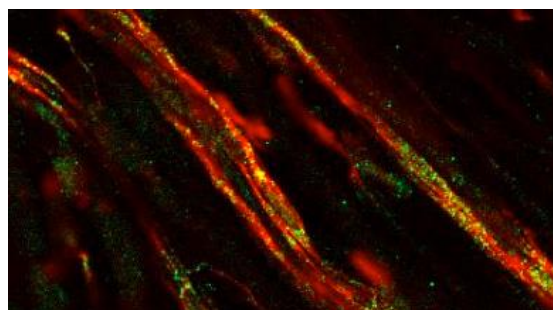
Developed by Dr. David Stone while he was a UA graduate student in environmental science, a novel iron-based cement-like material dubbed “Ferrock™” hardens through a benign chemical equivalent of corrosion. Under proper conditions, the energy released can be used to form strong bonds between sand grains and other aggregates. In hydraulic cements, bonds between growing crystals are formed by hydration. In this new material, crystals grow by reacting with carbon dioxide to form iron carbonates, so carbon dioxide becomes an integral, permanent part of the crystalline matrix. The result is a pioneering example of a new class of carbonate cements. Traditional concrete includes silicate materials like sand and gravel. Recently, finer forms of silica like fly ash (waste from coal-burning power plants) have been substituted, and can increase the density and strength of concrete. The new “iron cement” takes this approach further, using much more fly ash and creating stronger bonds between the silica particles, thus yielding a material with a compressive strength higher than that of traditional cement. Perhaps most interestingly today, unlike the production of traditional cement, which consumes enormous energy and releases large amounts of environmentally undesirable CO<sub>2</sub>, this new cement is produced in a process that consumes CO<sub>2</sub> and takes place at ambient temperatures...actually making this a carbon negative process.



Carbonate cement Ferrock™

- **UA13-118 Provisional Patent Application Filed**

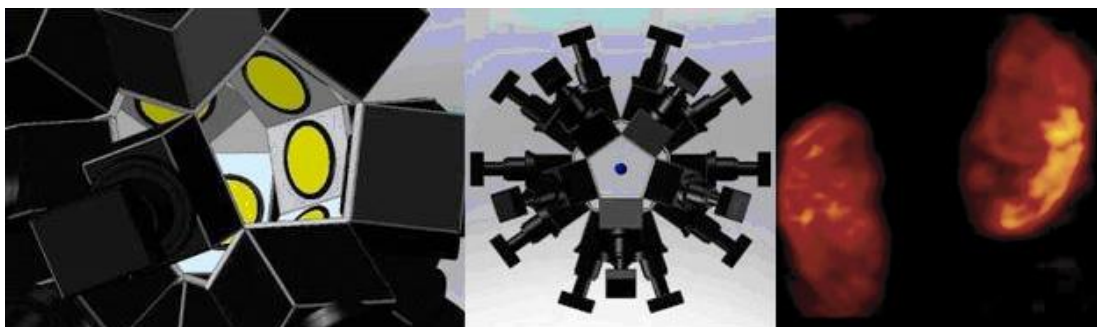
Led by Pharmacology faculty Theodore Price, a novel therapeutic has been developed that targets the activation of a signaling pathway to treat both acute post-surgical pain-and-itch, as well as prevent the transition to chronic pain. The invention contains a topical cream treatment at the incision site with either a commonly used, safe drug and/or a natural product that acts via the same pathway. The current implementation uses two drugs that possess different mechanisms of a particular signaling activation to demonstrate a shared endpoint. A combination use of oral drug and topical cream containing the natural product may have wide applications for chronic post-surgical pain prevention.



A new therapeutic blocks pain signaling

In addition to the start-ups discussed herein, a large portion of TTA's portfolio is licensed, or optioned, to a wide variety of companies, from large corporations such as Life Technologies and Hayden-McNeil, to smaller organizations such as The Burgundy Group Inc. Example innovations transferred under licenses or options include:

- **Student's Guide to First-Year Writing**, licensed to **Hayden-McNeil**, is a textbook created in the Writing Program of the English department connecting directly to student-learning outcomes for the UA first-year composition courses. The book provides students with substantial writing support to be successful in first-year writing courses, providing strategies and resources to address writing situations they will face during college...and beyond.
- **Novel Active Inhibitors of AKT**, co-owned by MD Anderson Cancer Center and licensed to **PHusis Therapeutics Inc.**, are novel non-lipid-based compounds that bind selectively to the PH domain of AKT, a serine/threonine-specific protein kinase. Currently lead molecules from this series of compounds show promise as a novel therapeutic that interrogates the AKT pathway and early results show activity in several broad categories of cancer cell types. To the best of our knowledge, successful AKT inhibitors have not been developed to date according to the literature and available patent information.
- **BazookaSPECT detector**, optioned to **Imagenomics LLC**, is a low-cost, ultra-high resolution (70um) gamma camera for small-animal SPECT and molecular imaging. The BazookaSPECT gamma camera relies on a unique combination of optics, an image intensifier, a structured scintillator, and a fast CCD. The advantages of the system including working with both low- and high-energy gamma rays, and a low-cost, easy to use system, providing broad application of gamma cameras. This technology is an outgrowth of the NIH-funded Center for Gamma Ray Imaging, the premier center in the world for SPECT technology development.



