

Metrics and Key Outcomes Related to SFAz Grant Programs



Key Metrics for SFAz Grants

Summary Findings

Based on Battelle's survey of Science Foundation Arizona (SFAz) grantees across all of its programs from FY 2007 through FY 2009 state funding, SFAz's performance-based, competitive grant programs in R&D partnerships, technology commercialization and science, technology, engineering and math (STEM) talent advancement are demonstrating a growing record of success and tangible economic benefits:

- **Leverage in R&D funding from SFAz grants rising and having broader economic and significant job impacts for Arizona over the first three years of funding:** Among the combined \$77.6 million in state funding to SFAz from FY 2007 through FY 2009, \$50.0 million has been invested in university and nonprofit research funding initiatives which resulted in an additional \$152.8 million in industry match and non-state research funding raised in support of SFAz's grant activities, or an additional \$3.06 from non-state sources for every \$1.00 in state funding.¹ This amount of leveraged funds is up from last year's cumulative total of \$109.8 million.

This additional \$152.8 million in industry match and non-state research funding represents new wealth brought into Arizona by SFAz's research activities, and has economic multiplier impacts on Arizona's economy. These broader economic impacts occur because of the successive cycles of spending, earning, and re-spending that add to the economic base of Arizona from the new wealth brought to Arizona from SFAz's leveraged funds. Battelle's analysis in applying an economic input-output model to measure these economic impacts finds an additional \$178.1 million is generated due to the multiplier effects, or the equivalent of an additional 1,490 jobs over the three year period.²

This is on top of the 1,151 direct jobs resulting from SFAz's overall grant activities identified from Battelle's survey of SFAz grant programs ... so, in total, an estimated 2,641 jobs result from just the research activities associated with SFAz's grant

Growing Direct Impacts from SFAz Programs:

SFAz continues to make strong progress. Over the past year, SFAz grant programs have shown significant gains across the range of key outcomes. Over the year, SFAz grant programs have:

- Increased total funds leveraged by industry match or other sources by \$43M; in turn increased leverage per dollar awarded by \$0.88 to \$3.06 from non-state sources for every \$1 in state funding.
- Increased direct jobs associated with the grants by 394 to 1,151.
- Increased companies formed by 5 to 16.
- Increased patents filed or issued by 34 to 84.
- Increased technology licenses by 2 to 11.
- Increased scientific publications by 407 to 760.
- Increased graduate research fellows by 46 to 223.
- Increased student involvement in STEM education programs (both direct and indirect) by over 78,000 to 160,000.
- Increased teacher involvement in STEM education programs (both direct and indirect) by more than 2,200 to 2,900.

¹ The leverage calculation is based only on those university and nonprofit research funding initiatives that involve an industry match or raising additional funds. These include CAA, SBC, and SRG awards and exclude GRF and STEM Education grants.

² For more detailed information on the approach to economic impact modeling for SFAz see the "Economic Impact Modeling" section that follows in this report.

funding over the FY 2007 to FY 2009 period.

Over the longer term, SFAz's programs that spur public-private research and development partnerships and technology commercialization throughout the State of Arizona will have even greater economic impacts through the private sector jobs created based upon new products developed and new start-up companies launched in Arizona.

- **SFAz grants are fueling innovation activities in Arizona.** The key measures to track whether SFAz's grant activities are well positioned to fuel future economic impacts for Arizona include publications of research results in peer-reviewed journals, patenting of intellectual property, licensing of intellectual property to industry and the formation of new technology businesses. In each of these measures, SFAz is demonstrating a growing innovation pipeline. As of June 2010, the cumulative impact of SFAz's grant activities has generated 760 publications, 84 patents filed and/or issued, 11 technology licenses in place, and 16 technology company formations in Arizona. This is a sizable rise from just last year, when SFA's cumulative grant activities were at 353 publications, 50 patents filed and issued, 9 technology licenses in place, and 11 technology companies formed in Arizona.

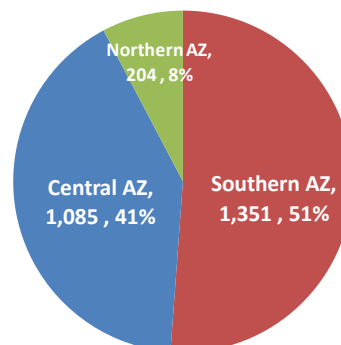
It is not just the cumulative totals in measures of innovation that make SFAz stand out, but its greater productivity in translating research funding into innovation. SFAz's research and development grants—with its focus on advancing university-industry partnerships and commercialization—appear to be outperforming the technology development activities typically found across the university research enterprise in Arizona (though lag slightly in licensing).

SFAz-supported projects generate:

- One patent applied for or issued for every \$2.2 million in total university research funding generated over the past three years, well ahead of the three-year Arizona university-wide average of one patent per \$4.2 million in funding.
 - One license for every \$17.0 million in total university research funding generated over the past three years, slightly behind the three-year Arizona university-wide average of one license per \$13.9 million. Licensed technologies are products or processes sold for commercial use.
 - One new company start-up for every \$11.7 million in total university research funding generated over the past three years, well ahead of the three-year Arizona university-wide average of one start-up per \$100.9 million.
- **SFAz STEM activities growing the next generation of talent in Arizona.** In STEM education activities, nearly 160,000 students and 2,900 teachers at the K-12 and community college level have been involved in SFAz funded education grants either directly or indirectly. A survey of program quality ratings from both teachers and students conducted this year were very positive, with average ratings of 2.8 for teachers and 2.7 for students out of a scale of 1 to 3, with 3 being the highest or “outstanding” rating. And SFAz is also advancing the growth in top talent across STEM fields with support for 223 graduate fellowships for PhD students in STEM fields, for which research universities in Arizona have contributed another \$7.3 million in university funds and tuition forgiveness.
 - **Statewide reach found across SFAz's research and development grant activities.** SFAz works with research universities and non-profit research and development organizations across the state—and the impacts of SFAz's grant activities in terms of leveraged funds raised, direct jobs created, and innovation measures is felt across Central, Northern and Southern Arizona.
 - In direct jobs resulting from SFAz funded research grants, 473 were located in Central Arizona, 89 in Northern Arizona and 589 in Southern Arizona.

- The leveraged funding from industry match and non-state research funding sources also were widely distributed with \$49.1 million in Central Arizona, \$5.1 million in Northern Arizona and \$56.3 million in Southern Arizona. This is equivalent to additional indirect and induced job impacts from the economic multipliers associated with the leveraged funding raised of 612 jobs for Central Arizona, 115 jobs for Northern Arizona and 762 jobs for Southern Arizona.

**Total Employment Impacts (direct, indirect, induced)
by Primary Region of SFAz Grant**



- Innovation measures, particularly from patents, licenses and new company formations resulting from SFAz grants are skewed more towards Central and Southern Arizona, though in publications all regions are well engaged.

Summary Highlights by SFAz Grant Programs

University and Nonprofit Research Funding Initiatives

Background: SFAz supports three major research funding initiatives, including:

- **Strategic Research Group (SRG)** grants, which seed strategic collaborations between Arizona’s nonprofit research-performing institutions and industry partners in order to create economic advantages for the state.³ There have been 13 FY 07 SRG grants, 7 FY 08 grants, and 6 FY 09 grants for a 3-year total of 26 SRG grants.
- **Small Business Catalytic (SBC)** grants, which invest in technologies being developed at Arizona’s research-performing institutions to allow a researcher to begin to move a concept toward company creation up to the point where federal research grants or venture capital funding can support the project. There have been 14 total SBC grants, with 9 in FY 07 and 5 in FY 08.⁴
- **Competitive Advantage Awards (CAA)**, which funds projects that offer sound potential to secure significant federal grants with strategic focus in three primary areas—sustainable systems, information communication technologies, and the biosciences. There have been 57 total CAA grants awarded with 26 in FY 07 and 31 in FY 08.

Key metrics for the university and nonprofit research funding initiatives span the continuum from discoveries to commercialization, and include scientific publications, patents filed and issued, technology licenses, companies created, jobs created from the research activity, dollars leveraged from other sources, industry match and talent development.

Key Findings:

- SFAz cumulative grant funding for university and nonprofit research funding initiatives has totaled \$50.0 million from FY07 through FY 09 and grant recipients have used this to leverage an additional \$152.8 million in total matching funds—\$42.4 million in industry

³ As a 501(c)(3) nonprofit, Science Foundation Arizona may only provide funding to public universities and other nonprofit organizations for scientific, medical and engineering research and education.

⁴ With the reduction in funding in 2009, no grants were awarded under the SBC and CAA programs.