Rendering of a mouse imager with multiple BazookaSPECT cameras (left and middle); SPECT image of mouse kidney using  $^{99m}\text{Tc}$  glucarate (right).

- **Metropia, Inc. (Tucson, AZ)**  
*Civil Engineering and Engineering Mechanics*  
*Professor Yi-Chang Chiu*

Metropia, Inc. was created to bring Chiu's new Smartrek app to the world. Using advanced traffic prediction and vehicle routing technologies, the app allows drivers to get suggestions for avoiding traffic, which simultaneously helps reduce traffic congestion. The company launched the app in Los Angeles and Phoenix, and is working with multiple city governments to expand coverage to other large metropolitan areas around the nation and other parts of the world.



Professor Yi-Chang Chiu

- **Innovative Energetics, LLC (Tucson, AZ)**  
*Chemistry & Biochemistry Associate Professor Jeffrey Pyun, Professor Bonner Denton and*  
*Research Scientist Roger Sperline*

Innovative Energetics, LLC is a Tucson-based technology company focused on the development of new materials and device technology for the production of next generation batteries, optical materials and optoelectronic materials.

- **Provision Recognition, LLC (Tucson, AZ)**  
*University Libraries Assistant Dean Jeremy Frumkin and Assistant Librarian Erika Castaño*

Provision Recognition, LLC is a Tucson-based technology company focused on supporting libraries' needs to garner recognition for their provisioning service by way of providing a web-based information resource branding service and a web-based business intelligence service.

**The Proof of Concept Program** was introduced to encourage investigators to describe the commercial potential of their inventions and propose a method of validating that potential or improving technical performance relative to this potential. This TRIF-supported program combined \$640K from TLA with \$77K from the Water, Energy, and Environmental Systems initiative, to provide \$10-\$40K for projects that could be completed prior to June 30, 2013. TLA received 46 proposals from 33 academic departments, and funded 19 Proof of Concept projects.

**Wheelhouse Arizona** was created to provide individual, in-depth commercialization support through the establishment of 1) a formal quality domain expertise network, and 2) operations, policies, processes, and procedures to enable the progression of UA technologies through early stage proof of concept development and into start-ups.

**The Student Fellow Program** was initiated to engage students in the intellectual property market, provide enhanced service to UA inventors, and offer more comprehensive assessments of UA inventions. Under the guidance of technology licensing professionals, up to 10 part-time student employees review and assess disclosed inventions.

**Licensing Standards and Procedures for Start-ups** were put in place to help commercialize faculty-developed IP more quickly and efficiently.

**Conflict of Interest and Regent Approval Procedures** were reengineered – through a partnership between the Conflict of Interest office (under the AVP for Responsible Conduct of Research) and Wheelhouse Arizona – to reduce Conflict of Interest reviews and assessments from six months or more to 70-75 days. This reasoned approach to meeting state requirements yielded an historic 12 requests vetted and scheduled at the September 2013 ABOR meeting, and a total of 22 requests planned September, November and February ABOR meetings.

**Innovation Day 2013** honored student and faculty researchers for their achievements in translating ideas from the laboratory to the marketplace in the name of advancing local, national and international communities and economies. Honorees included:

**Faculty Innovator of the Year:** Hsinchun Chen, PhD, inventor of COPLINK, a national model for public safety information sharing and analysis, adopted by 3500 law enforcement and intelligence agencies.

**Student Innovator of the Year:** Jared Griebel, Chemistry PhD student, whose work with plastics could translate the problem of waste sulfur into an opportunity to create batteries.

**Corporate Relations Arizona** operates two internal organizations to support the implementation and operations of the University's industry engagement objectives:

The **Corporate Relations Council**, started in 2008, is a responsive, campus-wide network of people engaged in business development efforts with companies.

The **Strategic Company Engagement Team**, launched in FY 2013, includes a subset of people from the Corporate Relations Council focused on identifying and developing potential company partners for the University.

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## **Strategic Initiatives**

Achieving UA targets for increased research and development expenditures and technology commercialization, with the ultimate goal of increasing the health and economic well-being of the citizens of Arizona, requires focused attention and investment. The Never Settle strategic academic and business plan, spearheaded by UA President Dr. Ann Weaver Hart, was developed throughout 2012-2013 with extensive input from faculty, staff, students, business and community leaders. The plan was presented to the November 2013 Arizona Board of Regents meeting and the Innovating section of this plan will form the roadmap for strategic initiatives and actions through 2020.