- match from the SRG program and \$110.4 million in other sources beyond the original funding. Additional dollars come through a variety of sources including federal, foundation, venture capital, or additional university or industry funding beyond the original match.
- For every \$1 funded by SFAz in university and nonprofit research funding initiatives, \$3.06 has been leveraged from other sources.
 - The SRG (\$52.6 million) and CAA (\$42.5 million) programs have brought in the majority of the \$110.4 million in cumulative funds leveraged from other sources, with 48% and 38% of funds, respectively.
 - Among the SFAz grants focused on university research, the cumulative, 3-year total number of scientific publications has reached 566. Half (293 publications) of these publications were related to research conducted under the CAA program which is not surprising given its strong focus on basic research.⁵
 - SFAz grant recipients have generated strong patent activity, with 73 patents filed in just a 3-year period. Given the young nature of these grant programs, just 8 patents have been issued thus far. Participants in the SRG and SBC programs have led the way in patent applications reflecting the programs' focus on technology commercialization from Arizona's research-performing institutions.
 - A total of 11 technology licenses have been issued across SRG-SBC-CAA programs. The SBC program has been responsible for 7 of these 11 technology licenses to date.
 - Since these programs began, a total of 16 companies have been created, primarily out of the SRG and SBC grant programs. SRG grants have led to the formation of 9 companies. The SBC, which has generated 5 companies to date, is specifically designed to act as a "catalyst" for company development with seed funds targeted at research with high-impact commercial potential.
 - University and nonprofit research funding initiatives and partnerships supported by SFAz have combined to create 1,121 jobs including jobs related directly to SFAz funding to nonprofit research performing institutions and additional jobs funded by industry.
 - A further benefit of the SFAz grants is developing young research talent within Arizona's universities. The SRG, SBC, and CAA programs combine to employ 469 student researchers including undergraduates, graduate students, and post-doctoral researchers. Graduate students make up just over four of every ten of these student jobs.

Graduate Research Fellowships

Background: Graduate Research Fellowships (GRF) are designed by SFAz to recruit the best and brightest graduate-level students in science, math and engineering from Arizona and beyond. The Fellowships were designed to create a "culture of research, excellence, and innovation" and plant the seed that Arizona is competitive with the nation's best universities. This effort can transform Arizona's competent graduate programs into world-competitive programs while developing a work force pipeline to meet the needs of Arizona's technology-related employers.

Annual metrics reports for the GRF program will focus on key outcomes related to post-doctoral research and placement of PhD fellows in industry and academic positions. Given the GRF program

⁵ The data presented here for University and Nonprofit Research Initiatives will not match totals presented in the previous section as those totals include metrics/outcomes associated with grants funded under the Stardust Director's Fund (SDF) and even the GRF that had impacts included in those totals including: publications (SDF had 3; GRF had 191); patent applications (SDF had 3); and total jobs (SDF had 30).

is relatively new (only in place for 3 years), the three participating universities report that none of the Fellows have yet received their Doctorate degree. Therefore, outcomes and metrics reported here are limited to total Fellows and their cumulative output of scientific publications.

Key Findings:

- Since its inception in 2007, SFAz has funded 223 Graduate Research Fellowships in science, technology, engineering and math (STEM) fields at Arizona's three major universities—the University of Arizona (108 fellows), Arizona State University (97 fellows), and Northern Arizona University (18 fellows).
- The 223 graduate students supported through the GRF program have generated a cumulative total of 191 scientific research publications as either an author or co-author.
- Although the GRF program does not require or leverage industry dollars, it has consistently leveraged significant tuition credits and waivers through agreements with the three participating State universities. Battelle has estimated that for the \$17.1 million awarded by SFAz to Fellows from FY 07 through FY 09, \$7.3 million in university funds have been leveraged. This represents \$0.43 in additional funds leveraged for each \$1.00 awarded by SFAz.

STEM Education Initiatives

Background: The K-12 Teacher and Student Discovery grants support programs that improve math and science instruction and learning. This year, the programs were expanded to include community college students and teachers. These grants include engaging motivated math and science teachers in paid laboratory research internships to update their knowledge and bring it back to the classroom. Also, these grants seek to broaden the participation of K-12/community college students—particularly those from rural and underserved communities—in scientific discovery activities with researchers and engineers.

To augment these programs, SFAz launched the STEM Education Initiative (Science, Technology, Engineering, and Math) in 2008 with private funds to build the high-skilled foundation for Arizona's 21st Century knowledge-based economy.

Currently, there are 19 active grants focused on STEM education programs.

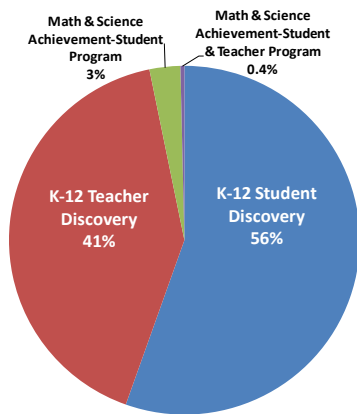
Key Findings:

- For the current school year ending June 2010, across all SFAz STEM education programs there were 78,461 student and 2,219 teacher participants involved either directly or indirectly. This brings the cumulative number of students involved from FY 07 through FY 09 to 159,688 and the cumulative number of teachers involved to 2,900.
- For the current year, the types of students served bring a strong emphasis on diversity, with 65.5% of the students being low income, 23.3% coming from rural areas and 4.6% being Native American.
- Program quality ratings by teachers in the Teacher Discovery Program were very positive with an average quality rating of 2.8 out of 3, and 85% judging the programs to be “outstanding.” Less than 1% of teachers indicated that the programs need improvement, out of the 186 teachers responding to the SFAz survey administered by grantees.
- Similarly, students participating in the Student Discovery Program also rated the programs highly, with an average quality rating of 2.7 out of 3, and 77% finding the programs

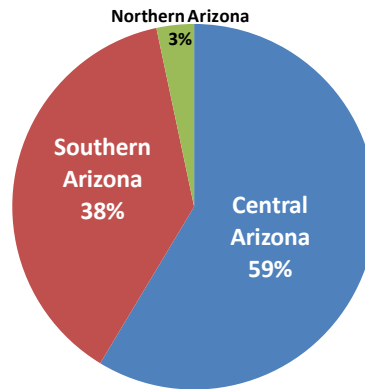
“outstanding.” Just 4% of students indicated that the programs need improvement, out of 5,453 students responding to the survey.