The Never Settle plan calls for doubling research expenditures by 2023. Because of decrease federal agency R&D spending, research awards are down since the fiscal year 2010 peak, meaning that in fiscal year 2014 and 2015, research expenditures are projected to decrease. Plans implemented now will bear fruit in increased and accelerating research expenditures beyond fiscal year 2016. The major strategies in place for research are listed below.

1. **Increase productivity of existing faculty.** UA will build capacity to make a large research engine even larger, foster a culture of collaboration, and create a support structure to improve our competitive advantage. Specifically, we will:
  - Achieve faculty flexibility and accountability through flexible workload models, and the revised promotion and tenure guidelines as described earlier.
  - Successfully compete for more large and complex awards by creating a research support office with personnel dedicated to facilitating faculty teams, and completing a Research Gateway portal with one-stop information from idea and proposal development through grant close-out. We will create the core research infrastructure (equipment and services) needed to support existing and new faculty.
  - Continue to develop contracting and compliance protocols, to increase our competitive edge as responsive, responsible partners.
  - Ensure that space is used efficiently by benchmarking productivity, and determining whether building or renovation is most effective in a growing research enterprise.
  - Develop partnerships to finance large projects through public-private partnerships and shared investment in large projects.
  - Ramp up our clinical trials infrastructure and increase partnering in biomedical areas.
  
2. **Dramatically increase research expenditures in strategic areas.** We have selected seven areas where UA has the ability, desire, and potential resources to double research expenditures. These areas are cross-cutting, aligned with known research strengths, and tied to specific grant and contract opportunities. To meet research expenditure goals, an investment will need to be made in 350 new faculty, research support, and new research building infrastructure.
  - Defense and Security- An area of strategic growth opportunity, UA has underperformed in obtaining Department of Defense funding. UA has strengths in cybersecurity, space and optics, sensors and technology, and medical/ neurosciences, among others- areas, which will be focused and leveraged into increased research expenditures.
  - Space Systems- UA's historical strength area, with 7x more funding than our peer institutions from NASA, still has considerable growth opportunity. Target areas include ground-based observations and earth sensing.



- Water and the Arid Environment- There are additional opportunities to leverage UA's broad-based strengths in water and arid environments through international research consortia, public-private partnerships, and synergies with space and public health areas.
- Population Health and Health Outcomes- UA is poised to excel in research for aging and rural populations, underserved communities, and to develop novel healthcare delivery models.
- Healthcare Disparities- Excellence in this area will be expanded upon, particularly in the UA strengths and the community concerns surrounding cancer, diabetes, Hispanic health disparities, and Native American women's health.
- Precision Health- UA's emergent infrastructure in genomics and big data, as evidenced in the iPlant Collaborative, will be applied to research in precision health, also called personalized medicine. Focus areas will be in cancer genetics, pharmacogenetics, a rare disease clinic, and nanobiotechnology.
- Neurosciences- A strong basic research program in neurosciences will be expanded and translated to clinical use especially in the areas of aging and cognition, Alzheimer's disease, stroke, and neuromuscular disease.

Although the above areas represent the largest targets of opportunity for research expenditure growth and will be subjects of significant investment, other areas of research will still be encouraged through initiatives designed to assist all investigators, such as access to grant opportunity alerts, support for large proposals, seed grants, and matching funds for equipment grants. As biomedical areas are a major opportunity for research growth, significant effort is being placed into growing the capabilities of the health sciences colleges, beginning with the hire of Joe "Skip" Garcia as Senior Vice President for Health Sciences, and putting in place personnel and services needed to make UA competitive for a Clinical Translational Sciences Award, a renewal of the UA Cancer Center core grant, and NIH-supported big data grants.

3. **Increase economic development activities.** Fiscal year 2013 was a time of tremendous growth in TLA, as detailed in the Technology Transfer sections above. TLA will continue to develop these programs in the coming years, and in concert with several other units on campus, will gear up for success. Overall, strategy will focus on increasing industry-sponsored research and collaboration, integrating the University Tech Parks with the mission of the University, and synergizing the TLA enterprise with the broader University and technology community. A major effort for TLA will be complete adoption of leading commercialization practices, such as having all patent applications filed by external counsel, offering comprehensive services, expanding communications through seminars, faculty meetings, workshops, and monthly newsletter, and expanding the Proof of Concept program.

Industry relationships will be critical to doubling research expenditures and driving economic development. UA will accelerate engagement of large regional companies in significant multifaceted relationships, and will partner with companies of all sizes to enhance industry participation in existing and new research initiatives, centers and institutes. An institute focused on Defense and Security is a prime example, as the institute will partner with Arizona aerospace and defense companies to complement each other's strengths and be most competitive for large federal grants.