- Students taking SFAz-sponsored Discovery programs overwhelmingly expressed an interest in pursuing more advanced science and math courses, with 87% indicating more interest in taking advanced math and science since participating in the SFAz program and only 13% expressing no interest out of 5,042 responding to that question in the survey.
- In addition to the established SFAz Discovery programs, new FY 09 “Mathematics and Science Achievement” (MSAG) Student and Teacher programs are getting underway. Early outcomes from these new programs are already demonstrating an impact with the Student programs reaching 2,229 students this school year with a high percentage low-income (73%) and a generally positive rating by students (2.4 out of 3).

Students Participating in SFAz STEM Programs, 2009-10 School Year



Students Participating in SFAz STEM Programs, 2009-10 School Year by Primary Geographic Area Served



Metrics

University Research Funding Initiatives

Methodology

The Battelle Technology Partnership Practice was retained to collect key metrics associated with, and outcomes related to Science Foundation Arizona's (SFAz) grant programs including Competitive Advantage Awards (CAA), Strategic Research Groups (SRG), Small Business Catalytic (SBC), and Strategic Initiatives (SI). SFAz grants require recipients to maintain comprehensive records related to quantitative outcomes of each research grant, this information was collected directly from the Principal Investigator (PI) for each grant via an online survey collection.

Key metrics and their definition in this context include:

- **Scientific Publications**, published or co-published by grantees since the start of the grant related to its research (included are peer-reviewed papers for journals and juried abstracts for conferences that have been accepted or published). If a publication was co-authored by more than one grantee it was counted only once.
- **Patents**. PIs were required to record both the total number of patents applied for, including those provisionally granted in addition to the total number of patents issued. Patents were reported based on current status only, i.e. one record per patent.
- **Technology Licenses**. PIs were required to record the number of technology licenses issued since the grant began. In this context, a Technology License includes any technology transferred for which the PI is receiving some type of compensation, whether royalty, equity, one-time payment or other arrangement.
- **Companies Created**. Certain SFAz programs are focused on the creation of new companies, especially the focus of the SBC program. In this context, PIs were asked to include only those “active” companies that are operational with at least one paid employee.
- **Jobs**. PIs were required to record the number of jobs created that were specifically associated with their SFAz grant. Individuals hired or working, regardless of the level of effort or considerations of hours, were counted as one job.
- **Funds Leveraged**. Above and beyond the industry match required for SRG grants, PIs were required to record the cumulative value of all dollars leveraged from all sources that fund research specific to this grant beyond the original amounts invested by SFAz or through industry matching funds. These funds only include dollars actually awarded (not pending) and were reported by funding source.
- **Industry Match**. This corresponds to the industry match verified by the Arizona Department of Commerce at the outset of the projects.
- **Talent Development**. This corresponds to the total number of undergraduates, graduate students and post-docs involved in SFAz funded grants.

In total, 100 individual grants were included in the metrics collection for the CAA, SRG, SBC, SI, and SDF programs, among these nearly all PIs participated and provided grant-related data (98%).

University Research Funding Initiatives: CAA, SBC, SRG, and SI Programs

Program Area	Scientific Publications							
	FY 07 Grants				FY 08 Grants			FY 09 Grants
	Yr. 1	Yr. 2	Yr. 3	Total FY 07 Grants	Yr. 1	Yr. 2	Total FY 08 Grants	Yr. 1
CAA	32	90	24	146	84	63	147	–
SBC	17	–	11	28	5	6	11	–
SRG	9	47	24	80	8	90	98	56
SDF/SI	–	–	2	2	–	1	1	–

Program Area	Patents Filed							
	FY 07 Grants				FY 08 Grants			FY 09 Grants
	Yr. 1	Yr. 2	Yr. 3	Total FY 07 Grants	Yr. 1	Yr. 2	Total FY 08 Grants	Yr. 1
CAA	–	3	3	6	5	4	9	–
SBC	12	6	–	18	6	4	10	–
SRG	8	–	9	17	6	–	6	7
SDF/SI	–	1	2	3	–	–	–	–

University Research Funding Initiatives: CAA, SBC, SRG, and SI Programs (continued)

Program Area	Patents Issued							
	FY 07 Grants				FY 08 Grants			FY 09 Grants
	Yr. 1	Yr. 2	Yr. 3	Total FY 07 Grants	Yr. 1	Yr. 2	Total FY 08 Grants	Yr. 1
CAA	-	-	1	1	1	1	2	-
SBC	-	1	3	4	-	-	-	-
SRG	-	-	1	1	-	-	-	-
SDF/SI	-	-	-	-	-	-	-	-

Program Area	Technologies Licensed							
	FY 07 Grants				FY 08 Grants			FY 09 Grants
	Yr. 1	Yr. 2	Yr. 3	Total FY 07 Grants	Yr. 1	Yr. 2	Total FY 08 Grants	Yr. 1
CAA	-	1	-	1	-	-	-	-
SBC	3	2		5	2	-	2	-
SRG	-	1	1	2	-	1	1	-
SDF/SI	-	-	-	-	-	-	-	-

University Research Funding Initiatives: CAA, SBC, SRG, and SI Programs (continued)

Program Area	Companies Created						
	FY 07 Grants			FY 08 Grants			FY 09 Grants
	Yrs 1 and 2	Yr. 3	Total FY 07 Grants	Yr. 1	Yr. 2	Total FY 08 Grants	Yr. 1
CAA	1	–	1	–	1	1	–
SBC	2		2	3	–	3	–
SRG	4	2	6	–	2	2	1
SDF/SI	–	–	–	–	–	–	–

Program Area	Jobs Created		
	Total FY 07 Grants	Total FY 08 Grants	Total FY 09 Grants
CAA	160	201	–
SBC	53	27	–
SRG	260	327	93
SDF/SI	24	6	–

University Research Funding Initiatives: CAA, SBC, SRG, and SI Programs (continued)

Program Area	Dollars Leveraged from Other Sources							
	FY 07 Grants				FY 08 Grants			FY 09 Grants
	Yr. 1	Yr. 2	Yr. 3	Total FY 07 Grants	Yr. 1	Yr. 2	Total FY 08 Grants	Yr. 1
CAA	\$13.9M	\$0.9M	\$7.7M	\$22.5M	\$10.9M	\$9.1M	\$20.0M	–
SBC	\$5.8M	\$2.7M	\$3.9M	\$12.4M	\$1.0M	\$0.7M	\$1.7M	–
SRG	\$11.3M	\$7.7M	\$16.9M	\$35.9M	\$4.1M	\$6.2M	\$10.3M	\$6.4M
SDF/SI	\$1.0M	\$0.2M	–	\$1.2M	–	–	–	–

Program Area	Industry Match							
	FY 07 Grants				FY 08 Grants			FY 09 Grants
	Yr. 1	Yr. 2	Yr. 3	Total FY 07 Grants	Yr. 1	Yr. 2	Total FY 08 Grants	Yr. 1
CAA	–	–	–	–	–	–	–	–
SBC	–	–	–	–	–	–	–	–
SRG	\$22.5M	–	–	\$22.5M	\$7.6M	\$7.7M	\$15.3M	\$4.6M
SDF/SI	–	–	–	–	–	–	–	–

Note: Industry matching figures reported here are only for those amounts committed through FY 2009. SRG program grants have additional commitments totaling \$22.2 million for FY 2010 and 2011.

University Research Funding Initiatives: CAA, SBC, SRG, and SI Programs (continued)

Program Area	Talent Development							
	FY 07 Grants				FY 08 Grants			FY 09 Grants
	Yr. 1	Yr. 2	Yr. 3	Total FY 07 Grants	Yr. 1	Yr. 2	Total FY 08 Grants	Yr. 1
CAA	N/A	N/A	29	86	65	55	120	–
SBC	N/A	N/A	9	32	10	–	10	–
SRG	N/A	N/A	57	127	29	28	57	37
SDF/SI	N/A	N/A	2	5	–	–	–	–

N/A = data not available for individual year.

Graduate Research Fellowships

Methodology

Battelle developed a survey sent to a representative from each of the three universities with Graduate Research Fellows (University of Arizona, Arizona State University, and Northern Arizona University) to capture the required annual metrics data. In its early stages, the universities report that none of the GRF's has received their doctorate degree and therefore, at this time, the metrics do not include post-doctoral outcomes for these students. Currently, the metrics only include scientific publications defined as follows.

- **Scientific Publications**, published or co-published by grantees since the start of the grant related to its research (included are peer-reviewed papers for journals and juried abstracts for conferences that have been accepted or published). If a publication was co-authored by more than one grantee it was counted only once.

Graduate Research Fellowships

Graduate Research Fellowships	Total Fellows	Scientific Publications	Doctorates Awarded	Post-Doctoral Studies/Positions		
				Fellowships Awarded	At Top 25% of Institutions/Labs	Working in Arizona
Total GRF	223	191	N/A	N/A	N/A	N/A
Univ. of Arizona	108	122	N/A	N/A	N/A	N/A
Arizona State Univ.	97	42	N/A	N/A	N/A	N/A
Northern Arizona Univ.	18	27	N/A	N/A	N/A	N/A

N/A = Not Applicable since Graduate Research Fellows still working toward Doctorate Degree.

Note: Publications data were not collected by funding year.

STEM Education Programs

Methodology

Battelle developed a survey to each of the STEM Education grantees to capture the required annual metrics data including:

- Numbers of teacher and student participants
- The diversity of students participating in the programs or enrolled in classes of the teachers participating in professional development programs, tracking low income students, rural students and Native American students.
- Program quality ratings by both teacher and student participants
- Retention of math and science teachers participating in the programs
- Interest of students in pursuing advanced courses in science and math in high school

To collect many of these measures required the STEM Education grantees to administer surveys to participating teachers and students. While grantees made active efforts to get responses from participating teachers and students, similar to all surveys not all student and teacher participants responded. Of the 19 active grants (several of which are just getting started), surveys were at least partially completed by 17 grantees.

Teacher Discovery

	Teachers Enrolled	Students of Teachers Enrolled			Teacher Quality Rating (out of 3 point scale)*	Teacher Retention*	
		Total Students Enrolled in Classes of Teachers	Percent Low Income Students	Percent Rural Students			Percent Native American Students
Current	319	32,461	29.5%	27.3%	2.5%	2.84 with 85% Outstanding	92%
Cumulative, FY2007-09	814	94,831	43.4%	25.6%	6.4%	2.90	93%

* 186 teachers responded

Student Discovery

	Teachers of Participating Students	Students Enrolled				Student Quality Rating (out of 3 point scale)*	Interest in Pursuing Advanced Science & Math**
		Total	Percent Low Income Students	Percent Rural Students	Percent Native American Students		
Current	1,737	43,487	91.7%	20.5%	5.4%	2.73 Average with 77% Outstanding	87%
Cumulative, FY2007-09	1,923	62,344	73.2%	36.7%	6.3%	2.71	88%

*Out of 5,453 student responses; **Out of 5,042 student responses

Mathematics and Science Achievement (MSAG) – Student Program

	Teachers of Participating Students	Students Enrolled				Student Quality Rating (out of 3 point scale)*	Interest in Pursuing Advanced Science & Math**
		Total	Percent Low Income Students	Percent Rural Students	Percent Native American Students		
Current	148	2,229	72.5%	9.7%	15.7%	2.38	66%

*Out of 606 student responses; **Out of 570 student responses

Mathematics and Science Achievement (MSAG) – Student and Teacher Program

	Teachers Participating	Students Enrolled				Student Quality Rating (out of 3 point scale)	Teacher Quality Rating (out of 3 point scale)*
		Total	Percent Low Income Students	Percent Rural Students	Percent Native American Students		
Current	15	284	100%	100%	35.9%	N/A	2.85

Consolidated Tracking of Students and Teachers in all STEM Education Programs

	Teachers Enrolled and those of Participating Students	Students Enrolled and those of Participating Teachers			
		Total	Percent Low Income Students	Percent Rural Students	Percent Native American Students
Current Year	2,219	78,461	65.5%	23.3%	4.6%
Cumulative, FY2007-09	2,900	159,688	58.4%	30.9%	6.6%

Metrics Beyond Program Classification: Return on Investments by Funding Source

SFAz funds its programs through several sources. This section takes an alternative approach to examining the same program metrics and outcomes presented above, though here through the lens of funding source as opposed to simply by program area only. Funding sources often cross-cut individual programs, for instance, the CAA grants are funded through the 21st Century Fund, the 21st Century Fund/Harrington, and some through Private Match/Bisgrove funds. Presenting outcomes by funding source allows for a different perspective on returns on investment.

Funding Sources: University Research Funding Initiatives

University Research Funding Initiatives: Metrics by Grant Funding Source, FY 07—FY09

Fund	Grant Funding Totals (FY07-09)	Scientific Publications	Patent Applications	Patents issued	Technology Licenses	Companies Created	Jobs	Funds Leveraged from Other Sources
21st Century Fund, Total	\$47,657,441	511	70	7	11	16	1,070	\$101,765,960
CAA	\$6,845,681	243	15	3	1	2	314	\$38,731,885
SBC	\$4,992,386	34	25	3	6	5	76	\$10,429,012
SRG	\$35,819,374	234	30	1	3	9	680	\$52,605,063
21st Century Fund/Harrington, Total	\$1,172,535	29	3	1	0	0	13	\$5,129,525
CAA	\$766,663	24	0	0	0	0	9	\$1,452,000
SBC	\$405,872	5	3	1	1	0	4	\$3,677,525
Private-match, Bisgrove, Total	\$1,088,872	27	0	0	0	0	38	\$2,316,717
CAA	\$938,872	26	0	0	0	0	38	\$2,316,717
SDF	\$150,000	1	0	0	0	0	0	\$-
Stardust Director's Fund	\$381,320	2	3	0	0	0	30	\$1,224,000

Note: Matching funds from industry help to support the 21st Century Funds with respect to the outcomes of the SRG program.

Funding Sources: Graduate Research Fellowships

Graduate Research Fellowships: Metrics by Grant Funding Source, FY 07—FY09

Fund	Grant Funding Totals (FY07-09)	Graduate Research Fellows Supported	Scientific Publications
21st Century Fund	\$12,706,000	223	164
Private Match, Bisgrove	\$4,400,000	N/A	27

Note: Bisgrove private match funds were used to fund one year of GRF's at the Univ. of Arizona (FY 08); number of GRF's cannot be separated out for this one year of ongoing Fellowships and therefore a specific GRF figure is "Not Available" for this funding source.

Funding Sources: STEM Education Initiatives

STEM Education Initiatives: Metrics by Grant Funding Source, FY 07—FY09

Fund	Grant Funding Totals (FY07-09)	Teachers Enrolled and those of Participating Students FY09	Students Enrolled FY09				Student Quality Rating (out of 3 point scale)	Teacher Quality Rating (out of 3 point scale)
			Total	Percent Low Income	Percent Rural	Percent Native American		
K-12 Teacher & Student Discovery	\$10,893,718	2,056	75,948	65.1%	23.4%	4.2%	2.69	2.68
21 st Century Fund	\$8,128,718	1,990	68,721	67.3%	22.0%	4.1%	2.73	2.67
21 st Century Fund/Harrington	\$2,375,000	52	5,511	41.7%	19.3%	5.1%	2.45	2.79
Private Match, Bisgrove	\$390,000	14	1,716	53.1%	95.7%	3.7%	N/A	3.00
MSAG STEM Board of Education	\$2,400,000	163	2,513	75.6%	19.9%	18.0%	2.38	2.85

Note: MSAG = Math and Science Achievement Grant

Regional Impacts

While SFAz grant activities are focused broadly on targeted partnerships and technology commercialization statewide, each tends to have a more primary focus and set of impacts in the region in which the PI and/or institution is located. By assigning one of three major Arizona regions—Central, Northern, or Southern—to each grant based on location, SFAz can relate impacts and benefits derived from grants more specifically to a local area. The tables below highlight metrics and outcomes by type of program and region and reveal the following:

- Grants based primarily in Southern Arizona have had the most success in generating total jobs (589 to date) and companies (10), and raising additional funds (\$56.3 million). The University of Arizona hosts the most Graduate Research Fellows with 108 in Southern Arizona. SFAz STEM education initiatives have a strong footprint in Southern Arizona with nearly 30,000 students engaged either directly or indirectly in these programs.
- Grants to Central Arizona institutions have led to a leading number of scientific publications (284 to date) and key intellectual property activities with 45 patent applications and 4 patents issued. Central Arizona has 97 Graduate Research Fellows attending Arizona State University. Central Arizona has seen the greatest impacts in terms of teachers and students involved either directly or indirectly in STEM education programs sponsored by SFAz with more than 1,900 teachers and over 46,000 students.
- Northern Arizona grants have been less impactful though they are fewer in number than those in the rest of the State—generating 50 scientific publications, 89 total jobs, and \$5.1 million in additional funds leveraged. Eighteen Graduate Research Fellows are conducting their research and graduate studies at Northern Arizona University. In STEM education programs, 83 teachers and more than 2,600 students in Northern Arizona are engaged either directly or indirectly.

University and Nonprofit Research Funding Initiatives: Metrics by Program and Region, FY07—FY09

SFAz Program	Central Arizona	Northern Arizona	Southern Arizona	Program Total
Scientific Publications				
Competitive Advantage Awards (CAA)	157	50	86	293
Small Business Catalytic (SBC)	24	0	15	39
Strategic Research Groups (SRG)	102	0	132	234
Stardust Director's Fund (SDF)	1	0	2	3
Scientific Publications, Total	284	50	235	569
Patent Applications				
Competitive Advantage Awards (CAA)	10	1	4	15
Small Business Catalytic (SBC)	15	0	13	28
Strategic Research Groups (SRG)	20	0	10	30
Stardust Director's Fund (SDF)	0	0	3	3
Patent Applications, Total	45	1	30	76
Patents Issued				
Competitive Advantage Awards (CAA)	2	1	0	3
Small Business Catalytic (SBC)	1	0	3	4
Strategic Research Groups (SRG)	1	0	0	1
Stardust Director's Fund (SDF)	0	0	0	0
Patents Issued, Total	4	1	3	8
Technology Licenses				
Competitive Advantage Awards (CAA)	0	0	1	1
Small Business Catalytic (SBC)	4	0	3	7
Strategic Research Groups (SRG)	1	0	2	3
Stardust Director's Fund (SDF)	0	0	0	0
Technology Licenses, Total	5	0	6	11

University and Nonprofit Research Funding Initiatives: Metrics by Program and Region, FY07—FY09 (continued)

SFAz Program	Central Arizona	Northern Arizona	Southern Arizona	Program Total
Companies Created				
Competitive Advantage Awards (CAA)	1	0	1	2
Small Business Catalytic (SBC)	3	0	2	5
Strategic Research Groups (SRG)	2	0	7	9
Stardust Director's Fund (SDF)	0	0	0	0
Companies Created, Total	6	0	10	16
Jobs				
Competitive Advantage Awards (CAA)	205	89	67	361
Small Business Catalytic (SBC)	35	0	45	80
Strategic Research Groups (SRG)	227	0	453	680
Stardust Director's Fund (SDF)	6	0	24	30
Jobs, Total	473	89	589	1,151
Funds Raised/Leveraged from Other Sources				
Competitive Advantage Awards (CAA)	\$22,851,218	\$5,059,986	\$14,589,398	\$42,500,602
Small Business Catalytic (SBC)	\$5,627,525	\$-	\$8,479,012	\$14,106,537
Strategic Research Groups (SRG)	\$20,590,000	\$-	\$32,015,063	\$52,605,063
Stardust Director's Fund (SDF)	\$-	\$-	\$1,224,000	\$1,224,000
Funds Raised/Leveraged, Total	\$49,068,743	\$5,059,986	\$56,307,473	\$110,436,202

Graduate Research Fellowships: Metrics by Region, FY07—FY09

Metrics	Central Arizona	Northern Arizona	Southern Arizona	Program Total
Total Fellows	97	18	108	223
Scientific Publications	42	27	122	191

STEM Education Initiatives: Metrics by Region, FY07—FY09

SFAz Program	Central Arizona	Northern Arizona	Southern Arizona	Program Total
Teachers Enrolled and those of Participating Students				
Teacher Discovery	52	54	213	319
Student Discovery	1,737	0	0	1,737
MSAG-Student Program	128	14	6	148
MSAG-Student & Teacher Program	0	15	0	15
Total Teachers	1,917	83	219	2,219
Students Enrolled and those of Participating Teachers				
Teacher Discovery	5,511	483	26,467	32,461
Student Discovery	39,111	1,101	3,275	43,487
MSAG-Student Program	1,386	748	95	2,229
MSAG-Student & Teacher Program	0	284	0	284
Total Students	46,008	2,616	29,837	78,461

Economic Impact Modeling

A substantial grant-funding organization like SFAz can generate significant positive economic impacts through its targeted investments that most immediately leverage additional funds that result in new wealth for Arizona. Over the longer term, SFAz’s programs that spur public-private partnerships and technology commercialization throughout the State of Arizona will have even greater economic impacts through the private sector jobs created.

The estimated economic impacts of the leveraged funding by Science Foundation Arizona were calculated using the Arizona specific input-output models from IMPLAN, one of the most widely used economic impact models in the nation. Input-output analysis is based on the use of multipliers, which describe the response of an economy to a change in demand or production. Multipliers measure the effects on an economy from a source of economic activity—in this case, the leveraged research and development funds from SFAz’s grant activities. The economic activity generated is greater than the direct value of the leveraged research and development funds because of the successive cycles of spending, earning, and re-spending. Four measures of the economic impact of the wealth-generating activities of SFAz leveraging additional research and development are considered:

- Direct Effects. The changes in economic activity being analyzed—in this case, the leveraged funding from SFAz’s grant activities.
- Indirect Effects. The changes in interindustry purchases, e.g., the purchase of services and goods from Arizona companies from university research and development activities.
- Induced Effects. The changes in spending from households as income and population increase because of changes in production.
- Total Effects. The combined total of direct, indirect, and induced effects.

Given the strong and primary emphasis on university research and development by SFAz, impacts were modeled using the Scientific Research and Development sector in IMPLAN. The leveraged dollar figures represent the cumulative amount over a three-year cycle of grants. The economic impact of SFAz is measured using two economic variables, including:

1. **Output.** The total value of production (sales) in all industries as a result of expenditures by SFAz. This is the number cited in a typical economic impact study.
2. **Employment.** The total number of jobs created in all industries (including both full- and part-time workers) by the expenditures of SFAz and its ongoing activities and employment base.

Economic Impacts of SFAz Matching Funds and Funds Leveraged from Other Sources

Economic Variable	Direct Impact	Indirect & Induced Impacts	Total Impacts
Output, Leveraged Funds	\$152.8M	\$178.1M	\$330.9M
Employment	1,151	1,490	2,641